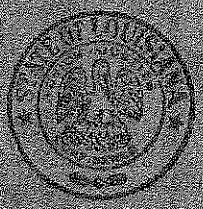
Standard Specifications

for

Roads and Bridges

October 1966



State of Louisiana

Department of Highways

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PART I

GENERAL PROVISIONS

Section 101

Definitions and Terms

Wherever in these specifications or in other contract documents the following terms or pronouns in place of them are used, the intent and meaning shall be interpreted as follows:

101.01 ABBREVIATIONS. Wherever the following abbreviations are used in these specifications or on the plans, they are to be construed the same as the respective expressions represented:

A.A.N.	American Association of Nurserymen
A.A.R.	Association of American Railroads
A.A.S.H.O.	American Association of State Highway Officials
A.G.C.	Associated General Contractors of America
A.I.A.	American Institute of Architects
A.R.A.	American Railway Association
A.R.E.A.	American Railway Engineering Association
A.S.A.	American Standards Association
A.S.C.E.	American Society of Civil Engineers
A.S.L.A.	American Society of Landscape Architects
A.S.T.M.	American Society for Testing and Materials
A.W.P.A.	American Wood-Preservers Association
A.W.W.A.	American Water Works Association
A.W.S.	American Welding Society
B.P.R.	Bureau of Public Roads, Department of Commerce
F.S.S.	Federal Specifications and Standards, General Services Administration
S.A.E.	Society of Automotive Engineers

101.02 ACCESS CONNECTION. Any roadway facility by means of which vehicles can enter or leave an arterial highway. Included are intersections at grade, private driveways, and ramps or separate lanes connecting with cross streets or frontage roads.

101.03 ADVERTISEMENT. The public announcement, as required by law, inviting bids for work to be performed or materials to be furnished.

101.04 ARTERIAL HIGHWAY. A general term denoting a highway primarily for through traffic, usually on a continuous route.

101.05 AUXILIARY LANE. The portion of the roadway adjoining the traveled way for parking, speed-change, or for other purposes supplementary to through traffic movement.

101.06 AWARD. The acceptance by the Department of a bid.

101.07 BIDDER. An individual, firm or corporation submitting a bid for the advertised work.

101.08 BRIDGE. A structure, including supports, erected over a depression or an obstruction, as water, highway, or railway, and having a track or passageway for carrying traffic or other moving loads and having a length measured along the center of roadway of more than 20 feet between under-copings of abutments or extreme ends of openings for multiple boxes.

Length. The length of a bridge structure is the overall length measured along the line of survey stationing back to back of backwalls of abutments, if present, otherwise end to end of the bridge floor; but in no case less than the total clear opening of the structure.

Roadway width. The clear width measured at right angles to the longitudinal centerline of the bridge between the bottom of curbs or guard timbers or in the case of multiple height of curbs, between the bottoms of the lower risers.

101.09 CALENDAR DAY. Every day shown on the calendar.

101.10 CHANGE ORDER. A written order issued by the engineer to the contractor, covering changes in the plans or quantities or both, within the scope of the contract and establishing the basis of payment and time adjustments for the work affected by the changes.

101.11 CONTRACT. The written agreement between the Department and the contractor setting forth the obligations of the parties thereunder, including, but not limited to, the performance of the work, the furnishing of labor and materials, and the basis of payment.

The contract includes the invitation for bids, proposal, contract form and contract bond, specifications, supplemental specifications, special provisions, general and detailed plans, and notice to proceed, also any change orders and agreements that are required to complete the construction of the work in an acceptable manner, including authorized extensions thereof, all of which constitute one instrument.

101.12 CONTRACT BOND. The approved form of security, executed by the contractor and his surety or sureties, guaranteeing complete execution of the contract and all supplemental agreements pertaining thereto and the payment of all legal debts pertaining to the construction of the project.

101.13 CONTRACT ITEM (Pay Item). A specifically described unit of work for which a price is provided in the contract.

101.14 CONTRACT TIME. The number of work days or calendar days allowed for completion of the contract, including authorized time extensions.

In case a calendar date of completion is shown in the proposal, in lieu of the number of working or calendar days, such work contemplated shall be completed by that date.

101.15 CONTRACTOR. The individual, firm or corporation contracting with the highway department for performance of prescribed work.

101.16 CONTROLLED ACCESS HIGHWAY. Any designated State Highway within or outside the limits of

any incorporated city, town or village, to or from which access is denied or controlled, in whole or in part, from or to abutting land or intersecting streets, roads, highways, alleys or other public or private ways.

101.17 CONTROL OF ACCESS. The condition where the right of owners or occupants of abutting land or other persons to access, light, air or view in connection with a highway is fully or partially controlled by public authority.

(1) Full Control: Full control of access means that the authority to control access is exercised to give preference to through traffic by providing access connections with selected public roads only and by prohibiting crossings at grade or direct private driveway connections.

(2) Partial Control: Partial control of access means that the authority to control access is exercised to give preference to through traffic to a degree that, in addition to access connections with selected public roads, there may become crossings at grade and some private driveway connections.

101.18 CULVERT. Any structure not classified as a bridge which provides an opening under the roadway.

101.19 DEPARTMENT. The Department of Highways of the State of Louisiana, constituted under the laws of the State for the administration of highway work.

101.20 DIRECTOR. Director of Louisiana Department of Highways.

101.21 DIVIDED HIGHWAY. A highway with separated roadways for traffic in opposite directions.

101.22 ENGINEER. The chief engineer of the Department, acting directly or through his duly authorized representatives, who is responsible for engineering supervision of the construction. When the term "Chief Engineer" is used, it shall mean the chief engineer in person.

101.23 EQUIPMENT. All machinery and equipment, together with the necessary supplies for upkeep and maintenance, and also tools and apparatus necessary

for the proper construction and acceptable completion of the work.

101.24 EXPRESSWAY. A divided arterial highway for through traffic with full or partial control of access and generally with grade separations at intersections.

101.25 EXTRA WORK. An item of work not provided for in the contract as awarded but found essential to the satisfactory completion of the contract within its intended scope.

101.26 EXTRA WORK ORDER. A change order concerning the performance of work or furnishing of materials involving extra work. Such extra work may be performed at agreed prices or on a force account basis as provided elsewhere in these specifications.

101.27 FREEWAY. An expressway with full control of access.

101.28 GRADE SEPARATION. A crossing of two highways, or a highway and a railroad, at different levels.

101.29 HIGHWAY, STREET OR ROAD. A general term denoting a public way for purposes of vehicular travel, including the entire area within the right of way. Recommended usage in urban areas—highway or street; in rural areas—highway or road.

101.30 HOLIDAYS. In the State of Louisiana, holidays occur on: New Years Day, Good Friday, Independence Day, August 30, Labor Day, Veteran's Day, Thanksgiving Day and Christmas Day.

If New Years Day, Independence Day or Christmas Day falls on a Sunday, the following Monday shall be considered a holiday.

101.31 INSPECTOR. The engineer's authorized representative assigned to make detailed inspections of contract performance.

101.32 INTERCHANGE. A grade-separated intersection with one or more turning roadways for travel between intersecting legs.

101.33 INVITATION FOR BIDS. The advertisement for proposals for all work or materials on which bids are

required. Such advertisement will indicate with reasonable accuracy the quantity and location of the work to be done or the character and quantity of the material to be furnished and the time and place of the opening of proposals.

101.34 LABORATORY. The testing laboratory of the Department or any other testing laboratory which may be designated by the engineer.

101.35 LOCAL STREET OR LOCAL ROAD. A street or road primarily for access to residence, business, or other abutting property.

101.36 MAJOR STREET OR MAJOR ROAD. An arterial highway with intersections at grade and direct access to abutting property, and on which geometric design and traffic control measures are used to expedite the safe movement of through traffic.

101.37 MATERIALS. Any substances specified for use in the construction of the project and its appurtenances.

101.38 MEDIAN. The portion of a divided highway separating the traveled ways for traffic in opposite directions.

101.39 NOTICE TO PROCEED. Written notice to the contractor to proceed with the contract work including, when applicable, the date of beginning of contract time.

101.40 PARISH. The parish in which the work herein specified is to be done.

101.41 PAVEMENT STRUCTURE. The combination of subbase, base course, and surface course placed on a subgrade to support the traffic load and distribute it to the roadbed.

(a) Flexible Pavement: A pavement structure which maintains intimate contact with and distributes loads to the subgrade and depends upon aggregate interlock, particle friction, and cohesion for stability.

(b) Rigid Pavement: A pavement structure which distributes loads to the subgrade having as one

course a Portland cement concrete slab of relatively high bending resistance.

101.42 PLANS. The approved plans, profiles, typical cross sections, general cross sections, working drawings and supplemental drawings, or exact reproductions thereof, which show the location, character, dimensions, and details of the work to be done.

101.43 PROFILE GRADE. The trace of a vertical plane intersecting the top surface of the proposed wearing surface, or other designated course usually along the longitudinal centerline of the roadbed. Profile grade means either elevation or gradient of such trace according to the context.

101.44 PROJECT. The specific section of the highway together with all appurtenances and construction to be performed thereon under the contract.

101.45 PROJECT ENGINEER. An engineer in charge of one or more specified projects.

101.46 PROJECT NUMBER. A number used for convenience to describe and delineate certain construction within definite geographical limits.

101.47 PROPOSAL. The offer of a bidder, on the prescribed form, to perform the work and to furnish the labor and materials at the prices quoted.

101.48 PROPOSAL FORM. The approved form on which the Department requires bids to be prepared and submitted for the work.

101.49 PROPOSAL GUARANTY. Security furnished with a bid to guarantee that the bidder will enter into the contract if his bid is accepted.

101.50 QUESTIONNAIRE. The specified forms on which the contractor shall furnish required information as to his ability to perform and finance the work.

101.51 RIGHT-OF-WAY. A general term denoting land, property, or interest therein, usually in a strip, acquired for or devoted to a highway.

101.52 ROADBED. The graded portion of a highway

within top and side slopes, prepared as a foundation for the pavement structure and shoulder.

101.53 ROADSIDE. A general term denoting the area adjoining the outer edge of the roadway. Extensive areas between the roadways of a divided highway may also be considered roadside.

101.54 ROADSIDE DEVELOPMENT. Those items necessary to the complete highway which provide for the preservation of landscape materials and features; the rehabilitation and protection against erosion of all areas disturbed by construction through seeding, sodding, mulching and the placing of other ground covers; such suitable planting and other improvements as may increase the effectiveness and enhance the appearance of the highway.

101.55 ROADWAY. The portion of a highway within limits of construction.

101.56 SERVICE ROAD OR FRONTAGE ROAD. A local street or road auxiliary to and located on the side of the roadway for service to abutting property and adjacent areas and for control of access.

101.57 SHOULDER. The portion of the roadway contiguous with the traveled way for accommodation of stopped vehicles, for emergency use, and for lateral support of base and surface courses.

101.58 SIDEWALK. That portion of the roadway primarily constructed for the use of pedestrians.

101.59 SPECIAL PROVISIONS. Additions and revisions to the standard and supplemental specifications covering conditions peculiar to an individual project.

101.60 SPECIFICATIONS. A general term applied to all directions, provisions and requirements pertaining to performance of the work.

101.61 STATE. The State of Louisiana, acting through its authorized representative.

101.62 STRUCTURES. Bridges, culverts, catch basins, drop inlets, retaining walls, cribbing, manholes, endwalls, buildings, sewers, service pipes, underdrains,

foundation drains and other features which may be encountered in the work and not otherwise classed herein.

101.63 SUBBASE. The layer or layers of specified or selected material of designed thickness placed on a subgrade to support a base course.

101.64 SUBCONTRACTOR. An individual, firm or corporation to whom the contractor sublets part of the contract.

101.65 SUBGRADE. The top surface of a roadbed upon which the pavement structure and shoulders are constructed.

101.66 SUBSTRUCTURE. All of that part of the structure below the bearings of simple and continuous spans, skewbacks or arches and tops of footings of rigid frames, together with the backwalls, wingwalls and wing protection railings.

101.67 SUPERINTENDENT. The contractor's authorized representative in responsible charge of the work.

101.68 SUPERSTRUCTURE. The entire structure except the substructure.

101.69 SUPPLEMENTAL AGREEMENT. A written agreement made and entered into by and between the contractor and the Department covering work not otherwise provided for, revisions in or amendments to the terms of the contract, or conditions specifically prescribed in the specifications as requiring supplemental agreements. Such supplemental agreement becomes a part of the contract when approved and properly executed.

101.70 SUPPLEMENTAL SPECIFICATIONS. Additions and revisions to the standard specifications that are adopted subsequent to issuance of the printed book.

101.71 SURETY. The corporation, partnership or individual, other than the contractor, executing a bond furnished by the contractor.

101.72 TITLES (or Headings). The titles or headings of the sections and subsections herein are intended

for convenience of reference and shall not be considered as having any bearing on their interpretation.

101.73 THROUGH AND LOCAL TRAFFIC.

(a) Through traffic is that traffic which has neither its origin nor its destination within the limits of the project.

(b) Local traffic is that traffic which has either its origin or its destination within the limits of the project.

101.74 THROUGH STREET OR THROUGH HIGHWAY. Every highway or portion thereof on which vehicular traffic is given preferential right of way, and at the entrances to which vehicular traffic from intersecting highways or streets is required by law to yield right of way to vehicles on such through highway in obedience to either a stop sign or a yield sign, when such signs are erected.

101.75 TRAFFIC LANE. The portion of a traveled way for the movement of a single line of vehicles.

101.76 TRAVELED WAY. The portion of the roadway for the movement of vehicles, exclusive of shoulders and auxiliary lanes.

101.77 WORK. Work shall mean the furnishing of all labor, materials, equipment, and other incidentals necessary or convenient to the successful completion of the project and the carrying out of all the duties and obligations imposed by the contract.

101.78 WORKING DAY. A calendar day, exclusive of Saturdays, Sundays and State recognized holidays, on which weather and working conditions not under control of the contractor will permit operations to proceed for at least 5 continuous hours of the day with the normal working force engaged in performing the controlling item or items of work which would be in progress at that time.

Except in case of unforeseen emergency, concurred in by the engineer in writing, no work requiring engineering supervision or inspection will be done on

January first, Friday preceding Easter, July fourth, Labor Day, Thanksgiving Day, Christmas Day and the day preceding Christmas Day, and none of these days will be charged as working days.

101.79 WORKING DRAWINGS. Stress sheets, shop drawings, erection plans, falsework plans, framework plans, cofferdam plans, bending diagrams for reinforcing steel, or any other supplementary plans or similar data which the contractor is required to submit to the engineer for approval.

101.80 WORK ORDER. A written order, signed by the engineer, of a contractual status requiring performance by the contractor without negotiation of any sort.

101.81 In order to avoid cumbersome and confusing repetition of expressions in these specifications, it is provided that whenever anything is, or is to be, done, if, as, or, when, or where "contemplated, required, determined, directed, specified, authorized, ordered, given, designated, indicated, considered necessary, deemed necessary, permitted, reserved, suspended, established, approval, approved, disapproved, acceptable, unacceptable, suitable, accepted, satisfactory, unsatisfactory, sufficient, insufficient, rejected, or condemned," it shall be understood as if the expression were followed by the words "by the engineer" or "to the engineer."

Section 102

Bidding Requirements and Conditions

102.01 PREQUALIFICATION OF BIDDERS. Prior to submitting a bid, the bidder may be required to file an experience questionnaire and a confidential financial statement which shall be certified to by a certified public accountant. The statement will include a complete report of the bidder's financial resources and liabilities, equipment, past record, and personnel.

Bidders intending to consistently submit proposals shall prequalify at least once a year. However, prequalification may be changed during that period upon the submission of additional favorable reports or upon unsatisfactory performance.

102.02 CONTENTS OF PROPOSAL FORMS. Upon request, the Department will furnish the prospective bidder with a proposal form. This form will state the location and description of the contemplated construction and will show the approximate estimate of the various quantities and kinds of work to be performed or materials to be furnished, and will have a schedule of items for which unit bid prices are invited. The proposal form will state the time in which the work must be completed, the amount of the proposal guaranty, and the date, time and place of the opening of proposals. The form will also include any special provisions or requirements which vary from or are not contained in the standard specifications.

All papers bound with or attached to the proposal form are considered a part thereof and must not be detached or altered when the proposal is submitted.

The plans, specifications and other documents designated in the proposal form, will be considered a part of the proposal whether attached or not.

The prospective bidder will be required to pay the Department the sum stated in the notice to contractors for each set of plans.

102.03 ISSUANCE OF PROPOSALS. The Department reserves the right to disqualify or refuse to issue a proposal if a bidder is in default for any of the following reasons:

(a) Lack of competency and adequate machinery, plant and other equipment, as revealed by the financial statement and experience questionnaires required under subsection 102.01.

(b) Uncompleted work which, in the judgment of the Department, might hinder or prevent the prompt completion of additional work if awarded.

(c) Failure to pay, or satisfactorily settle, all bills due for labor and material on former contracts in force at the time of issuance of proposals.

(d) Failure to comply with any qualification regulations of the Department.

(e) Default under previous contracts.

102.04 INTERPRETATION OF QUANTITIES IN BID SCHEDULE. The quantities appearing in the bid schedule are approximate only and are prepared for the comparison of bids. Payment to the contractor will be made only for the actual quantities of work performed and accepted or materials furnished in accordance with the contract. The scheduled quantities of work to be done and materials to be furnished may each be increased, decreased, or omitted as hereinafter provided.

102.05 EXAMINATION OF PLANS, SPECIFICATIONS, SPECIAL PROVISIONS, AND SITE OF WORK. The Department will prepare full, complete, and accurate plans and specifications giving such directions as will enable any competent contractor to carry them out. The bidder is expected to examine carefully the site of the proposed work, the proposal, plans, specifications, supplemental specifications, special provisions, and contract forms before submitting a proposal. The submission of a bid shall be considered prima facie evidence that the bidder has made such examination and is satisfied as to the conditions to be encountered in performing the work and as to the requirements of

the plans, specifications, supplemental specifications, special provisions, and contract.

102.06 PREPARATION OF PROPOSAL. The bidder shall submit his proposal upon the forms furnished by the Department. The bidder shall specify a unit price in words and figures for each pay item, or alternate pay item, for which a quantity is given and shall also show the products of the respective unit prices and quantities written in figures in the column provided for that purpose. All the words and figures shall be in ink or typed. In case of a discrepancy between the prices written in words and those written in figures the prices written in words shall govern.

The bidder's proposal must be signed with ink by the individual, by one or more members of the partnership, by one or more members or officers of each firm representing a joint venture, or by one or more officers of a corporation, or by an agent of the contractor legally qualified and acceptable to the State. If the proposal is made by an individual, his name and post office address must be shown; by a partnership, the name and post office address of each partnership member must be shown; as a joint venture, the name and post office address of each member or officer of the firms represented by the joint venture must be shown; by a corporation, the name of the corporation and the business address of its corporate officials must be shown.

102.07 IRREGULAR PROPOSALS. Proposals will be considered irregular and may be rejected for the following reasons:

(a) If the proposal is on a form other than that furnished by the Department; or if the form is altered or any part thereof is detached.

(b) If there are unauthorized additions, conditional or alternate bids, or irregularities of any kind which may tend to make the proposal incomplete, indefinite, or ambiguous as to its meaning.

(c) If the bidder adds any provisions reserving the right to accept or reject an award, or to enter into a contract pursuant to an award.

(d) If the proposal does not contain a unit price for each pay item listed except in the case of authorized alternate pay items.

102.08 PROPOSAL GUARANTY. No proposal will be considered unless accompanied by a guaranty of the character and in an amount not less than the amount indicated in the proposal form.

102.09 DELIVERY OF PROPOSALS. Each proposal should be submitted in a special envelope furnished by the Department. The blank spaces on the envelope shall be filled in correctly to clearly indicate its content. When an envelope other than the special one furnished by the Department is used, it shall be of the same general size and shape and be similarly marked to clearly indicate its contents. When sent by mail, the sealed proposal shall be addressed to the Department at the address and in care of the official in whose office the bids are to be received. All proposals shall be filed prior to the time and at the place specified in the notice to contractors. Proposals received after the time for opening of bids will be returned to the bidder unopened.

102.10 WITHDRAWAL OR REVISION OF PROPOSALS. A bidder may withdraw or revise a proposal after it has been deposited with the Department, provided the request for such withdrawal or revision is received by the Department, in person or in writing or by telegram before the time set for opening proposals.

102.11 COMBINATION OR CONDITIONAL PROPOSALS. If the Department so elects, proposals may be issued for projects in combination or on separate units of the combination. The Department reserves the right to make awards on combination bids or separate bids to the best advantage of the Department. No combination bids, other than those specifically set up in the proposals by the Department, will be considered. Separate contracts will be written for each individual project included in the combination.

Conditional proposals will be considered when so stated in the special provisions.

102.12 PUBLIC OPENING OF PROPOSALS. Proposals will be opened and read publicly at the time and place indicated in the notice to contractors. Bidders, their authorized agents, and other interested parties are invited to be present.

102.13 DISQUALIFICATION OF BIDDERS. Either of the following reasons may be considered as being sufficient for the disqualification of a bidder and the rejection of his proposal or proposals:

(a) More than one proposal for the same work from an individual, firm, or corporation under the same or different name.

(b) Evidence of collusion among bidders. Participants in such collusion will receive no recognition as bidders for any future work of the Department until any such participant shall have been reinstated as a qualified bidder.

102.14 MATERIAL GUARANTY. The successful bidder may be required to furnish a complete statement of the origin, composition, and manufacture of any or all materials to be used in the construction of the work together with samples, which samples may be subjected to the tests provided for in these specifications to determine their quality and fitness for the work.

Section 103
Award and Execution of Contract

103.01 CONSIDERATION OF PROPOSALS. After the proposals are opened and read, they will be compared on the basis of the summation of the products of the approximate quantities shown in the bid schedule by the unit bid prices. The results of such comparisons will be immediately available to the public. In the event of a discrepancy between unit bid prices and extensions, the unit bid price shall govern.

The right is reserved to reject any or all proposals, to waive technicalities or to advertise for new proposals, if in the judgment of the awarding authority the best interests of the Department will be promoted thereby.

103.02 AWARD OF CONTRACT. The award of contract, if it be awarded, will be made within 30 calendar days after the opening of proposals to the lowest responsible and qualified bidder whose proposal complies with all the requirements prescribed. The successful bidder will be notified, by letter mailed to the address shown on his proposal, that his bid has been accepted and that he has been awarded the contract.

103.03 CANCELLATION OF AWARD. The Department reserves the right to cancel the award of any contract at any time before the execution of said contract by all parties without any liability against the Department.

103.04 RETURN OF PROPOSAL GUARANTY. All proposal guaranties, except those of the two lowest bidders, will be returned immediately following the opening and checking of the proposals. The retained proposal guaranty of the unsuccessful of the two lowest bidders will be returned within 10 days following the award of contract and that of the successful bidder will be returned after a satisfactory bond has been furnished and the contract has been executed.

103.05 REQUIREMENT OF CONTRACT BOND. At the time of the execution of the contract, the successful bidder shall furnish a surety bond or bonds in a sum equal to the full amount of the contract. The form of the bonds and the security shall be acceptable to the Department.

103.06 EXECUTION AND APPROVAL OF CONTRACT. The contract shall be signed by the successful bidder and returned, together with the contract bond, within 15 days after the contract has been mailed to the bidder. If the contract is not executed by the Department within 15 days following receipt from the bidder of the signed contract and bond, the bidder shall have the right to withdraw his bid without penalty. No contract shall be considered as effective until it has been fully executed by all of the parties thereto.

103.07 FAILURE TO EXECUTE CONTRACT. Failure to execute the contract and file acceptable bond within 15 days after the contract has been mailed to the bidder shall be just cause for the cancellation of the award and the forfeiture of the proposal guaranty which shall become the property of the Department, not as a penalty, but in liquidation of damages sustained. Award may then be made to the next lowest responsible bidder or the work may be readvertised and constructed under contract, as the Department may decide.

Section 104
Scope of Work

104.01 INTENT OF CONTRACT. The intent of the contract is to provide for the construction and completion in every detail of the work described. The contractor shall furnish all labor, materials, equipment, tools, transportation and supplies required to complete the work in accordance with the plans, specifications and terms of the contract.

When an item in the proposal and contract contains a choice to be made by the contractor as to the type material to be furnished, the contractor, before the work is initiated, shall indicate his choice in accordance with the specifications for that particular item. Such notification shall be submitted to the project engineer, in writing, and thereafter no further choice will be permitted.

104.02 ALTERATION OF PLANS OR CHARACTER OF WORK. The Department reserves the right to make, at any time during the progress of the work, such increases or decreases in quantities and such alterations in the details of construction, including alterations in the grade or alinement of the road or structure or both, as may be found to be necessary or desirable. Such increases or decreases and alterations shall not invalidate the contract nor release the surety, and the contractor agrees to accept the work as altered, the same as if it had been a part of the original contract.

Under no circumstances shall alterations of plans or of the nature of the work involve work beyond the termini of the proposed construction except as may be necessary to satisfactorily complete the project.

Unless such alterations and increases or decreases materially change the character of the work to be performed or the cost thereof, the altered work shall be paid for at the same unit prices as other parts of the work. If, however, the character of the work or the unit costs thereof are materially changed, an allow-

ance shall be made on such basis as may have been agreed to in advance of the performance of the work, or in case no such basis has been previously agreed upon, then an allowance shall be made, either for or against the contractor, in such amount as the engineer may determine to be fair and equitable.

No claim shall be made by the contractor for any loss of anticipated profits because of any such alteration, or by reason of any variation between the approximate quantities and the quantities of work as done.

Payment for work occasioned by changes or alterations will be made in accordance with the provisions set forth under Subsection 109.03. If the altered or added work is of sufficient magnitude as to require additional time in which to complete the project, such time adjustment may be made in accordance with the provisions of Subsection 108.06.

Unforeseen Conditions. Should the contractor encounter, or the Department discover during the progress of the work, subsurface or latent physical conditions at the site differing materially from those indicated in this contract, or unknown physical conditions at the site of an unusual nature, differing materially from those ordinarily encountered and generally recognized as inherent in work of the character provided for in the contract, the engineer shall be promptly notified, in writing, of such unforeseen conditions before they are disturbed. The engineer will, thereupon, promptly investigate the conditions and, if he finds they do so materially differ and cause an increase or decrease in the cost of, or the time required for performance of the contract, an equitable adjustment will be made and the contract modified accordingly.

Any adjustment in compensation because of a change or changes resulting from unforeseen conditions, as described in the foregoing paragraph, will be made in accordance with the provisions of Subsection 109.03. Any adjustment in contract time because of such change or changes will be made in accordance with the provisions of Subsection 108.06.

If the quantities of work, or increases or decreases in the cost therefor, due to alteration of plans or character of work which cannot be attributed to unforeseen conditions as defined above, result in an increase or decrease of more than 25 per cent of the total amount of the original contract, a supplemental agreement to the contract may be executed between the Department and the contractor, upon demand of either party, and when a supplemental agreement is executed, the consent of the contractor's surety to such supplement shall be obtained.

104.03 EXTRA WORK. The contractor shall perform unforeseen work, for which there is no price included in the contract, whenever it is deemed necessary or desirable in order to complete fully the work as contemplated. Such work shall be performed in accordance with the specifications and as directed, and will be paid for as provided under Subsection 109.04.

104.04 MAINTENANCE OF TRAFFIC. Reasonable provisions for local traffic throughout the length of the project and the life of the contract must be made by the contractor, at his own expense, during construction.

When required on the plans or in the special provisions, the contractor may also be required to provide for through traffic, at his own expense, over the entire project or any designated portion thereof.

If the engineer directs special maintenance for the benefit of the traveling public, then the contractor will be paid therefor at unit prices in the contract or as provided in Subsection 104.03. The engineer will be the sole judge of work to be classed as special maintenance.

104.05 RIGHTS IN AND USE OF MATERIALS FOUND ON THE WORK. The contractor, with the approval of the engineer, may use on the project such stone, gravel, sand, or other material determined suitable by the engineer, as may be found in the excavation and will be paid both for the excavation of such materials at the corresponding contract unit price and for the pay item for which the excavated material is

used. He shall replace at his own expense with other acceptable material all of that portion of the excavation material so removed and used which was needed for use in the embankments, backfills, approaches, or otherwise. No charge for the materials so used will be made against the contractor. The contractor shall not excavate or remove any material from within the highway location which is not within the grading limits, as indicated by the slope and grade lines, without written authorization from the engineer.

Unless otherwise provided, the material from any existing old structure may be used temporarily by the contractor in the erection of the new structure. Such material shall not be cut or otherwise damaged except with the approval of the engineer.

104.06 FINAL CLEANING UP. Before final acceptance, the highway right of way, borrow pits, and all ground occupied by the contractor in connection with the work shall be cleaned of all rubbish, excess materials, temporary structures, haul roads, and equipment; and all parts of the work shall be left in an acceptable condition.

Section 105

Control of Work

105.01 AUTHORITY OF THE ENGINEER. The engineer will decide all questions which may arise as to the quality and acceptability of materials furnished and work performed and as to the rate of progress of the work; all questions which may arise as to the interpretation of the plans and specifications; all questions as to the acceptable fulfillment of the contract on the part of the contractor.

The engineer will have the authority to suspend the work wholly or in part due to the failure of the contractor to correct conditions unsafe for the workmen or the general public; for failure to carry out provisions of the contract; for failure to carry out orders; for such periods as he may deem necessary due to unsuitable weather; for conditions considered unsuitable for the prosecution of the work or for any other condition or reason deemed to be in the public interest.

105.02 PLANS AND WORKING DRAWINGS. Plans will show details of all structures, lines, grades, typical cross sections of the roadway, location and design of all structures and a summary of items appearing on the proposal. Only general features will be shown for steel bridges. The contractor shall keep one set of plans available on the work at all times.

The plans will be suplemented by such working drawings as are necessary to adequately control the work. Working drawings for structures shall be furnished by the contractor and shall consist of such detailed plans as may be required to adequately control the work and are not included in the plans furnished by the Department. They shall include stress sheets, shop drawings, erection plans, false work plans, cofferdam plans, bending diagrams for reinforcing steel or any other supplementary plans or similar data required of the contractor. All working drawings must be approved by the engineer and such approval shall not operate to relieve the contractor of any of his respon-

sibility under the contract for the successful completion of the work.

The contract price shall include the cost of furnishing all supplementary working drawings.

105.03 CONFORMITY WITH PLANS AND SPECIFICATIONS. All work performed and all materials furnished shall be in reasonably close conformity with the lines, grades, cross sections, dimensions, and material requirements, including tolerances, shown on the plans or indicated in the specifications.

In the event the engineer finds the materials or the finished product in which the materials are used or the work performed are not in reasonably close conformity with the plans and specifications and have resulted in an inferior or unsatisfactory product, the work or materials shall be removed and replaced or otherwise corrected by and at the expense of the contractor.

105.04 COORDINATION OF PLANS, SPECIFICATIONS, SUPPLEMENTAL SPECIFICATIONS, AND SPECIAL PROVISIONS. These specifications, the supplemental specifications, the plans, special provisions, and all supplementary documents are essential parts of the contract, and a requirement occurring in one is as binding as though occurring in all. They are intended to be complementary and to describe and provide for a complete work. In case of discrepancy, calculated dimensions will govern over scaled dimensions; plans will govern over specifications; supplemental specifications will govern over specifications; special provisions will govern over both specifications and plans.

Neither the contractor nor the Department shall take advantage of any apparent error or omission in the plans or specifications. In the event the contractor discovers such an error or omission, he shall immediately notify the engineer. The engineer will then make such corrections and interpretations as may be deemed necessary for fulfilling the intent of the plans and specifications.

105.05 COOPERATION BY CONTRACTOR. The contractor will be supplied with a minimum of two sets of approved plans and contract assemblies including special provisions, one set of which the contractor shall keep available on the work at all times.

The contractor shall give the work the constant attention necessary to facilitate the progress thereof, and shall cooperate with the engineer, his inspectors, and other contractors in every way possible.

The contractor shall have on the work at all times, as his agent, a competent superintendent capable of reading and thoroughly understanding the plans and specifications and thoroughly experienced in the type of work being performed, who shall receive instructions from the engineer or his authorized representatives. The superintendent shall have full authority to execute orders or directions of the engineer without delay, and to promptly supply such materials, equipment, tools, labor and incidentals as may be required. Such superintendence shall be furnished irrespective of the amount of work sublet.

105.06 COOPERATION WITH UTILITIES. The Department will notify all utility companies, all pipe line owners, or other parties affected, and endeavor to have all necessary adjustments of the public or private utility fixtures, pipe lines and other appurtenances within or adjacent to the limits of construction, made as soon as possible.

Upon award of the contract, utility companies affected will be advised by the Department of the name and address of the contractor, the approximate date work will begin and other pertinent information.

Unless otherwise specifically provided, and regardless of whether the utility is shown on the plans or otherwise referred to in these specifications or in the special provisions, any adjustment or relocation of water lines, gas lines, wire lines, service connections, water and gas valve boxes, light standards, cableways, signals and all other utility appurtenances within the limits of the right of way are to be done by the owners at no expense to the contractor. In case the utility is

located on supports outside the limits of the right of way, but overhangs same, this shall be considered as occupancy of the right of way.

Where a utility is adjacent to, but occupies no portion of the Department's right of way, or has an overhead crossing but no supports located within the limits of the right of way and the utility will not have the Department's required clearance when the work is completed, it shall be the Department's responsibility to arrange for necessary relocation to the required clearance only, at no expense to the contractor. If the required clearance will exist when the work is completed, the contractor will, at his own expense, make arrangements with the owner for any relocation or adjustment he considers necessary or convenient to his operations. In such cases, upon completion of the work and prior to final acceptance, the final location of the utility must be acceptable to the Department. Nothing in these requirements shall be interpreted, directly or by implication, to mean that the Department waives any of its rights to control the entrance onto, or location on, its right of way, of any utility or appurtenance.

It is understood and agreed that the contractor has considered in his bid all the permanent and temporary utility appurtenances in their present or relocated positions as shown on the plans and that no additional compensation will be allowed for any delays, inconvenience, or damage sustained by him due to any interference from the said utility appurtenances or the operation of moving them.

In general, the contract will indicate various utility items, certain of which are to be relocated or adjusted by the utility owner and others which are to be relocated or adjusted by the contractor. The special provisions shall indicate the means of adjudication, if any, in case of failure by the utility owner to comply with their responsibility in relocating or adjusting their facility.

105.07 COOPERATION BETWEEN CONTRACTORS. The Department reserves the right at any time to

contract for and perform other or additional work on or near the work covered by the contract.

When separate contracts are let within the limits of any one project, each contractor shall conduct his work so as not to interfere with or hinder the progress or completion of the work being performed by other contractors. Contractors working on the same project shall cooperate with each other as directed.

Each contractor involved shall assume all liability, financial or otherwise, in connection with his contract and shall protect and save harmless the Department from any and all damages or claims that may arise because of inconvenience, delay, or loss experienced by him because of the presence and operations of other contractors working within the limits of the same project.

The contractor shall arrange his work and shall place and dispose of the materials being used so as not to interfere with the operations of the other contractors within the limits of the same project. He shall join his work with that of the others in an acceptable manner and shall perform it in proper sequence to that of the others.

105.08 CONSTRUCTION STAKES, LINES AND GRADES. The engineer will set construction stakes necessary to establish the lines, slopes and continuous profile-grade for roadway work and will provide the contractor with all construction layout lines, control measurements and stakes along with construction grades necessary for the prosecution of the work contracted for under these specifications in accordance with the related project plans and special provisions for culvert work, bridge work, protective or accessory structures with all necessary appurtenances.

These layout lines, control measurements, and stakes along with construction grades shall constitute the field control by and in accordance with which the contractor shall establish such other necessary auxiliary controls as he may desire in performing the work contracted for under these specifications, project plans and special provisions.

The contractor shall be held responsible for the preservation of all stakes and marks established by the engineer and, if any of the construction stakes or marks have been carelessly or willfully destroyed or disturbed by the contractor, the cost of replacing same will be charged to the contractor and will be deducted from the payments for the work.

The Department shall be responsible for the accuracy of all lines, measurements, stakes, elevations and grades or other engineering layout and control work done by its authorized representatives except as may be specifically exempted elsewhere in these specifications or unless otherwise stipulated in the special provisions.

105.09 AUTHORITY AND DUTIES OF PROJECT ENGINEER. As the direct representative of the engineer, the project engineer has immediate charge of the engineering details of each construction project. He is responsible for the administration and satisfactory completion of the project. The project engineer shall have the authority to reject defective material and to suspend any work that is being improperly performed. In no case shall he perform any duties for or act as the representative of the contractor.

105.10 DUTIES OF THE INSPECTOR. Inspectors employed by the Department will be authorized to inspect all work done and materials furnished. Such inspection may extend to all or any part of the work and to the preparation, fabrication or manufacture of the materials to be used. The inspector will not be authorized to alter or waive the provisions of these specifications. The inspector will not be authorized to issue instructions contrary to the plans and specifications, or to act as foreman for the contractor.

105.11 INSPECTION OF WORK. All materials and each part or detail of the work shall be subject to inspection by the engineer. The engineer shall be allowed access to all parts of the work and shall be furnished with such information and assistance by the contractor as is required to make a complete and detailed inspection.

If the engineer requests it, the contractor, at any time before acceptance of the work, shall remove or uncover such portions of the finished work as may be directed. After examination, the contractor shall restore said portions of the work to the standard required by the specifications. Should the work thus exposed or examined prove acceptable, the uncovering, or removing, and the replacing of the covering or making good of the parts removed will be paid for as extra work; but should the work so exposed or examined prove unacceptable, the uncovering, or removing, and the replacing of the covering or making good of the parts removed, will be at the contractor's expense.

Any work done or materials used without supervision or inspection by an authorized Department representative may be ordered removed and replaced at the contractor's expense.

When any unit of government or political subdivision or any railroad corporation is to pay a portion of the cost of the work covered by this contract, its respective representatives shall have the right to inspect the work. Such inspection shall in no sense make any unit of government or political subdivision or any railroad corporation a party to this contract, and shall in no way interfere with the rights of either party hereunder.

105.12 REMOVAL OF UNACCEPTABLE AND UNAUTHORIZED WORK. All work which does not conform to the requirements of the contract will be considered as unacceptable work.

Unacceptable work, whether the result of poor workmanship, use of defective materials, damage through carelessness or any other cause, found to exist prior to the final acceptance of the work, shall be removed immediately and replaced in an acceptable manner.

No work shall be done without lines and grades having been given by the engineer. Work done contrary to the instructions of the engineer, work done beyond the lines shown on the plans, or as given, except as herein specified, or any extra work done without au-

thority, will be considered as unauthorized and will not be paid for under the provisions of the contract. Work so done may be ordered removed or replaced at the contractor's expense.

Upon failure on the part of the contractor to comply forthwith with any order of the engineer, made under the provisions of this subsection, the engineer will have authority to cause unacceptable work to be remedied or removed and replaced and unauthorized work to be removed and to deduct the costs from any monies due or to become due the contractor.

105.13 LOAD RESTRICTIONS. The contractor shall comply with all legal load restrictions in the hauling of materials or equipment on public roads beyond the limits of the project. A special permit will not relieve the contractor of liability for damage which may result from the moving of equipment.

The operation of equipment on the project of such weight or so loaded as to cause damage or overstress to structures or the roadway or to any other type of construction will not be permitted. Hauling of materials over the base course or surface course under construction shall be limited as directed. The contractor shall be responsible for all damage done by his hauling equipment.

105.14 MAINTENANCE DURING CONSTRUCTION. The contractor shall maintain the work during construction and until the project is accepted. This maintenance shall constitute continuous and effective work prosecuted day by day, with adequate equipment and forces to the end that the roadway, or structures, are kept in satisfactory condition at all times.

In the case of a contract for the placing of a course upon a course or subgrade previously constructed, the contractor shall maintain the previous course or subgrade during all construction operations.

Except as provided elsewhere in these specifications, all cost of maintenance work during construction and before the project is accepted shall be included in the unit prices bid on the various pay items

and the contractor will not be paid an additional amount for such work.

105.15 FAILURE TO MAINTAIN ROADWAY OR STRUCTURE. If the contractor, at any time, fails to comply with the provisions of Subsection 105.14 the engineer will immediately notify the contractor, in writing, of such non-compliance. If the contractor fails to remedy unsatisfactory maintenance within 24 hours after receipt of such notice, the engineer may immediately proceed to maintain the project, and the entire cost of this maintenance will be deducted from monies due or to become due the contractor on his contract.

105.16 ACCEPTANCE.

(a) Partial Acceptance. If at any time during the prosecution of the project, the contractor satisfactorily completes a unit or portion of the project, such as a structure, an interchange, or a section of road or pavement that can be used advantageously for traffic, he may request the engineer to make final inspection of that unit. If the engineer finds upon inspection that the unit has been satisfactorily completed in compliance with the contract he may accept that unit as being completed and the contractor will be relieved of further responsibility for that unit. Such partial acceptance shall in no way void or alter any of the terms of the contract.

(b) Final Acceptance. Upon due notice from the contractor of presumptive completion of the entire project, the engineer will make an inspection. If all construction provided for and contemplated by the contract is found completed to his satisfaction, that inspection shall constitute the final inspection and the engineer will make the final acceptance and notify the contractor in writing of this acceptance as of the date of the final inspection.

If, however, the inspection discloses any work, in whole or in part, as being unsatisfactory, the engineer will give the contractor the necessary instructions for correction of same, and the contractor shall immediately comply with and execute such instructions. Upon

correction of the work, another inspection will be made which shall constitute the final inspection provided the work has been satisfactorily completed. In such event, the engineer will make the final acceptance and notify the contractor in writing of this acceptance as of the date of final inspection.

105.17 CLAIMS FOR ADJUSTMENT AND DISPUTES. If, in any case, the contractor deems that additional compensation is due him for work or material not clearly covered in the contract or not ordered by the engineer as extra work, as defined herein, the contractor shall notify the engineer in writing of his intention to make claim for such additional compensation before he begins the work on which he bases the claim. If such notification is not given, and the engineer is not afforded proper facilities by the contractor for keeping strict account of actual cost as required, then the contractor hereby agrees to waive any claim for such additional compensation. Such notice by the contractor, and the fact that the engineer has kept account of the cost as aforesaid, shall not in any way be construed as proving or substantiating the validity of the claim. If the claim, after consideration by the engineer, is found to be just, it will be paid for as extra work or as provided herein for force account work. Nothing in this subsection shall be construed as establishing any claim contrary to the terms of Subsection 104.02.

Section 106
Control of Material

106.01 SOURCE OF SUPPLY AND QUALITY REQUIREMENTS. The materials used on the work shall meet all quality requirements of the contract. In order to expedite the inspection and testing of materials, the contractor shall notify the engineer of his proposed sources of materials prior to delivery. At the option of the engineer, materials may be approved at the source of supply before delivery is started. If it is found after trial that sources of supply for previously approved materials do not produce specified products the contractor shall furnish materials from other sources or make necessary changes to provide acceptable materials.

106.02 LOCAL MATERIAL SOURCES.

(a) Designated Sources. Possible sources of local materials may be designated on the plans and described in the special provisions. The quality of material in such deposits will be acceptable in general, but the contractor shall determine for himself the amount of equipment and work required to produce a material meeting the specifications. It shall be understood that it is not feasible to ascertain from samples the limits for an entire deposit, and that variations shall be considered as usual and are to be expected. The engineer may order procurement of material from any portion of a deposit and may reject portions of the deposit as unacceptable prior to incorporation in the work.

The Department may acquire and make available to the contractor the right to take materials from the sources designated on the plans and described under special provisions, together with the right to use such property as may be specified, for plant site, stockpiles and hauling roads.

(b) Contractor Furnished Sources. If the contractor desires to use material from sources other than

those designated, he shall acquire the necessary rights to take materials from the sources and shall pay all costs related thereto, including any which may result from an increase in length of haul. All costs of exploring and developing such other sources shall be borne by the contractor. The use of material from other than designated sources will not be permitted until representative samples taken by the engineer have been approved and written authority is issued for the use thereof.

When material deposits are not designated in the special provisions, the contractor shall provide sources of material acceptable to the engineer.

When sources of material or material deposits are provided by the contractor, the Department may assume the cost of processing samples to determine the suitability of the material.

Sites from which material has been removed shall, upon completion of the work be left in a neat and presentable condition.

Unless otherwise authorized by the engineer, in writing, borrow pits, gravel pits, and quarry sites shall be located not less than 300 feet from the highway right of way.

106.03 SAMPLES, TESTS, CITED SPECIFICATIONS. All materials will be inspected, tested and accepted by the engineer before incorporation in the work. Any work in which untested and unaccepted materials are used, without approval or written permission of the engineer, shall be performed at the contractor's risk and may be considered as unacceptable and unauthorized and will not be paid for. Unless otherwise designated, samples and tests will be run in accordance with the most recent cited standard method of the Department's Sampling Manual and the Testing Procedures Manual; if not contained therein, by the AASHO methods. If a procedure is not available in AASHO then the ASTM procedure will be used. Sampling and testing procedures not contained as above shall be as determined by the engineer. All procedures will be the most recent cited which are current on the

date of the advertisement for bids. Unless otherwise designated, all testing will be made by and at the expense of the Department. Samples will be taken by a qualified representative of the Department. All materials being used are subject to inspection, test or rejection at any time prior to incorporation into the work. Copies of all test reports will be furnished to the contractor's representative at his request.

106.04 PLANT INSPECTION. The engineer may undertake the inspection of materials at the source.

In the event plant inspection is undertaken the following conditions shall be met:

(a) The engineer shall have the cooperation and assistance of the contractor and the producer with whom he has contracted for materials.

(b) The engineer shall have full entry at all times to such parts of the plant as may concern the manufacture or production of the materials being furnished.

(c) If required by the engineer, the contractor shall arrange for an approved building for the use of the inspector; such building to be located conveniently near the plant, independent of any building used by the material producer and conforming to the requirements of Subsection 106.05.

(d) Adequate safety measures are to be provided and maintained.

It is understood that the Department reserves the right to retest all materials prior to incorporation into the work which have been tested and accepted at the source of supply after the same have been delivered and to reject all materials which, when retested, do not meet the requirements of these specifications, or those established for the specific project.

106.05 FIELD LABORATORY. The contractor shall provide one or more suitable shelters or field laboratories as required in accordance with Section 720 to house and use the equipment essential to the Department's inspectors to carry on the required tests.

106.06 STORAGE OF MATERIALS. Materials shall be so stored as to assure the preservation of their quality and fitness for the work. Stored materials, even though approved before storage, may again be inspected prior to their use in the work. Stored materials shall be located so as to facilitate their prompt inspection. Approved portions of the right-of-way may be used for storage purposes and for the placing of the contractor's plant and equipment, but any additional space required therefor must be provided by the contractor at his expense. Private property shall not be used for storage purposes without written permission of the owner or lessee, and if requested by the engineer copies of such written permission shall be furnished him. All storage sites shall be restored to their original condition by the contractor at his expense. This shall not apply to the stripping and storing of topsoil, or to other materials salvaged from the work.

106.07 HANDLING MATERIALS. All materials shall be handled in such manner as to preserve their quality and fitness for the work. Aggregates shall be transported from the storage site to the work in tight vehicles so constructed as to prevent loss or segregation of materials after loading and measuring in order that there may be no inconsistencies in the quantities of materials intended for incorporation in the work as loaded, and the quantities as actually received at the place of operations.

106.08 UNACCEPTABLE MATERIALS. All materials not conforming to the requirements of the specifications at the time they are used shall be considered as unacceptable and all such materials will be rejected and shall be removed immediately from the site of the work unless otherwise instructed by the engineer. No rejected material, the defects of which have been corrected, shall be used until approval has been given.

106.09 DEPARTMENT-FURNISHED MATERIAL. The contractor shall furnish all materials required to complete the work, except those specified to be furnished by the Department.

Material furnished by the Department will be de-

livered or made available to the contractor at the points specified in the special provisions.

The cost of handling and placing all materials after they are delivered to the contractor shall be considered as included in the contract price for the item in connection with which they are used.

The contractor will be held responsible for all material delivered to him, and deductions will be made from any monies due him to make good any shortages and deficiencies, from any cause whatsoever, and for any damage which may occur after such delivery, and for any demurrage charges.

106.10 ADJUSTMENT FOR CHANGES IN COMMON CARRIER RATES. It is understood and agreed that the accepted proposal for this project is based on common carrier rates on file with the Interstate Commerce Commission or with a corresponding intrastate commission or body and in effect on the date of opening of bids. Payments to the contractor will be adjusted to compensate for increases and decreases in cost due to changes in common carrier rates becoming effective after the date of opening of bids and before the date stipulated for completion of the work, as adjusted because of authorized extensions of time. The adjustment shall be limited to an amount determined as follows:

The adjustment shall be the product of the increase or decrease in the said common carrier rates multiplied by the net quantity of material shipped at the new rates to the work and incorporated therein, all as shown by receipted common carrier bills.

This provision is in no way intended to apply to any other than shipments by common carrier.

Section 107
Legal Relations and Responsibility to Public

107.01 LAWS TO BE OBSERVED. The contractor shall keep fully informed of all Federal, State and local laws, ordinances, and regulations and all orders and decrees of bodies or tribunals having any jurisdiction or authority, which in any manner affect those engaged or employed on the work, or which in any way affect the conduct of the work. He shall at all times observe and comply with all such laws, bylaws, ordinances, regulations, orders, and decrees; and shall protect and indemnify the State and its representatives against any claim or liability arising from or based on the violation of any such law, bylaw, ordinance, regulation, order, or decree, whether by himself or his employees.

107.02 PERMITS, LICENSES AND TAXES. Except as otherwise provided, the contractor shall procure all permits and licenses, pay all charges, fees, and taxes, and give all notices necessary and incidental to the due and lawful prosecution of the work.

107.03 PATENTED DEVICES, MATERIALS, AND PROCESSES. If the contractor employs any design, device, material, or process covered by letters of patent or copyright, he shall provide for such use by suitable legal agreement with the patentee or owner. The contractor and the surety shall indemnify and save harmless the State, any affected third party, or political subdivision, from any and all claims for infringement by reason of the use of any such patented design, device, material or process, or any trademark or copyright, and shall indemnify the State for any costs, expenses, and damages which it may be obliged to pay by reason of any infringement, at any time during the prosecution or after the completion of the work.

107.04 RESTORATION OF SURFACES OPENED BY PERMIT. The right to construct or reconstruct any

utility service in the highway or street or to grant permits for same, at any time, is hereby expressly reserved by the Department for the proper authorities of the municipality in which the work is done and the contractor shall not be entitled to any damages either for the digging up of the street or for any delay occasioned thereby.

Any individual, firm, or corporation wishing to make an opening in the highway must secure a permit from the Department. The contractor shall allow parties bearing such permits, and only those parties, to make openings in the highway. The contractor shall, when ordered by the engineer, make in an acceptable manner all necessary repairs due to such openings and such necessary work will be paid for as extra work, or as provided in these specifications, and will be subject to the same conditions as original work performed.

107.05 FEDERAL AID PROVISIONS. When the United States Government pays all or any portion of the cost of a project, the Federal laws and the rules and regulations made pursuant to such laws must be observed by the contractor, and the work shall be subject to the inspection of the appropriate Federal agency.

Such inspection shall in no sense make the Federal Government a party to this contract and will in no way interfere with the rights of either party hereunder.

107.06 SANITARY PROVISIONS. The contractor shall provide and maintain in a neat, sanitary condition such accommodations for the use of his employees as may be necessary to comply with the requirements of the State and local Board of Health, or of other bodies or tribunals having jurisdiction.

107.07 PUBLIC CONVENIENCE AND SAFETY. The contractor shall at all times so conduct his work as to assure the least possible obstruction to traffic.

When the road under construction is to be kept open for the use of the traveling public, special attention shall be paid to keeping both the subgrade and newly laid surfacing reasonably free from dust and in such

condition that the public can travel the road in safety. The safety and convenience of the general public and the residents along the highway and the protection of persons and property shall be a primary responsibility of the contractor.

107.08 RAILWAY-HIGHWAY PROVISIONS. If the plans require that materials be hauled across the tracks of any railway, the Department will make arrangements with the railway for any new crossings required or for the use of any existing crossings. If the contractor elects to use crossings other than those shown on the plans he shall make his own arrangements for the use of such crossings.

All work to be performed by the contractor in construction on the railroad right-of-way shall be performed at such times and in such manner as not to unnecessarily interfere with the movement of trains or traffic upon the track of the railway company. The contractor shall use all care and precaution in order to avoid accidents, damage, or unnecessary delay or interference with the railway company's trains or other property.

107.09 BRIDGES OVER NAVIGABLE WATERS. All work on navigable waters shall be so conducted that free navigation of the waterways will not be interfered with and that the existing navigable depths will not be impaired except as allowed by permit issued by the U. S. Army Corps of Engineers.

107.10 BARRICADES AND WARNING SIGNS. The contractor shall provide, erect, and maintain all necessary barricades, suitable lights, danger signals, signs and other traffic control devices, and shall take all necessary precautions for the protection of the work and safety of the public. Highways closed to traffic shall be protected by effective barricades, and obstructions shall be illuminated during hours of darkness. Suitable warning signs shall be provided to properly control and direct traffic.

The contractor shall erect warning signs in advance of any place on the project where operations may interfere with the use of the road by traffic, and at all

intermediate points where the new work crosses or coincides with an existing road. Such warning signs shall be constructed and erected in accordance with the plans furnished.

All barricades, warning signs, lights, temporary signals, and other protective devices must conform with the Louisiana Manual on Uniform Traffic Control Devices.

Unless a pay item for "Signs and Barricades" is provided in the contract, all materials furnished and work performed as provided by this subsection shall be considered as subsidiary and the costs thereof shall be included in the various bid items of the contract.

107.11 USE OF EXPLOSIVES. When the use of explosives is deemed necessary for the prosecution of the work and approved, the contractor shall exercise the utmost care not to endanger life or property including new work. Their use shall be in strict compliance with all laws and ordinances. The contractor shall be responsible for any and all damage resulting from the use of explosives.

All explosives shall be stored in a secure manner, in compliance with all laws and ordinances, and all such storage places shall be clearly marked. Where no local laws or ordinances apply, storage shall be provided satisfactory to the engineer and in general not closer than 1,000 feet from the road or from any building or camping area or place of human occupancy.

The contractor shall notify in writing each public utility company, having structures in proximity to the site of the work, of his intention to use explosives and such notice shall be given sufficiently in advance to enable the companies to take such steps as they may deem necessary to protect their property from injury.

107.12 PRESERVATION AND RESTORATION OF PROPERTY, LANDSCAPE, AND SURVEY MONUMENTS. The contractor shall be responsible for the preservation of all public and private property and shall protect carefully from disturbance and damage all land monuments, property line markers, and/or horizontal

and vertical control monuments such as those established by the United States Coast and Geodetic Survey, Louisiana Geodetic Survey, Corps of Engineers, United States Geological Survey, etc.

Before removing and resetting any of the above listed type monuments, the contractor shall give sufficient advance notice in writing to the appropriate agency responsible for the particular monument as well as to the project engineer of his intention to perform the work in order that the proper authority of such agency may have a representative present if he so desires. Under no conditions should the contractor disturb or move any such monument without the approval of the project engineer.

The project engineer shall designate the location and the precise manner in which these monuments are to be reset.

The contractor shall be responsible for all damage or injury to property of any character, during the prosecution of the work, resulting from any act, omission, neglect, or misconduct in his manner or method of executing the work, or at any time due to defective work or materials.

When or where any direct or indirect damage or injury is done to public or private property by or on account of any act, omission, neglect, or misconduct in the execution of the work, or in consequence of the nonexecution thereof by the contractor, he shall restore, at his own expense, such property to a condition similar or equal to that existing before such damage or injury was done, by repairing, rebuilding, or otherwise restoring as may be directed, or he shall make good such damage or injury in an acceptable manner.

107.13 FOREST PROTECTION. In carrying out work within or adjacent to State or National Forests, the contractor shall comply with all regulations of the State Fire Marshal, Conservation Commission, Forestry Department, or other authority having jurisdiction, governing the protection of forests and the carrying out of work within forests, and shall observe all sanitary laws and regulations with respect to the performance of work in forest areas. He shall keep the areas

in an orderly condition, dispose of all refuse, obtain permits for the construction and maintenance of all construction camps, stores, warehouses, residences, latrines, cesspools, septic tanks, and other structures in accordance with the requirement of the forest supervisor.

The contractor shall take all reasonable precaution to prevent and suppress forest fires and shall require his employees and subcontractors, both independently and at the request of forest officials, to do all reasonably within their power to prevent and suppress and to assist in preventing and suppressing forest fires and to make every possible effort to notify a forest official at the earliest possible moment of the location and extent of any fire seen by them.

107.14 RESPONSIBILITY FOR DAMAGE CLAIMS. The contractor shall indemnify and save harmless the Department, its officers and employees, from all suits, actions, or claims of any character brought because of any injuries or damage received or sustained by any person, persons, or property on account of the operations of the said contractor; or on account of or in consequence of any neglect in safeguarding the work; or through use of unacceptable materials in constructing the work; or because of any act or omission, neglect, or misconduct of said contractor; or because of any claims or amounts recovered from any infringements of patent, trademark, or copyright; or from any claims or amounts arising or recovered under the "Workmen's Compensation Act," or any other law, ordinance, order, or decree; and so much of the money due the said contractor under and by virtue of his contract as may be considered necessary by the Department for such purpose, may be retained for the use of the State; or, in case no money is due, his surety may be held until such suit or suits, action or actions, claim or claims for injuries or damages as aforesaid shall have been settled and suitable evidence to that effect furnished to the Department; except that money due the contractor will not be withheld when the contractor produces satisfactory evidence that he is adequately protected by public liability and property damage insurance.

107.15 OPENING SECTIONS OF PROJECT TO TRAFFIC. Opening of sections of the work to traffic prior to completion of the entire contract may be desirable from a traffic service standpoint, or may be necessary due to conditions inherent in the work, or by changes in the contractor's work schedule, and may be required due to conditions or events unforeseen at the time of the contract. Such openings as may be necessary due to any of the foregoing conditions shall be made when so ordered by the engineer. Under no condition shall such openings constitute acceptance of the work or a part thereof, or a waiver of any provisions of the contract.

Special provisions shall state, insofar as possible, which sections shall be opened prior to completion of the contract. On any section opened by order of the engineer, whether covered in the special provisions or not, the contractor shall not be required to assume any expense entailed in maintaining the road for traffic. Such expense shall be borne by the Department, or compensated for in a manner provided hereinafter in Subsection 109.04. On such portions of the project which are ordered by the engineer to be opened for traffic, in the case of unforeseen necessity which is not the fault of the contractor, compensation for additional expense, if any, to the contractor and allowance of additional time, if any, for completion of any other items of work on the portions of the project ordered by the engineer to be opened in the event of such unforeseen necessity, shall be as set forth in a change order mutually agreed on by the engineer and the contractor as set forth hereinafter.

If the contractor is dilatory in completing shoulders, drainage structures, or other features of the work, the engineer may so notify him in writing and establish therein a reasonable period of time in which the work should be completed. If the contractor is dilatory, or fails to make a reasonable effort toward completion in this period of time, the engineer may then order all or a portion of the project opened to traffic. On such sections which are so ordered to be opened, the contractor shall conduct the remainder of his construction operations so as to cause the least obstruc-

tion to traffic and shall not receive any added compensation due to the added cost of the work by reason of opening such section to traffic.

On any section opened to traffic under any of the above conditions, whether stated in the special provisions or opened by necessity of contractor's operations, or unforeseen necessity, any damage to the highway not attributable to traffic which might occur on such section (except slides) shall be repaired by the contractor at his expense. The removal of slides shall be done by the contractor on a basis agreed to prior to the removal of such slides.

107.16 CONTRACTOR'S RESPONSIBILITY FOR WORK. Until final written acceptance of the project by the engineer, the contractor shall have the charge and care thereof and shall take every precaution against injury or damage to any part thereof by the action of the elements, or from any other cause, whether arising from the execution or from the non-execution of the work. The contractor shall rebuild, repair, restore, and make good all injuries or damages to any portion of the work occasioned by any of the above causes before final acceptance and shall bear the expense thereof except damage to the work due to unforeseeable causes beyond the control of and without the fault or negligence of the contractor, including but not restricted to acts of God, of the public enemy or of governmental authorities.

In case of suspension of work from any cause whatever, the contractor shall be responsible for the project and shall take such precautions as may be necessary to prevent damage to the project, provide for normal drainage and to erect any necessary temporary structures, signs, or other facilities at his expense. During such period of suspension of work, the contractor shall properly and continuously maintain in an acceptable growing condition all living material in newly established plantings, seedings, and soddings furnished under his contract, and shall take adequate precautions to protect new tree growth and other important vegetative growth against injury.

107.17 CONTRACTOR'S RESPONSIBILITY FOR UTILITY PROPERTY AND SERVICES. At points where the

contractor's operations are adjacent to properties of railway, telegraph, telephone, and power companies, or are adjacent to other property, damage to which might result in considerable expense, loss, or inconvenience, work shall not be commenced until all arrangements necessary for the protection thereof have been made.

The contractor shall cooperate with the owners of any underground or overhead utility lines in their removal and rearrangement operations in order that these operations may progress in a reasonable manner and that duplication of rearrangement work may be reduced to a minimum, and that services rendered by those parties will not be unnecessarily interrupted.

In the event of interruption to water or utility services as a result of accidental breakage, or as a result of being exposed or unsupported, the contractor shall promptly notify the proper authority and shall cooperate with the said authority in the restoration of service. If water service is interrupted repair work shall be continuous until the service is restored. No work shall be undertaken around fire hydrants until provisions for continued service have been approved by the local fire authority.

107.18 FURNISHING RIGHT-OF-WAY. The Department will be responsible for the securing of all necessary rights-of-way in advance of construction. Any exceptions will be indicated in the contract.

107.19 PERSONAL LIABILITY OF PUBLIC OFFICIALS. In carrying out any of the provisions of these specifications, or in exercising any power or authority granted to them by or within the scope of the contract, there shall be no liability upon the director, engineer, or their authorized representatives, either personally or as officials of the State, it being understood that in all such matters they act solely as agents and representatives of the State.

107.20 NO WAIVER OF LEGAL RIGHTS. Upon completion of the work, the Department will expeditiously make final inspection and notify the contractor of acceptance. Such final acceptance, however, shall not

preclude or estop the Department from correcting any measurement, estimate, or certificate made before or after completion of the work, nor shall the Department be precluded or estopped from recovering from the contractor or his surety, or both, such overpayment as it may sustain, or by failure on the part of the contractor to fulfill his obligations under the contract. A waiver on the part of the Department of any breach of any part of the contract shall not be held to be a waiver of any other or subsequent breach.

The contractor, without prejudice to the terms of the contract, shall be liable to the Department for latent defects, fraud, or such gross mistakes as may amount to fraud, or as regards the Department's rights under any warranty or guaranty.

Section 108

Prosecution and Progress

108.01 SUBLETTING OF CONTRACT. The contractor shall not sublet, sell, transfer, assign, or otherwise dispose of the contract or contracts or any portion thereof, or of his right, title, or interest therein, without written consent of the engineer. In case such consent is given, the contractor will be permitted to sublet a portion thereof, but shall perform with his own organization, work amounting to not less than 50 per cent of the total contract cost, except that any items designated in the contract as "specialty items" may be performed by subcontract and the cost of any such specialty items so performed by subcontract may be deducted from the total cost before computing the amount of work required to be performed by the contractor with his own organization. No subcontracts, or transfer of contract, shall in any case release the contractor of his liability under the contract and bonds.

108.02 NOTICE TO PROCEED. The "Notice to Proceed" will stipulate the date on which it is expected the contractor will begin the construction and from which date contract time will be charged. Commencement of work by the contractor may be deemed and taken as a waiver on his part of this notice.

108.03 PROSECUTION AND PROGRESS. The contractor, when required, shall furnish the engineer with a "Progress Schedule" for his approval. The progress schedule may be used as the basis for establishing major construction operations and as a check on the progress of the work. The contractor shall provide sufficient materials, equipment, and labor to guarantee the completion of the project in accordance with the plans and specifications within the time set forth in the proposal. Should the prosecution of the work for any reason be discontinued, the contractor shall notify the engineer in writing at least 24 hours in advance of resuming operations.

108.04 LIMITATION OF OPERATIONS. The contractor

shall conduct the work at all times in such a manner and in such sequence as will assure the least interference with traffic. He shall have due regard to the location of detours and to the provisions for handling traffic. He shall not open up work to the prejudice or detriment of work already started, and the engineer may require the contractor to finish a section on which work is in progress before work is started on any additional sections if the opening of such section is essential to public convenience.

108.05 CHARACTER OF WORKMEN; METHODS AND EQUIPMENT. The contractor shall at all times employ sufficient labor and equipment for prosecuting the several classes of work to full completion in the manner and time required by these specifications.

All workmen shall have sufficient skill and experience to perform properly the work assigned to them. Workmen engaged in special work or skilled work shall have sufficient experience in such work and in the operation of the equipment required to perform all work properly and satisfactorily.

Any person employed by the contractor or by any subcontractor who, in the opinion of the engineer, does not perform his work in a proper and skillful manner or is intemperate or disorderly shall, at the written request of the engineer, be removed forthwith by the contractor or subcontractor employing such person, and shall not be employed again in any portion of the work without the approval of the engineer.

Should the contractor fail to remove such person or persons as required above, or fail to furnish suitable and sufficient personnel for the proper prosecution of the work, the engineer may suspend the work by written notice until such orders are complied with.

All equipment which is proposed to be used on the work shall be of sufficient size and in such mechanical condition as to meet requirements of the work and to produce a satisfactory quality of work. Equipment used on any portion of the project shall be such that no injury to the roadway, adjacent property, or other highways will result from its use.

When the methods and equipment to be used by the

contractor in accomplishing the construction are not prescribed in the contract, the contractor is free to use any methods or equipment that he demonstrates to the satisfaction of the engineer will accomplish the contract work in conformity with the requirements of the contract.

When the contract specifies that the construction be performed by the use of certain methods and equipment, such methods and equipment shall be used unless others are authorized by the engineer. If the contractor desires to use a method or type of equipment other than those specified in the contract, he may request authority from the engineer to do so. The request shall be in writing and shall include a full description of the methods and equipment proposed to be used and an explanation of the reasons for desiring to make the change. If approval is given, it will be on the condition that the contractor will be fully responsible for producing construction work in conformity with contract requirements. If, after trial use of the substituted methods or equipment, the engineer determines that the work produced does not meet contract requirements, the contractor shall discontinue the use of the substitute method or equipment and shall complete the remaining construction with the specified methods and equipment. The contractor shall remove the deficient work and replace it with work of specified quality, or take such other corrective action as the engineer may direct. No change will be made in basis of payment for the construction items involved nor in contract time as result of authorizing a change in methods or equipment under these provisions.

108.06 DETERMINATION AND EXTENSION OF CONTRACT TIME. The number of days allowed for the completion of the work included in the contract will be stated in the proposal and contract, and will be known as the "contract time."

When the contract time is on a working day basis the engineer will furnish the contractor a monthly statement showing the number of days charged to the contract for the preceding month, and the number of days specified for completion of the contract. The con-

tractor will be allowed 10 days in which to file a written protest setting forth in what respect said monthly statement is incorrect, otherwise the statement shall be deemed to have been accepted by the contractor as correct.

When the contract time is on a calendar day basis it shall consist of the number of calendar days stated in the contract counting from the effective date of the engineer's order to commence work, including all Sundays, holidays and non-work days. All calendar days elapsing between the effective dates of any orders of the engineer to suspend work and to resume work for suspensions not the fault of the contractor shall be excluded.

When the contract completion time is a fixed calendar date it shall be the date on which all work on the project shall be substantially completed.

The number of days for performance allowed in the contract as awarded is based on the original quantities as defined in Subsection 102.04. If satisfactory fulfillment of the contract requires performance of work in greater quantities than those set forth in the proposal, the contract time allowed for performance shall be increased on a basis commensurate with the amount and difficulty of the added work.

If the contractor finds it impossible for reasons beyond his control to complete the work within the contract time as specified or as extended in accordance with the provisions of this subsection, he may, at any time prior to the expiration of the contract time as extended, make a written request to the engineer for an extension of time setting forth therein the reasons which he believes will justify the granting of his request. The contractor's plea that insufficient time was specified is not a valid reason for extension of time. If the engineer finds that the work was delayed because of conditions beyond the control and without the fault of the contractor, he may extend the time for completion in such amount as the conditions justify. The extended time for completion shall then be in full force and effect the same as though it were the original time for completion.

When final acceptance has been duly made by the engineer as prescribed in Subsection 105.16, the daily time charge will cease.

108.07 FAILURE TO COMPLETE ON TIME. For each calendar day or work day, as specified, that any work shall remain uncompleted after the contract time specified for the completion of the work provided for in the contract, the sum specified below will be deducted from any money due the contractor not as a penalty but as liquidated damages; provided however, that due account shall be taken of any adjustment of the contract time for completion of the work granted under the provisions of Subsection 108.06.

Permitting the contractor to continue and finish the work or any part of it after the time fixed for its completion, or after the date to which the time for completion may have been extended, will in no way operate as a waiver on the part of the Department of any of its rights under the contract.

The Department may waive such portions of the liquidated damages as may accrue after the work is in condition for safe and convenient use by the traveling public.

Based on the amount of the original contract, the following charges per contract day will be made for each such day after the expiration of the contract time or extended contract time, as the case may be.

When the contract time is on either the calendar day or fixed calendar date basis, the schedule for calendar days shall be used. When the contract time is on a work day basis, the schedule for work days shall be used.

ORIGINAL CONTRACT AMOUNT		DAILY CHARGE	
From More Than	To and Including	Calendar Day or Fixed Date	Work Day
$ 0	$ 25,000	$ 30.00	$ 42.00
25,000	50,000	50.00	70.00
50,000	100,000	75.00	105.00
100,000	500,000	100.00	140.00
500,000	1,000,000	150.00	210.00
1,000,000	2,000,000	200.00	280.00
2,000,000	.....	300.00	420.00

The amount of liquidated damages, determined as provided above, will be deducted from any money due the contractor under this contract, and the contractor and his surety shall be liable for any liquidated damages in excess of amounts due the contractor.

108.08 DEFAULT AND TERMINATION OF CONTRACT. If the contractor:

(a) Fails to begin the work under the contract within the time specified in the "Notice to Proceed," or

(b) Fails to perform the work with sufficient workmen and equipment or with sufficient materials to assure the prompt completion of said work, or

(c) Performs the work unsuitably or neglects or refuses to remove materials or to perform anew such work as may be rejected as unacceptable and unsuitable, or

(d) Discontinues the prosecution of the work, or

(e) Fails to resume work, which has been discontinued, within a reasonable time after notice to do so, or

(f) Becomes insolvent or is declared bankrupt, or commits any act of bankruptcy or insolvency, or

(g) Allows any final judgment to stand against him unsatisfied for a period of 10 days, or

(h) Makes an assignment for the benefit of creditors, or

(i) For any other cause whatsoever, fails to carry on the work in an acceptable manner, the engineer will give notice in writing to the contractor and his surety of such delay, neglect, or default.

If the contractor or surety, within a period of 10 days after such notice, shall not proceed in accordance therewith, then the Department will, upon written notification from the engineer to the contractor and surety of the fact of such delay, neglect or default and the contractor's failure to comply with such notice, have full power and authority without violating the contract, to take the prosecution of the

work out of the hands of the said contractor. The Department may appropriate or use any or all materials and equipment on the ground as may be suitable and acceptable and may enter into an agreement for the completion of said contract according to the terms and provisions thereof, or use such other methods as in the opinion of the engineer will be required for the completion of said contract in an acceptable manner.

All costs and charges incurred by the Department, together with the cost of completing the work under contract, will be deducted from any monies due or which may become due said contractor. If such expense exceeds the sum which would have been payable under the contract, then the contractor and the surety shall be liable and shall pay to the Department the amount of such excess.

108.09 TERMINATION OF CONTRACTOR'S RESPONSIBILITY. The contract will be considered complete when all work has been satisfactorily completed, the final inspection made, and the work accepted by the Chief Engineer. The contractor will then be released from further obligation except as set forth in his contract bond, and except as provided in Subsection 107.20.

108.10 TERMINATION OF CONTRACT. If, at any time during the progress of the work, all of said work or all of the major controlling operations are delayed any single period of time for more than 90 consecutive calendar days, by reason of war conditions involving the United States, or by reason of orders of the United States Government or its duly authorized agencies, or Executive Order with respect to prosecution of war or national defense, the Department may enter into an agreement of postponement with the contractor covering postponement of the performance of part or all the work for a specified period of time, or may terminate the contract by notifying the contractor, in writing, of such action. If an agreement of postponement is made, it shall be executed by the contractor and the Department and shall be approved by the surety.

In the event of delay, as hereinbefore provided, the

contractor shall be paid 95 per cent of value of all work completed or partially completed, as provided in the specifications, in accordance with the terms of the agreement of postponement; or, in the event of termination of contract, the contractor shall be paid in full, in accordance with the terms of the contract and particularly of Subsection 109.07, for all work done and completed in accordance therewith; and he shall be paid a reasonable amount or amounts, which shall be fixed or determined by the engineer, for work partially completed; but he shall not be paid any amount for loss of anticipated gain or profit, or any work not performed. Nothing herein contained shall be in derogation of any rights or remedies vested in or available to the Department by the terms of the contract.

Accepted materials obtained by the contractor for the work, but not in excess of job requirements, that have been inspected, tested and accepted by the Department, and that are not incorporated in the work, shall be purchased from the contractor at actual cost as shown by receipted bills at such points of delivery as may be designated by the Department.

Section 109
Measurement and Payment

109.01 MEASUREMENT OF QUANTITIES. All work completed under the contract will be measured by the engineer according to United States standard measure.

A station when used as a definition or term of measurement will be 100 linear feet.

The method of measurement and computations to be used in determination of quantities of material furnished and of work performed under the contract will be those methods generally recognized as conforming to good engineering practice.

Unless otherwise specified, longitudinal measurements for area computations will be made along the surface of the finished pavement, base, etc., and no deductions will be made for individual fixtures having an area of 9 square feet or less. Unless otherwise specified, transverse measurements for area computations will be the neat dimensions shown on the plans or ordered in writing by the engineer.

Structures will be measured according to neat lines shown on the plans or as altered to fit field conditions.

All items which are measured by the linear foot, such as pipe culverts, guardrail, underdrains, etc., will be measured parallel to the base or foundation upon which such structures are placed, unless otherwise shown on the plans.

In computing volumes of excavation the average end area method or other acceptable methods will be used.

The term gage, when used in connection with the measurement of plates, will mean the U. S. Standard Gage, except that when reference is made to the measurements of galvanized sheets used in the manufacture of corrugated metal pipe, metal plate pipe culverts and arches, and metal cribbing, the term gage

will mean that specified in the AASHO Designation: M 36 or AASHO Designation: M 167.

When the term gage refers to the measurement of wire, it will mean the wire gage specified in the AASHO Designation: M 32.

The term ton will mean the short ton consisting of 2,000 pounds avoirdupois. All materials which are measured or proportioned by weight shall be weighed on accurate, approved scales by competent, qualified personnel at locations designated by the engineer. If material is shipped by rail, the car weight may be accepted provided the actual weight of material only will be paid for. However, car weights will not be acceptable for material to be passed through mixing plants. Trucks used to haul material being paid for by weight shall be weighed empty at such times as the engineer directs, and each truck shall bear a plainly legible identification mark.

Materials to be measured by volume in the hauling vehicle shall be hauled in approved vehicles and measured therein at the point of delivery. Vehicles for this purpose may be of any size or type acceptable to the engineer, provided that the body is of such shape that the actual contents may be readily and accurately determined. All vehicles shall be loaded to at least their water level capacity upon arrival at the point of delivery.

When requested by the contractor and approved by the engineer in writing, material specified to be measured by the cubic yard may be weighed and such weights will be converted to cubic yards for payment purposes. Factors for conversion from weight measurement to volume measurement will be determined by the engineer and shall be agreed to by the contractor before such method of measurement of pay quantities is used.

Bituminous materials will be measured by the gallon or ton.

Volumes will be measured at 60° F or will be corrected to the volume using ASTM Designation: D 1250 for asphalts or ASTM Designation: D 633 for tars.

Net certified scale weights or weights based on certified volumes in the case of shipments by rail, truck or other transport will be used as a basis of measurement, subject to correction when material has been lost in transit, wasted, or otherwise not incorporated in the work.

When bituminous materials are shipped by truck or transport net certified weights or volume, subject to correction for loss or foaming, may be used for computing quantities.

Cement will be measured by the barrel. The term barrel will mean 376 pounds of cement.

Timber will be measured by the thousand feet board measure (M.F.B.M.) actually incorporated in the structure. Measurement will be based on nominal widths and thicknesses and the extreme length of each piece.

The term "lump sum" when used as an item of payment will mean complete payment for the work described in the contract.

When a complete structure or structural unit (in effect, "lump sum" work) is specified as the unit of measurement, the unit will be construed to include all necessary fittings and accessories.

Rental of equipment will be measured by time in hours of actual working time and necessary traveling time of the equipment within the limits of the project unless special equipment has been ordered by the engineer in connection with force account work in which case travel time and transportation to the project will be measured. If equipment has been ordered held on the job on a standby basis by the engineer, half time rates for the equipment will be paid.

When standard manufactured items are specified such as fence, wire, plates, rolled shapes, pipe conduit, etc., and these items are identified by gage, unit weight, section dimensions, etc., such identification will be considered to be nominal weights or dimensions. Unless more stringently controlled by tolerances in cited specifications, manufacturing tolerances established by the industries involved will be accepted.

109.02 SCOPE OF PAYMENT. The contractor shall receive and accept compensation provided for in the contract as full payment for furnishing all materials and for performing all work under the contract in a complete and acceptable manner and for all risk, loss, damage, or expense of whatever character arising out of the nature of the work or the prosecution thereof, subject to the provisions of Subsection 107.20.

If the "Basis of Payment" clause in the specifications relating to any unit price in the bid schedule requires that the said unit price cover and be considered compensation for certain work or material essential to the item, this same work or material will not also be measured or paid for under any other pay item which may appear elsewhere in the specifications.

109.03 COMPENSATION FOR ALTERED QUANTITIES. When the accepted quantities of work vary from the quantities in the bid schedule the contractor shall accept as payment in full, so far as contract items are concerned, payment at the original contract unit prices for the accepted quantities of work done. No allowance except as provided in Subsection 104.02 will be made for any increased expense, loss of expected reimbursement, or loss of anticipated profits suffered or claimed by the contractor resulting either directly from such alterations or indirectly from unbalanced allocation among the contract items of overhead expense on the part of the bidder and subsequent loss of expected reimbursements therefor or from any other cause.

109.04 EXTRA AND FORCE ACCOUNT WORK. Extra work performed in accordance with the requirements and provisions of Subsection 104.03 will be paid for at the unit prices or lump sum stipulated in the order authorizing the work or the Department may require the contractor to do such work on a force account basis, to be compensated in the following manner:

(a) Labor. For all labor and foremen in direct charge of the specific operations, the contractor shall receive the rate of wage (or scale) agreed upon in writing before beginning work for each and every hour that said labor and foremen are actually engaged in such work.

The contractor shall receive the actual costs paid to, or in behalf of, workmen by reason of subsistence and travel allowances, health and welfare benefits, pension fund benefits or other benefits, when such amounts are required by collective bargaining agreement or other employment contract generally applicable to the classes of labor employed on the work.

An amount equal to 20 per cent of the sum of the above items will also be paid the contractor.

(b) Bond, Insurance, and Tax. For property damage, liability, and workmen's compensation insurance premiums, unemployment insurance contributions and social security taxes on the force account work, the contractor shall receive the actual cost thereof, to which 6 per cent will be added. The contractor shall furnish satisfactory evidence of the rate or rates paid for such bond, insurance, and tax.

(c) Materials. For materials accepted by the engineer and used, the contractor shall receive the actual cost of such materials delivered on the work, including transportation charges paid by him (exclusive of machinery rentals as hereinafter set forth), to which cost 15 per cent will be added.

(d) Equipment. For any machinery or special equipment (other than small tools) including fuel and lubricants, plus transportation costs, the use of which has been authorized by the engineer, the contractor shall receive the rental rates agreed upon in writing before such work is begun for the actual time such equipment is in operation on the work.

(e) Miscellaneous. No additional allowance will be made for general superintendence, the use of small tools, or other costs for which no specific allowance is herein provided.

(f) Compensation. The contractor's representative and the engineer shall compare records of the cost of work done as ordered on a force account basis. Such comparison shall be made daily if required by the engineer.

(g) Statements. No payment will be made for work performed on a force account basis until the contractor has furnished the engineer with duplicate itemized statements of the cost of such force account work detailed as follows:

(1) Name, classification, date, daily hours, total hours, rate and extension for each laborer and foreman.

(2) Designation, dates, daily hours, total hours, rental rate, and extension for each unit of machinery and equipment.

(3) Quantities of materials, prices, and extensions.

(4) Transportation of materials.

(5) Cost of property damage, liability and workmen's compensation insurance premiums, unemployment insurance contributions, and social security tax.

Statements shall be accompanied and supported by receipted invoices for all materials used and transportation charges. However, if materials used on the force account work are not specifically purchased for such work but are taken from the contractor's stock, then in lieu of the invoices the contractor shall furnish an affidavit certifying that such materials were taken from his stock, that the quantity claimed was actually used, and that the price and transportation claimed represent the actual cost to the contractor.

109.05 ELIMINATED ITEMS. Should any items contained in the proposal be found unnecessary for the proper completion of the work, the engineer may, upon written order to the contractor, eliminate such items from the contract, and such action shall in no way invalidate the contract. When a contractor is notified of the elimination of items, he will be reimbursed for actual authorized work done and all costs incurred, including mobilization of materials prior to said notification.

109.06 PARTIAL PAYMENTS. So long as the work herein contracted for is prosecuted in accordance with

the provisions of the contract, and with such progress as may be satisfactory to the engineer, the engineer will make or cause to be made, the first progress estimate one calendar month from the date indicated to begin work in the "Notice to Proceed." Each successive progress estimate will be made on this same date of each month thereafter until completion of the contract. Each progress estimate shall be an approximation of the proportionate value of the work performed up to and including the date the estimate is made and shall be based on material in place and labor expended thereon, but no more than 95 per cent of the contract price of the work shall be paid in advance of full completion of the contract and its acceptance by the Department.

The amount of said estimate, after deducting 5 per cent and all previous payments, shall be due and payable to the contractor.

The monthly estimates will be approximate only, and all partial or monthly estimates and payments shall be subject to corrections in the estimate rendered following discovery of any error in any previous estimates.

Should any defective work or material be discovered, or should a reasonable doubt arise as to the integrity of any part of the work completed previous to the final acceptance and payment, there will be deducted from the first estimate rendered after the discovery of such defective or questioned work an amount equal in value to the defective or questioned work, and this work will not be included in a subsequent estimate until the defects have been remedied or the causes for doubt removed.

The payment of the monthly estimate shall not in any respect be taken as an admission that the work is done or that its quality is satisfactory, nor as a release of the contractor from the responsibility for any portion thereof, but the whole work and all particulars relating thereto shall be subject to revision and adjustment by the engineer at the time of final acceptance and the payment of the final estimate.

109.07 PAYMENT FOR MATERIAL ON HAND. Upon written request, 90 percent of the invoice cost of the appropriate value of approved specification materials delivered by the contractor at the project site or other designated location in the vicinity of such construction will be paid. Payment will not exceed the total estimated quantity required to complete the project. The agreed value will not exceed the appropriate portion of the contract item or items in which such materials are to be incorporated. Payment for stockpiled materials shall be limited to bulky materials that are durable in nature and represent a significant portion of the project cost, such as aggregates, bridge timber, structural steel, reinforcing steel, etc. Perishable articles and small warehouse items will not be included.

The contractor will furnish the engineer a certified inventory of the quantity of each stockpiled item and its invoiced cost when advanced payment is requested.

Within thirty days after payment by the State the contractor shall submit a copy of a certified paid invoice statement for each item for which payment has been made. In the event certification of payment is not presented with the thirty day period the advanced payment will be deducted from the next progressive payment.

Title, ownership and incidentals thereto of materials for which advancements have been made by the Department shall not vest in the Department until such materials are actually incorporated in the work and the work accepted by the Department and the making of advancements therefor by the Department shall not release the contractor from the responsibility for any portion thereof. The contractor shall save the Department harmless in the event of loss or damage of materials for which advancements have been made, regardless of cause of loss or damage.

109.08 ACCEPTANCE AND FINAL PAYMENT. Upon the completion and acceptance of the work, the Chief Engineer shall execute a certificate that the whole work provided for in this contract has been completed and accepted under the terms and conditions of the contract, and said certificate of acceptance shall be

recorded in the office of the Recorder of Mortgages of the Parish in which the work has been done, and the entire balance found to be due the said contractor, including all retained percentages (all prior certificates or estimates upon which payments have been made being approximate only and subject to correction in the final payment) shall be paid to the contractor after the Department has satisfied itself that the quantities shown on the final estimate are correct; provided, however, that before the payment of said final estimate shall be made, the contractor shall submit to the Department a certificate from the Recorder of Mortgages of the Parish in which the said work has been done to the effect that there are no claims or liens recorded against the said contract. The date of said certificate shall be not prior to the expiration of 45 days after the certificate of acceptance was recorded by the Department in the Mortgage office.

It is expressly stipulated and understood that payment of the final estimate shall not operate to release the contractor or his sureties from liability for any fraud in construction, or in obtaining progress payments, or in payment for materials, labor, or other supplies or services incidental to the work, or for any and all claims for damages, loss or injury sustained by any person or persons whomsoever, through the fault, negligence or conduct of the said contractor or any of his employees.

PART II
EARTHWORK

Section 201
Clearing and Grubbing

201.01 DESCRIPTION. This work shall consist of clearing, grubbing, removing and disposing of all vegetation and debris within the limits of the right of way and easement areas, except such objects as are designated to remain or are to be removed in accordance with other sections of these specifications. This work shall also include the preservation from injury or defacement of all vegetation and objects designated to remain.

201.02 CLEARING. This work shall consist of cutting, removing, burning and clearing up of timber, logs, brush, stumps and debris from within the entire construction area and to a point in fills 10 feet beyond the toes of foreslopes and in cuts 10 feet beyond the tops of backslopes when width of right of way permits; also from such areas required for offtake ditches, channel changes and borrow pits furnished by the Department. Also, where fencing is required, it shall include an area 10 feet wide adjacent to and inside the right of way line. In addition, it shall include clearing of fruit trees, shrubbery and flowers within the above limits which are not removed by their owners, except shrubbery which is to be removed and transplanted by the contractor in connection with other bid items.

201.03 SELECTIVE CLEARING. This work shall consist of selectively clearing all areas within the limits of the right of way which are not included under "Clearing" in the foregoing paragraph of all non-valuable trees, shrubs, vines, logs, brush, stumps, snags and debris, for the purpose of leaving valuable vegetation to remain. Items to remain shall be selected and designated by the project engineer.

201.04 GRUBBING. This work shall consist of the excavation and removal of all stumps, roots, submerged logs, snags, corduroy and other perishable and objectionable materials from all areas to be cleared or selectively cleared as provided above.

CONSTRUCTION REQUIREMENTS

201.05 GENERAL. The engineer will establish right of way lines and construction lines and shall designate all trees, shrubs, plants and other items to remain. The contractor shall preserve all items designated to remain. Trees shall be felled and removed in such manner as to avoid injury to other items marked to remain. In case of injuries to bark, trunks, limbs or roots of vegetation marked to remain, the contractor shall repair such damage without additional compensation, by corrective pruning, bark tracing, wood painting and other acceptable horticultural and tree surgery practices. Trees falling outside the right of way limits shall be removed.

201.06 CLEARING AND GRUBBING. All surface objects and all trees, stumps, roots and other protruding obstructions, not designated to remain, shall be cleared and/or grubbed, including mowing, as required, except undisturbed stumps and roots and nonperishable solid objects which will be a minimum of 2 feet below subgrade or slope of embankments. When authorized, the contractor may leave stumps and nonperishable solid objects provided they do not extend more than 6 inches above the ground line or low water level.

Grubbing with explosives will not be permitted in swampy areas or adjacent to high pressure oil and gas lines without special permission.

Except in areas to be excavated, stump holes and other holes from which obstructions are removed shall be backfilled and compacted to the approximate density of the surrounding natural ground all in accordance with the applicable requirements of Section 203 and as directed.

If perishable material is burned, it shall be burned under the constant care of competent watchmen at

such times and in such a manner that anything designated to remain on the right of way, the surrounding forest cover or other adjacent property will not be jeopardized. Burning shall be done in accordance with applicable laws and ordinances.

Materials and debris which cannot be burned and perishable materials which are not burned shall be removed from the right of way and disposed of at locations off the project outside the limits of view from the project with the written permission of the property owner on whose property the materials and debris are placed. The contractor shall make all necessary arrangements with property owners for obtaining suitable disposal locations and the cost involved shall be included in the unit price bid. Copies of all agreements with property owners shall be furnished the engineer.

All merchantable timber in the clearing area which has not been removed from the right of way prior to the beginning of construction, shall become the property of the contractor, unless otherwise provided.

Low hanging branches and unsound or unsightly branches on trees or shrubs designated to remain shall be removed as directed. Branches of trees extending over the roadbed shall be trimmed to give a clear height of 20 feet above the roadbed surface. All trimming shall be done by skilled workmen and in accordance with good tree surgery practices.

201.07 SELECTIVE CLEARING. Areas indicated on the plans, or as much thereof as the engineer may direct, shall be cleared of all trees and vegetation, except those selected to remain, and also of all stumps, rubbish and other perishable or objectionable matter. The contractor shall notify the engineer at least 2 weeks in advance of the work to be done. The engineer shall select and mark, or otherwise designate to remain, all trees and other standing vegetation which are considered valuable. Selective clearing may be performed by hand or machine methods or a combination of both.

In order to facilitate the removal of trees, vegetation, etc., the following procedures shall apply:

(a) Except in instances as listed below in (b), spacings between trees to remain shall be approximately 50 feet. No attempt should be made to "line up" any trees. This is applicable to thick woods growth, in order to give the contractor working space for equipment. The engineer should consider the kinds of trees to be marked as to their present spread or ultimate spread of tops, in order to leave sufficient space.

(b) In exceptional instances, where groups of trees or native shrubs are to be left standing, such groups may be left with closer spacing than stated in (a). Such closer spacing will be applicable to such trees and shrubs as pines, magnolias, and flowering trees —dogwood, redbud, holly (American and Yaupon), hawthorn and others which form upright growths or shrub effects.

Any trees found to be dead or dying in an area that has been selectively cleared, before project is accepted, shall be removed by the contractor at his own expense.

In all other respects, clearing in areas designated herein or on the plans to be selectively cleared shall be performed in accordance with the requirements under Subsection 201.06.

201.08 METHOD OF MEASUREMENT. Measurement will be by one or more of the following alternate methods:

(a) Area Basis. The work to be paid for will be the number of acres and fractions thereof acceptably cleared, grubbed, selectively cleared, or cleared and grubbed within the limits shown on the plans or staked for clearing and grubbing by the engineer. Areas not shown on the plans, or not staked for clearing and grubbing will not be measured for payment.

(b) Lump Sum Basis. When the bid schedule contains a clearing and grubbing lump sum item, no measurement of area will be made.

201.09 BASIS OF PAYMENT. The accepted quantities of clearing, grubbing, selective clearing and clearing

and grubbing will be paid for at the contract unit prices as follows:

(a) Area Basis. The quantities determined will be paid for at the contract unit price bid per acre respectively for each of the particular pay items listed that appear in the bid schedule.

(b) Lump Sum Basis. When the bid schedule contains a lump sum item, the lump sum price so bid will be paid and shall be full compensation for all required clearing and grubbing.

(c) Exclusions. When the bid schedule does not contain an estimated quantity or a lump sum item for clearing and grubbing, the work will not be paid for directly, but will be considered as a subsidiary obligation of the contractor under other contract items.

Payment will be made under:

Item Number	Pay Item	Pay Unit
201(1)	Clearing	Acre, lump sum
201(2)	Grubbing	Acre, lump sum
201(3)	Selective Clearing	Acre, lump sum
201(4)	Clearing and Grubbing	Acre, lump sum

Section 202

Removal of Structures and Obstructions

202.01 DESCRIPTION. This work shall consist of the removal and satisfactory disposal of all buildings, fences, structures, old pavements, abandoned pipe lines, and any other obstructions which are not designated or permitted to remain, except for the obstructions to be removed and disposed of under other items in the contract as directed. It shall also include the salvaging of designated materials and backfilling the resulting trenches, holes, and pits. When the proposal does not include pay items for removal of structures and obstructions, as set out in this section, cost of such work shall be included in prices bid on other construction items.

202.02 CONSTRUCTION REQUIREMENTS. The contractor shall remove and dispose of all buildings and foundations, structures, fences and other obstructions, any portions of which are on the right of way, except utilities and those for which other provisions have been made for removal. All designated salvageable material shall be removed, without unnecessary damage, in sections or pieces which may be readily transported and shall be stacked at specified storage areas by the contractor within the project limits or hauled to a designated maintenance storage yard and stacked. All materials designated not to be salvaged may be destroyed or disposed of off the project outside the limits of view with written permission of the property owner on whose property the material is placed. Copies of all agreements with property owners are to be furnished the engineer. Basements or cavities left by structure removal shall be filled to the level of the surrounding ground and, if within the prism of construction, shall be compacted to the approximate density of the surrounding ground.

202.03 REMOVAL OF BRIDGES, CULVERTS AND OTHER DRAINAGE STRUCTURES. Bridges, culverts and other drainage structures in use by traffic shall

not be removed until satisfactory arrangements have been made to accommodate traffic.

Unless otherwise directed, the substructures of existing structures shall be removed down to the natural stream bottom and those parts outside of the stream shall be removed down one foot below natural ground surface. Where such portions of existing structures lie wholly or in part within the limits for a new structure, they shall be removed as necessary to accomodate the construction of the proposed structure.

Steel bridges and wood bridges as specified, shall be carefully dismantled without unnecessary damage. This dismantling shall include the stripping of all hardware and the removal of all nails. Steel members shall be match marked before dismantling, unless otherwise indicated. All salvaged material shall be stored or removed as specified in Subsection 202.02.

Blasting or other operations necessary for the removal of an existing structure or obstruction, which may damage new construction, shall be completed prior to placing the new work.

Unless waived in writing, all concrete removed which is of suitable size for riprap and not needed for such use on the project shall be stockpiled on the project as directed for use by the Department. When waived, the removed concrete shall be disposed of by the contractor off the project as specified in Subsection 202.02.

202.04 REMOVAL OF PIPE. Unless otherwise provided, all pipe shall be carefully removed and every precaution taken to avoid breaking or damaging the pipe. Pipes to be relaid shall be removed and stored when necessary, so that there will be no loss or damage before relaying. The contractor will be required to replace sections lost from storage or damaged by negligence or by use of improper methods. Pipes not to be relaid and considered usable shall be salvaged, cleaned of soils or other materials, stored or removed and stacked as specified in Subsection 202.02.

202.05 REMOVAL OF PAVEMENT, SIDEWALKS, CURBS, ETC. All concrete pavement, base course, side-

walks, curbs, gutters, etc., designated for removal, shall be:

(a) Broken into pieces and used for riprap on the project, or

(b) broken into sizes suitable for riprap and stockpiled at designated locations on the project for use by the Department, or

(c) otherwise disposed of as directed.

When specified, ballast, gravel, bituminous material or other surfacing or pavement materials shall be removed and stockpiled as required in Subsection 202.02, otherwise, such materials shall be disposed of as directed.

There will be no separate payment for excavating for removal of structures and obstructions or for backfilling and compacting the remaining cavity.

202.06 METHOD OF MEASUREMENT. When the contract stipulates that payment will be made for removal of obstructions on a lump sum basis, the pay item, removal of obstructions, will include all structures and obstructions encountered within the right of way in accordance with the provisions as set out in this section. Where the proposal stipulates that payment will be made for the removal of specific items on a unit basis, measurement will be made by the unit stipulated in the contract.

Unless otherwise specified, the cost of removing pipe culverts will be included in cost of other items. When specifically provided as a pay item the length of pipe removed will be measured in linear feet, computed by multiplying the number of commercial lengths removed by the nominal laying length, or by measuring in place prior to removal, if practicable.

Hauling salvaged material will be measured by the lump.

202.07 BASIS OF PAYMENT. The accepted quantities of removal of structures and obstructions will be paid for at the contract lump sum price bid, which price shall be full compensation for removing and disposing of the obstructions in accordance with the contract.

Specific obstruction items, including pipe removal, stipulated for removal or disposal under unit price pay items will be paid for at the contract unit price bid per unit specified in the proposal, which price shall be full compensation for removal and disposal of such items, excavation and subsequent backfill incidental to their removal. The price shall also include salvage of materials removed, their custody, preservation, storage on the right of way and disposal as provided herein.

When an item for hauling salvaged material is provided, the hauling of such material to the designated maintenance storage yard will be paid for at the contract lump sum price bid.

Payment will be made under:

Item No.	Pay Item	Pay Unit
202(1)	Removal of Structures and Obstructions	Lump Sum
202(2)	Removal of _____	Each, Linear Feet, Square Yard
202(3)	Hauling Salvaged Material	Lump Sum

Section 203
Excavation and Embankment

203.01 DESCRIPTION. This work shall consist of excavating, removing and satisfactorily disposing of all materials encountered within the limits of the work, except structural excavation and such other work as may be covered by other pay items. It shall include excavation for the roadway, ditches, channel changes and all operations necessary for the construction of the roadway in accordance with these specifications and in reasonably close conformity with the lines, grades, thickness and typical cross sections shown on the plans or established by the engineer. Excavation will be classified as "Unclassified Excavation", "Drainage Excavation", "Muck Excavation", "Borrow", "Special Borrow", or "Hydraulic Embankment".

203.02 UNCLASSIFIED EXCAVATION. Unclassified excavation shall consist of all excavation not otherwise classified and paid for.

203.03 DRAINAGE EXCAVATION. Drainage excavation includes all excavation made for the primary purpose of facilitating drainage beyond the limits of the roadway section except for wing ditches at cuts. Drainage excavation also includes inlet and outlet ditches to structures or roadway; changes in or deepening of channels of streams, berm ditches, ditches parallel to or adjacent to the roadway, ditches draining borrow pits and material excavated from areas under bridges.

203.04 MUCK EXCAVATION. Muck excavation shall consist of the removal of deposits of saturated or unsaturated mixtures of soils and organic matter not suitable for foundation material. Muck shall include materials which will decay or produce unsatisfactory subsidence in the embankment and may be made up of decaying stumps, roots, logs, humus, or other material not satisfactory for incorporation in the embankment. The engineer shall determine the material to be classified as muck and wasted and the material

that is satisfactory for use in the embankment in accordance with the specifications.

The method of determination of muck elevation, both before and after mucking operation, shall follow the procedure as set forth in LDH Designation: TR 426.

203.05 BORROW. Borrow excavation shall include all excavation obtained from borrow pits furnished by the Department, as shown on plans or designated by the engineer. Borrow excavation material shall be tested and classified by the Laboratory before being placed in embankments and, subject to the restrictions for suitable materials hereinafter contained, shall be AASHO soil identification classes (AASHO Designation: M 145) A-1-a, A-1-b, A-3, A-2-4, A-2-5, A-2-6, A-2-7, A-4, A-5, A-6, A-7-5 and/or A-7-6 except that material in the A-5, A-6, A-7-5 and A-7-6 classes considered unsatisfactory by the engineer will not be accepted, and should a material of the A-3 Class (Sand) be used, the contractor will be required to use on slopes a material of the A-4, A-6, A-7-5 and/or A-7-6 Classification. Should a material of the A-1-b Class (Coarse sand or gravelly sand) be used, the contractor will be required to use on slopes a plastic material of the A-4, A-6, A-7-5, and/or A-7-6 Classification at the discretion of the engineer.

No charge will be made against the contractor for material secured from pits furnished by the Department, but the contractor shall construct and maintain, at his own expense, any necessary haul roads from the pits to the highway. The Department will secure all necessary easements along the approved routes of haul roads without cost to the contractor.

203.06 SPECIAL BORROW. Special borrow excavation shall include all acceptable excavation obtained from borrow pits furnished by the contractor. Unless otherwise provided special borrow excavation material shall be tested and classified by the Laboratory before being placed in the embankment and shall meet the requirements set up for borrow excavation in Subsection 203.05.

Securing of exclusive option by any contractor on borrow pit areas and/or materials for the work to be

done will be interpreted as a violation of Section 423 of Title 48 of the Louisiana Revised Statutes of 1950 and will be used as a basis for rejection of bids or such other action the Department may deem advisable.

Clearing, grubbing, stripping of pits, and material not used in the embankment will not be measured or paid for. Any overhaul involved in moving material from pits to the embankment will not be measured or paid for. The contractor shall provide and maintain all necessary haul roads from the borrow pits to the work at his own expense.

Borrow pits shall be located a minimum distance of 300 feet from the right of way, except as may be otherwise altered by written approval of the Chief Engineer.

203.07 HYDRAULIC EMBANKMENT. Hydraulic embankment shall consist of acceptable material pumped from lakes, canals, or other designated locations and placed in the roadway embankment by hydraulic methods.

CONSTRUCTION REQUIREMENTS

203.08 GENERAL. The excavation and embankments for the roadway, intersections and entrances, shall be finished to reasonably smooth and uniform surfaces. No material shall be wasted without permission of the engineer. Excavation operations shall be conducted so that material outside of the limits of slopes will not be disturbed. Prior to beginning excavation, grading, and embankment operations in any area, all necessary clearing and grubbing in that area shall have been performed in accordance with Section 201 Clearing and Grubbing.

Drainage excavation shall be done along with rough grading unless otherwise directed. Drainage excavation shall be disposed of or placed in the embankment as directed. Roots, stumps, and other obstructions in sides and bottom of ditches and channel changes shall be cut to conform to required cross section and grade. No excavated material shall be left within 3 feet of the edge of ditch.

If the contractor places more borrow than is required and thereby causes a waste of excavation, the amount

of such waste will be deducted from the borrow volume as measured in the borrow area. All borrow areas shall be left in such shape as to permit accurate measurements after excavation has been completed. The contractor shall not excavate beyond the dimensions and elevations established, and no material shall be removed prior to the staking out and cross sectioning of the site. When necessary to remove fencing, the fencing shall be replaced in as good condition as it was originally. The contractor shall be responsible for the confinement of livestock when a portion of the fence is removed.

When required or directed, obliteration of old roadways shall include all grading operations necessary to incorporate the old roadway into the new roadway and surroundings in order to provide a pleasing appearance from the new roadway. Removal of pavements and stabilized base course will be paid for as a contract item. Roadway obliteration will be paid for as excavation.

When the contractor's excavating operations encounter remains of prehistoric people's dwelling sites or artifacts of historical or archeological significance, the operations shall be temporarily discontinued. The engineer will contact archeological authorities to determine the disposition thereof. When directed, the contractor shall excavate the site in such a manner as to preserve the artifacts encountered and shall remove them for delivery to the custody of the proper state authorities. Such excavation will be considered and paid for as extra work.

Where excavation to the finished graded section results in a subgrade or slopes of unsuitable or unstable soil, the engineer may require the contractor to remove the unsuitable or unstable materials by undercutting and backfill to the finished graded section with approved material. The contractor shall conduct his operations in such a way that the engineer can take the necessary cross-sectional measurements before the backfill is placed. Undercut will be paid for as unclassified excavation.

203.09 EMBANKMENT CONSTRUCTION OTHER THAN HYDRAULIC. Embankment construction shall

consist of constructing roadway embankments, including preparation of the areas upon which they are to be placed; the construction of dikes within or outside the right of way when required by the plans; the placing and compacting of approved material within roadway areas where unsuitable material has been removed; the placing and compacting of embankment material in holes, pits and other depressions within the roadway area; and the placing and compacting of embankment material for backfilling structures. Only approved materials shall be used in the construction of embankments and backfills.

When required by the plans, the top of the embankment in both cut and fill sections shall be constructed of selected materials which shall be interpreted to mean materials of AASHO Classes A-1-a, A-1-b, A-3, A-2-4, A-2-6, A-4 or A-6 with a maximum L.L. of 35 and a maximum P.I. of 15, or as modified by the plans or special provisions.

203.10 CONSTRUCTION METHODS FOR EMBANKMENTS OTHER THAN HYDRAULIC. Rocks, broken concrete, or other solid materials shall not be placed in embankment areas where piling is to be placed or driven.

When embankments are constructed on a hillside, sloping more than 6:1 from the horizontal, the slope of the ground on which the embankment is to be placed shall be plowed or cut into steps before the fill is placed. Where a new road is to be constructed on an old road, the old road shall be plowed or scarified and broken up full width to a depth of not less than 6 inches, regardless of height of new fill, and recompacted as directed.

Unless shown otherwise by the plans or special provisions, where an embankment is to be constructed to a height of 3 feet or less, heavy sod and objectionable vegetable matter shall be removed from the surface upon which the embankment is to be placed, and the cleared surface shall be completely broken up by plowing, scarifying or stepping to a minimum depth of approximately 6 inches. This area shall then be recompacted to the approximate density of surround-

ing ground. When height of fill is greater than 3 feet, sod not required to be removed shall be thoroughly disked and recompacted to the approximate density of surrounding ground before construction of embankment.

If embankment material is to be deposited on one side only of abutments, wing walls, piers or culvert headwalls, care shall be taken that the area immediately adjacent to the structure is not compacted to the extent that it will cause overturning of or excessive pressure against the structure. Unless otherwise indicated, the fill adjacent to the end bent of a bridge shall not be placed higher than the top of the substructure until the superstructure is in place. When embankment is to be deposited on both sides of a concrete wall, or similar type structure, operations shall be so conducted that the embankment is always at approximately the same elevation on both sides of the structure. Backfilling of structures to natural ground shall be performed as outlined in Subsection 203.14.

All excess or unsuitable excavated material, including rock and boulders, that cannot be used in embankments may be placed on the side slopes of the nearest fill or berm in a satisfactory manner and shall be placed so as to maintain a distinct shoulder line by keeping all such waste material the specified distance below the finished shoulder. In case it is impossible to dispose of all such material in the manner described, the remainder shall become the property of the contractor and shall be satisfactorily disposed of beyond the limits of the right of way.

Roadway embankment of earth material shall be placed in layers or lifts approximately parallel to the finished grade line not exceeding approximately 9 inches (loose measurement). Each lift shall be placed for the full width of the embankment and compacted as specified before the next layer is placed. Effective spreading equipment shall be used on each lift to obtain reasonably uniform thickness prior to compacting. As the compaction of each layer progresses, necessary spreading and manipulating will be required to assure uniform density. Water shall be added or re-

moved, if necessary, in order to obtain the required density.

When embankments are constructed through or into lakes, streams, swamps or other unstable areas that do not afford a satisfactory foundation for embankments and the unstable material cannot be economically removed, or drained, the requirement for placing material in lifts as outlined above may be waived in these areas and the embankment placed by end dump or other approved methods to an elevation where it is determined that normal construction methods can begin. This elevation shall be determined by the engineer during construction. Material placed below this determined elevation shall be compacted according to the applicable requirements of Subsection 203.14. Embankments placed above this determined elevation shall be constructed in approximately 9 inch lifts as specified above.

When the excavated material consists predominantly of rock fragments of such size that the material cannot be placed in layers of the thickness prescribed, without crushing, pulverizing or further breaking down the pieces resulting from excavation methods, such material may be placed in the embankment in layers not exceeding in thickness the approximate average size of the larger rocks. Each layer shall be leveled and smoothed with suitable leveling equipment. The lifts shall not be constructed above an elevation 2 feet below the finished subgrade. Rock fills placed in this manner shall be compacted according to applicable requirements of Subsection 203.14.

The balance of the embankment shall be composed of approved material placed in layers not exceeding approximately 9 inches in loose thickness and compacted as specified for embankments.

203.11 HYDRAULIC EMBANKMENTS. Hydraulic embankments shall be constructed of acceptable materials dredged and pumped from approved sources shaped to reasonably conform to the lines, grades and cross sections indicated on the plans.

Unless otherwise provided the contractor must procure all necessary permits from the proper authorities

to operate in waters under their control. He shall also obtain all necessary permits for passage of discharge pipe over private property.

Dredging and other equipment adequate to insure completion of project shall be furnished and shall be subject to approval.

In the event information is shown on the plans indicating the availability of material suitable for hydraulic embankment, it is understood that these data are for the information of the contractor. The Department does not guarantee the depth, extent and character of the material so indicated. No additional compensation will be allowed should it develop that the material is of a different nature from that indicated. There will be no classification of material for purposes of payment.

203.12 CONSTRUCTION METHODS FOR HYDRAULIC EMBANKMENTS. No material shall be obtained from sources closer than 500 feet from the toe of the slope of the embankment shown on plans, unless otherwise specifically permitted. Unsatisfactory material shall be removed from the borrow area before embankment material is removed. All muck and unsuitable material shall be removed from the embankment area to the line, grade and section shown on the plan. Any muck or other unsuitable material entrapped or brought to the top of the embankment shall be removed. Placement of material, in the embankment, shall begin at the center line and then proceed in either or both directions towards the toes of the slopes and the discharge shall always be along and parallel to the center line, unless otherwise permitted. Method of discharge shall not cause erosion or damage to property of others. Material shall be deposited in such manner as to maintain a higher elevation at the center. Retaining levees, along highways, that may cause damage will not be permitted. Operations shall be conducted in such a manner that will insure the completion of the embankment in reasonable conformity with cross section shown on plans except that flatter side slopes will be permitted. However, if material is deposited on private property, satisfactory permission from the owners must be secured. All necessary pre-

cautions shall be taken to prevent filling existing streams and waterways. The contractor assumes all responsibility for compression, subsidence, displacement or slides that may take place in the hydraulic fill and no payment will be made for materials outside the limits of the net pay section.

Where discharge pipe lines cross the surface of an existing highway, they must be bridged in a satisfactory manner and traffic properly protected by warning signs and/or signals at all times. Any damage done to existing highway facilities shall be repaired without expense to the Department.

203.13 CONSTRUCTION OF EMBANKMENT AND TREATMENT OF CUT AREAS WITH DENSITY CONTROL. Unless otherwise provided all embankments are to be constructed with density control, and the distance below finished subgrade elevation to which such methods shall be applied shall be as shown on the plans. The moisture content of the soils at the time of compaction shall be as specified or directed.

In cut areas, for the full width of roadbed in all cut sections, the top 6 inch layer on which fill or base material is to be placed, shall be thoroughly scarified and the moisture content increased or reduced as necessary. This 6-inch layer shall then be compacted to not less than 95 per cent of the maximum density. When required by the plans, the top of the embankment in both cut and fill sections shall be constructed of selected material and compacted to not less than 95 per cent of maximum density.

All material in embankments requiring density control shall be placed in layers not to exceed 9 inches in thickness, and shall be compacted to not less than 95 per cent of maximum density. At the option of the contractor, approximately the top 2 inches of intermediate layers may be compacted in conjunction with the next succeeding layer. The material used for building this portion of the embankment shall be dried or moistened to be within reasonable limits of optimum moisture before compaction.

Compaction of embankments may be accomplished by any satisfactory method or methods that will obtain

the required density unless a specific method is required by the special provisions.

Dumping and rolling areas shall be kept separate and no lift shall be covered by another until density complying with the requirements of this subsection is secured.

Maximum density shall be determined in accordance with LDH TR 418 and the in-place density determined by LDH TR 401 as described in the Department's Testing Procedures Manual.

203.14 COMPACTION OF EMBANKMENTS NOT CONSTRUCTED WITH DENSITY CONTROL. Except for rock fills, sand fills below the water table, and the first layer of fills over swampy ground, embankment materials shall be deposited in layers not exceeding approximately 9 inches in thickness and compacted in such a manner as to result in a satisfactory embankment. Compacting equipment and methods employed for the entire depth of the embankment shall be sufficient to obtain not less than 90 per cent of maximum density in the top layer of such embankment.

Embankments constructed of rock fills, sand fills placed in water and in the first layer of fills constructed through or into lakes, streams, swamps and other soft areas shall be constructed and compacted in such a manner as to permit construction of superimposed layers as specified. These materials shall be placed in accordance with Subsections 203.10 and 203.12.

203.15 SUBGRADE. The subgrade is the top surface of a roadbed upon which the pavement structure and shoulders are constructed.

All materials that will not satisfactorily compact shall be removed and replaced with suitable material and the subgrade, for its entire width, shall be brought to line and grade within reasonable limits and compacted to uniform density. Where the subgrade is of a nonuniform compacted nature, or where required, it shall be scarified to a depth of not less than 6 inches for its full width, and the material spread and compacted to a uniform density.

All submerged roots, stumps or other perishable matter encountered in the preparation of the subgrade shall be removed to a depth of not less than 2 feet below subgrade elevation.

After the subgrade has been prepared as specified above it shall be maintained in such condition as to drain. If damaged by hauling or handling materials the subgrade shall be scarified and re-compacted to required density. The subgrade shall be in final condition for receiving the base or surface for a distance of at least 500 feet in advance of placing subsequent courses. Subsequent courses shall not be placed until the subgrade has been approved by the engineer.

203.16 METHOD OF MEASUREMENT. Measurement will be made by either of the following methods or as designated on plans.

(a) Contract Quantity Payment. The quantities of excavation for which payment will be made will be those shown in the contract for the various items, provided the project is constructed essentially to the lines and grades shown on the plans.

When the plans have been altered or when disagreement exists between the contractor and the engineer, as to the accuracy of the plan quantities in any balance, or the entire project, either party shall have the right to request and cause the quantities involved to be measured in accordance with measured quantities. When the quantities are measured for payment, the original plan cross sections plotted on the plans shall be used as original field cross sections. Additional original cross sections may be interpolated at points where necessary to more accurately determine the quantities.

(b) Measured Quantities. When payment is specified on a volume basis, all accepted excavation and borrow shall be measured in its original position by cross-sectioning the area excavated, which measurements will include slides in unclassified material not attributable to carelessness of the contractor. Volumes will be computed from the cross-section measurements by the average end area method.

Measurements will be made for unsuitable materials actually excavated and removed to obtain proper compaction in cut sections and in foundations for fill sections.

No measurement will be made of the suitable material temporarily removed and replaced to facilitate compaction of the material for the full depth shown on the plans.

Where it is impractical to measure material by the cross-section method due to the erratic location of isolated deposits, acceptable methods involving three-dimensional measurements may be used.

(c) Measurement on a Linear Basis. When it is specified that an item of excavation is to be measured and paid for on a linear basis, the actual length will be measured in the units specified in the contract.

(d) Measurement of Embankments. When specified in the contract, embankments constructed will be measured and paid for in accordance with the terms set forth.

Where the contract does not specifically provide for payment for embankment, the work of embankment construction will not be paid for as such, but will be considered incidental to the various classifications of excavation.

When payment for embankment is specified as a separate bid item, the volume so constructed will be computed in cubic yards by the engineer from the dimensions of the embankment cross section.

(e) Hydraulic Embankment shall be measured by the cubic yard and the quantity shall be computed by the average end area method. The pay quantity shall be the volume of material in place within the limits of the typical section.

(f) Water used will not be measured or paid for, but will be incidental to the work.

203.17 BASIS OF PAYMENT. The accepted quantities of excavation and embankment will be paid for at the

contract price per unit of measurement for each of the pay items listed below that is included in the bid schedule.

Payment will be made under:

Item No.	Pay Item	Pay Unit
203(1)	Unclassified Excavation	Cubic Yard
203(2)	Drainage Excavation	Cubic Yard
203(3)	Muck Excavation	Cubic Yard
203(4)	Borrow Excavation	Cubic Yard
203(5)	Special Borrow Excavation	Cubic Yard
203(6)	Embankments	Cubic Yard
203(7)	Hydraulic Embankments	Cubic Yard
203(8)	Linear Grading	Station or Mile

No measurement will be made for excavation for culverts or culvert headwalls, except as provided below.

Whenever the invert of a pipe or box culvert is lowered or relocated so that additional excavation is necessary over and above that required at the originally planned location, the additional excavation involved will be paid for at 3 times the contract unit price for Unclassified Excavation, or Special Borrow Excavation in event Unclassified Excavation is not an item in the contract. In no event will such additional excavation be paid for if the additional amount for each such structure is 10 cubic yards or less.

In the event the invert elevation is raised or relocated so that a lesser amount of excavation than that required at the originally planned location is required, the Department will deduct from the contractor's estimate the value of the decreased quantity of excavation, at the rate of three times the unit contract price of Unclassified Excavation, or Special Borrow Excavation in event Unclassified Excavation is not an item in the contract. If the volume involved for each such structure is 10 cubic yards or less such deduction will be waived.

Section 204

Overhaul

204.01 DESCRIPTION. Overhaul shall consist of authorized hauling of all type soils (unclassified, drainage, borrow, etc.) from pits or areas furnished by the Department in excess of the free-haul distance. Overhaul will not be paid for on borrow from pits furnished by the contractor.

Free-haul distance is the specified distance that excavated material shall be hauled without additional compensation. Unless otherwise provided in the contract documents, the free-haul distance shall be 2,000 feet.

204.02 METHOD OF MEASUREMENT. The limit of free haul shall be determined from a mass diagram by fixing on the volume curve, 2 points, one on each side of the neutral grade point, one in excavation and the other in embankment, such that the distance between them equals the free-haul distance, and the included quantity of excavation and embankment are in balance. All materials within the free-haul limit shall be eliminated from further consideration. The distance between the center of gravity of the remaining mass of excavation and the remaining mass of embankment minus the free-haul distance, shall be the overhaul distance. The quantity of overhaul shall be the product of the overhaul distance multiplied by the number of units of material hauled in excess of the free-haul distance. Analytical methods may be used for computing overhaul in lieu of the mass diagram method described herein.

204.03 BASIS OF PAYMENT. The quantity of overhaul measured as provided above will be paid for at the contract price. Unit of measurement will be as tabulated below.

Item No.	Pay Item	Unit of Quantity	Unit of Distance	Pay Unit
204(1)	Overhaul	Cubic Yard	Station	Station yard

In the event it is specified that overhaul will not be paid for separately on some items of work, it will not be measured and paid for if the material can be secured and used as shown on the plans. Should changes from the plans cause an increase in the necessary overhaul, payment will be made for such increase at the contract price. In case no contract price for overhaul has been established in the contract, increased haul costs will be paid for as extra work.

PART III
BASE COURSES

Section 301
Base Course

301.01 DESCRIPTION. This work shall consist of furnishing and placing a base course on a prepared surface in accordance with these specifications, in reasonably close conformity with the lines, grades, thickness and typical cross sections shown on the plans or established by the engineer.

Unless otherwise specified on the plans or in the special provisions, the base course is to be composed of any of the types of material listed below, at the option of the contractor. Unless otherwise approved in writing by the engineer, the same type material shall be used throughout the project. Typical sections to establish equivalent thicknesses shall be shown on the plans.

(A) Soil Cement

(B) Sand Clay Gravel (Grade A)

(C) Cement Stabilized Sand Clay Gravel (Grade B)

(D) Clam and Reef Shell

(E) Reef Shell and Sand

(F) Clam Shell and Sand

(G) Clam and Reef Shell and Sand

301.02 MATERIALS. Materials shall conform to the requirements of the following subsections of Part IX—Materials.

Portland Cement	901.01
Water	915.01
Emulsified Asphalt	902.03
Sand Clay Gravel	903.04(a)

Clam and Reef Shell	903.04(b)
Reef Shell and Sand	903.04(c)
Clam Shell and Sand	903.04(d)
Clam Shell, Reef Shell and Sand	903.04(e)
Lime	915.03

Unless otherwise specified, Portland cement may be either Type I or Type II.

The materials furnished shall be of such quality that, when properly proportioned and mixed, a satisfactory base will be produced. Any material failing to meet the requirements of these specifications will be rejected.

301.03 SOILS FOR SOIL CEMENT BASE COURSE. Soil for base course shall consist of suitable materials that will stabilize with Portland cement. Suitable materials shall be interpreted to mean selected soils of the AASHO Classification Groups, A-1-a, A-1-b, A-3, A-2-4, A-4, or A-2-6 and A-6 with a maximum L. L. of 35 and a maximum P.I. of 15, or as modified by the plans or special provisions.

The contractor shall obtain the material, which is to be stabilized with cement, from outside the limits of the right of way, except as provided in Subsection 104.05.

Upon completion of the embankment in reasonably close compliance to the typical section, the soils to be stabilized will be tested by the Laboratory to determine their acceptability and the per cent of cement, by volume, required for stabilization. Soils furnished by the contractor and placed in the embankment which are found not suitable for stabilization shall be corrected or removed and replaced at no cost to the Department. If the contractor elects to stock-pile the material, or to use a pugmill for mixing, samples of material from the stock piles will be tested prior to use.

CONSTRUCTION REQUIREMENTS

301.04 SUBGRADE. The base course materials shall be placed on a subgrade prepared in accordance with

Section 203 or if specifically provided in accordance with Section 302.

301.05 MIXING.

(A) Soil Cement

(C) Cement Stabilized Sand Clay Gravel (Grade B)

Materials meeting these specifications shall be combined with Portland cement and water by travel plant, central plant, or other approved methods and shaped and formed on the approved subgrade. All mixing equipment shall be equipped with a device that will introduce the required quantity of water when needed.

The percentage of cement required will be determined by the Laboratory in accordance with AASHO Designation: T 135 prior to mixing, and the method of mixing employed shall be such that the actual amount of cement used and incorporated can be readily determined. When other than in-place mixing is used, a minus variation of ½ per cent in the volume of cement required, as determined by the Laboratory, will be permitted.

The optimum moisture of the mixture shall be determined by the Laboratory in accordance with the LDH Designation: TR 418. The percentage of moisture in the mixture on the basis of dry weight shall not vary from the specified optimum percentage of moisture by more than plus or minus 2 percentage points at the time of compaction.

Seventy per cent of the pulverized soil, by dry weight, exclusive of gravel or stone, that is to be furnished in conjunction with soil cement base, shall pass the No. 4 sieve when tested by laboratory sieve. Any material retained on a 3-inch sieve shall be removed.

(B) Sand Clay Gravel (Grade A)

(D) Clam and Reef Shell

(E) Reef Shell and Sand

(F) Clam Shell and Sand

(G) Clam and Reef Shell and Sand

The base course materials shall be uniformly mixed either on the prepared subgrade or prior to placement. If mixed prior to placement it shall be mixed in an approved pugmill or on a mixing table. Materials shall be wetted during mixing operations, if necessary for proper blending. Premixing will not be required if the material is a natural mix meeting all specification requirements.

Samples for testing shall be secured after the materials have been thoroughly mixed, except clam and reef shell and sand base courses having components that are hauled in separately. These various components shall be tested and approved prior to mixing. The proper proportioning of the approved materials shall be as directed. Materials failing to meet specifications shall be rejected until the necessary corrective measures are taken as to assure compliance.

301.06 TRANSPORTING AND PLACING ON SUBGRADE. Transportation and spreading methods shall be such that minimum damage is done to the subgrade. The base course shall be placed in one or more approximately equal layers as necessary and as directed in order to obtain the required compaction. The thickness of each layer shall in no event exceed 9 inches compacted thickness. It shall be the contractor's responsibility to place and spread sufficient material to obtain required width and compacted thickness within the tolerances set forth in Subsection 301.11. Every effort shall be made to prevent materials from the subgrade from becoming mixed with or incorporated into the aggregate mix. Such introduction will require retesting and correction of deficiencies.

301.07 COMPACTING AND FINISHING.

(A) Soil Cement

(C) Cement Stabilized Sand Gravel (Grade B)

The mixture shall be uniformly compacted immediately upon completion of mixing operations or after placement by approved rollers of the size, type, shape and weight best suited to do the work. The rate of operation and the number of rollers used

shall be sufficient to uniformly compact the base course for the specified width and depth within 3 hours after water has been added to the mixture.

Compaction shall continue until the entire depth of each lift of the stabilized base has met the requirements set forth in Subsection 301.11 and in accordance with LDH Designation: TR 401.

At all places inaccessible to rollers, such as edges adjacent to curb and gutter sections, the mixture shall be compacted to required density using hand tampers, pneumatically operated mechanical tampers, vibrating compactors, or any other approved device that will obtain uniform compaction to required density without damage to the adjacent structures.

When the compaction of a base course has been completed, the thickness shall be checked by construction forces. Any deviation noted at this time from the accepted tolerances as set forth elsewhere herein shall be corrected as directed, by and at the expense of the contractor.

At the end of each section processed, joint construction with subsequent sections shall be approved by the engineer.

All compaction shall be completed within 3 hours of the application of water to the cement mixed base course. Final finishing shall be done as directed. The finished base course shall have a smooth, uniform, closely knit surface, free from ridges, undulations, loose material or laitance.

(B) Sand Clay Gravel (Grade A)

(D) Clam and Reef Shell

(E) Reef Shell and Sand

(F) Clam Shell and Sand

(G) Clam and Reef Shell and Sand

Following the placing, spreading and shaping of the base course material, it shall be brought to moisture content required for compaction to the required

density. Optimum moisture and maximum density shall be determined in the Laboratory in accordance with LDH Designation: TR 418. The density of the material in place on the roadway shall be determined in accordance with LDH Designation: TR 401. Any waves or irregularities that develop under rolling shall be corrected by scarifying and adding or removing material until the surface presents a smooth appearance. Between rollings, the surface shall be machined as necessary. Machining, watering and rolling shall continue until the material is compacted to 100 per cent of maximum density for full depth of base course, The finished base course shall have a smooth, uniform, closely knit surface, free from ridges, depressions or loose material.

301.08 PROTECTION AND CURING.

(A) Soil Cement

(C) Cement Stabilized Sand Clay Gravel (Grade B)

Upon completion of smooth rolling of the final lift, the base shall be kept protected against rapid drying for a period of 72 hours by applying emulsified asphalt Grade EA-4 at the minimum rate of 0.10 gallon per square yard. Any additional applications required as hereinafter set forth shall be placed by the contractor at his expense.

The emulsified asphalt, diluted with water, shall be applied so as to provide a continuous seal over the base. The application shall be placed immediately following smooth rolling and shall be adequately maintained during the 72-hour curing period. Equipment or traffic shall not be allowed on the completed base during the curing period, except equipment used in construction of Portland cement concrete pavement, unless specifically permitted. When the base is to be covered by Portland cement concrete pavement, the pavement slab may be constructed at any time following placement of the emulsified asphaltic seal and completion of all tests.

In the event traffic is permitted to use the completed base subsequent to the 72-hour curing period and prior to the construction of the surface course, the

base shall be further protected by such additional applications of the dilution of emulsified asphalt and water as the engineer may deem necessary and as specified above.

In any event, if traffic is permitted to use the completed base prior to the construction of the surface course, any damages thereto caused by traffic shall be properly corrected without additional compensation.

(B) Sand Clay Gravel (Grade A)

(D) Clam and Reef Shell

(E) Reef Shell and Sand

(F) Clam Shell and Sand

(G) Clam and Reef Shell and Sand

The completed base course will be opened to traffic when required by the special provisions or as directed. Any weak spots that may develop shall be satisfactorily corrected and the base shall be kept free from holes, waves and undulations. The base shall be kept reasonably true to profile, grade and cross section. The base shall not be allowed to become dusty with consequent loss of binder. The surface shall be kept moist, as directed, to avoid loosening of material. Water used in processing base course materials shall be included in price bid on Base Course.

301.09 MAINTENANCE. The contractor shall be required to maintain and protect the completed base against both the public traffic and the traffic caused by his own employees. All ditches and drains shall be in such condition as to provide effective drainage. When berms of earth are placed along the shoulders, proper provisions shall be made for surface drainage.

301.10 WEATHER LIMITATIONS.

(A) Soil Cement

(C) Cement Stabilized Sand Clay Gravel (Grade B)

Mixing will not be permitted when the base material or subgrade is frozen. Mixing shall be discon-

tinued when a descending air temperature in the shade and away from artificial heat reaches 40°F, and not resumed until an ascending air temperature in the shade and away from artificial heat reaches 35°F.

301.11 REQUIREMENTS AND TOLERANCES FOR ACCEPTANCE. The completed base shall be checked for determining acceptance as provided herein. The sampling schedule contained herein shall not prevent the project engineer from taking such additional tests as may be required for adequate control of the work in progress, but such tests shall be independent of the tests taken herein for acceptance.

Density Requirements. Upon completion of compaction operations, the density of the completed base shall be determined in accordance with LDH Designation: TR 401. One density test shall be taken per 500 linear feet per roadway. Upon determining that any density test is below the requirements, 2 additional tests shall be taken within 5 feet of the location of the failing test and the average of the 3 tests shall be used as the value for that test location.

The density requirements shall be as below:

Material	Per Cent of Maximum Density
Stabilized Base Course (cement)	95%
Aggregate Base Course (non-stabilized)	100%

Stabilized Bases. In the event that a test, representing 500 linear feet of roadway, does not meet the required 95 per cent compaction, but is not below 93 per cent, then this section is acceptable provided the average of this test, the 2 tests of the 2 preceding sections and the 2 tests of the 2 succeeding sections meet the 95 per cent requirement. In computing this average per cent compaction, any test value in excess of 100 per cent compaction shall be considered as 100 per cent.

In the event that the average per cent of compaction does not meet the 95 per cent requirement, but is not

below 93 per cent and no test value used to compute the average is below 90 per cent, then this section may remain in place at a penalty of 25 per cent reduction in the contract unit price for the quantity involved.

In the event that the average per cent is below 93 per cent, but not below 90 per cent and no test value used to compute the average is below 90 per cent, then this section may remain in place at a penalty of 50 per cent reduction in the contract unit price for the quantity involved.

Any section not meeting these tolerances shall be reconstructed in accordance with these specifications at the contractor's expense.

Aggregate Bases (non-stabilized). In the event any test value is less than the required 100 per cent, compaction shall continue until 100 per cent is attained.

Thickness and Width Requirements. The thickness and width of the completed base shall be determined in accordance with LDH Designation TR 602. The thickness of the base shall not vary in excess of the following tolerances for any individual test.

Plan Thickness	(All Bases) Under Thickness	(Stabilized Bases) Over Thickness*
6 inches & under	½ inch	1 inch
Over 6 inches & less than 8 inches	¾ inch	1¼ inch
8 inches & over	1 inch	1½ inch

*When stabilized material is pugmill mixed, over thickness shall be waived at no additional cost to the Department.

Variations from plan width measured along the surface of the base shall not be in excess of ± 3 inches on either side of center line. For shoulder base construction, variations from plan width shall not be in excess of ± 3 inches on the outside edge. When stabilized material is pugmill mixed, over widths shall be waived at no additional cost to the Department.

Whenever an individual test is found to exceed the allowable tolerances, 2 additional tests shall be taken within 5 feet of the location of the failing test and the average of the 3 tests shall be used as the value for that location.

Areas showing deficiencies beyond the tolerances outlined above shall be corrected as follows:

1. Aggregate Bases—shall be corrected by adding, scarifying and compacting additional materials as required to bring deficient area to plan dimensions at no additional cost to Department.

2. Stabilized Bases—shall be replaced at no additional cost to the Department. Deficient areas may be replaced with stabilized material meeting these specifications, Asphaltic Concrete meeting LDH specifications, or Portland Cement Concrete (4 bags of cement per cu. yd.) designed by the Central Testing Laboratory for this purpose.

Average Minimum Thickness—2,000 Ft. Section. The average thickness of the completed base for a 2,000 foot section shall not be less than ½ inch of the thickness shown on the plans. In computing the average thickness of each 2,000 foot section; any thickness in excess of one inch of the thickness shown on the plans shall be considered as one inch.

Sections showing deficiencies beyond the tolerances outlined above shall be penalized, corrected or removed as follows:

Deficiency (less than Plan Thickness)	Disposition (For Pay Purposes)
½ inch to ¾ inch	75% of Contract Unit Price
¾ inch to 1 inch	50% of Contract Unit Price
Over 1 inch	(1) Correct or (2) Remove

1. Aggregate Bases—deficient areas within a section can be corrected by adding, scarifying and compacting additional materials as required to bring deficient area to plan thickness at no additional cost to the Department.

2. Stabilized Bases—deficient areas shall be replaced, at no additional cost to the Department, by one of the following methods.

(1) Replace with stabilized material meeting these specifications (entire depth).

(2) Replace with Asphaltic Concrete meeting LDH specifications.

(3) Replace with Portland Cement Concrete (4 bags of cement per cu. yd.) designed by the Central Testing Laboratory for this purpose (entire depth).

Final Acceptance. Final acceptance will be based on test holes or cores taken and filled by the Department at no cost to the contractor. Required test shall be taken within 7 days after completion. Subsequent courses shall not be placed until base has hardened sufficiently for adequate thickness and width determinations.

301.12 SHOULDER CONSTRUCTION WITH STABILIZED BASE. Aggregate and earth materials required on the shoulders in conjunction with stabilized base shall be constructed to the depths shown on the plans and shall meet the requirements of Sections 203 and 401.

EQUIPMENT

301.13 GENERAL. All necessary equipment shall be on the project, in satisfactory working condition, and shall have been approved before construction begins.

301.14 SPREADING EQUIPMENT. Spreading equipment shall be of such weight and type to adequately spread the material.

301.15 COMPACTION EQUIPMENT. Rollers or other equipment used to compact base may be any approved type or combination of types that will obtain the required density.

301.16 WATERING EQUIPMENT. Provisions shall be made by the contractor for furnishing sufficient water at the work site. Water vehicles or other approved sprinkling devices shall be provided.

301.17 MIXING MACHINE. If a mixing machine is used, it shall be an approved mechanical mixer that will satisfactorily mix the materials and shall be capable of producing a satisfactory product. The machine shall be equipped with a watering device so water can be introduced in the proportion required to perform the moist mixing operation.

301.18 PUGMILL. The pugmill shall be of an approved type capable of effectively mixing all required materials in the approximate proportions designated.

301.19 METHOD OF MEASUREMENT. The base course, completed and accepted, will be measured by the cubic yard (net section) as indicated on the plans. Measurement will be based on the typical sections shown on the plans and the length will be measured along the surface at the center line of each roadway. Base course for turnouts, ramps, and other irregular sections, if required on the plans, will be the calculated volume as constructed and determined by the engineer.

Shoulders, when shown on the plans to be separate from the roadway, will be measured by the cubic yard (net section) from dimensions shown on the plans; however, the actual length of the completed shoulders will be measured along the edge of shoulder adjacent to the roadway travel lane.

301.20 BASIS OF PAYMENT. The base course, completed and accepted, will be paid for at the contract unit price per cubic yard (net section).

All Portland cement, water and the furnishing and placing of emulsified asphalt for curing, as required, shall be included in the payment for this item.

Payment will be made under:

Item No.	Pay Item	Pay Unit
301(1)	Base Course	Cubic Yard

Section 302

Scarifying and Compacting Roadbed

302.01 DESCRIPTION. This work shall consist of scarifying, shaping, and compacting an existing roadbed to form a foundation or subbase for the base course material, in accordance with these specifications, and in reasonably close conformity with the lines, grades, thickness and cross section shown on the plans or established by the engineer.

302.02 CONSTRUCTION REQUIREMENTS. When new base course material (aggregate or soil cement) is to be placed on an existing roadbed, the contractor will be required to scarify the existing roadbed, for its full width, to a minimum depth of 6 inches and shape to the approximate section shown on the plans. The scarified and shaped surface shall be machined, watered if necessary, and compacted to a minimum of 95 per cent of maximum density as determined by LDH Designations: TR 401 and TR 418.

When the new base course is soil cement and the material in the roadbed is suitable for stabilizing with Portland cement, the contractor will be required to remove all material above the elevation of the bottom of the proposed soil cement base course prior to scarifying and compacting operations. The material removed shall be placed in windrows or stockpiled off the roadbed. After the material has been removed, the subgrade shall be scarified to a depth of 6 inches shaped, watered if necessary and compacted to a minimum of 95 per cent of maximum density as determined by LDH Designations: TR 401 and TR 418. Water required to process subbase shall be included in price bid on scarifying and compacting roadbed.

302.03 CONSTRUCTION LIMITATIONS. The work of scarifying roadbed shall not be performed in excess of one mile in advance of compacting the roadbed.

302.04 METHOD OF MEASUREMENT. Scarifying and compacting roadbed shall be measured by the mile along the centerline of the roadbed.

302.05 BASIS OF PAYMENT. The accepted quantity of scarifying and compacting roadbed shall be paid for at the contract unit price per mile.

Payment will be made under:

Item No.	Pay Item	Pay Unit
302(1)	Scarifying and Compacting Roadbed	Mile

PART IV
SURFACE COURSES

Section 401
Aggregate Type Surface Course

401.01 DESCRIPTION. This work shall consist of constructing an aggregate type surface course for roadway, shoulders or ramps on a prepared subgrade in accordance with these specifications, and in reasonably close conformity with the lines, grades, thicknesses and typical sections shown on the plans or established by the engineer.

401.02 TYPES AND MATERIALS. Unless otherwise specified, aggregate type surface course shall, at the option of the contractor, be sand clay gravel Grade A, washed gravel and binder, clam shell with or without binder, or reef shell with or without binder. Washed gravel, clam shell or reef shell shall be mixed with binder in the following approximate proportions:

	Aggregate	Binder
Washed Gravel	60%	40%
Clam Shell	60 to 100%	0 to 40%
Reef Shell	60 to 100%	0 to 40%

The materials shall meet the requirements specified in the following subsection of Part IX Materials:

Sand Clay Gravel	903.05(e)
Washed Gravel	903.05(a)
Clam Shell	903.05(d)
Reef Shell	903.05(f)
Binder	903.05(g)

The material furnished shall be of such quality that when properly proportioned and mixed, a satisfactory surface course, with sufficient binder for stability, will be produced.

CONSTRUCTION REQUIREMENTS

401.03 SUBGRADE. The subgrade shall be prepared

as provided in Section 203 and shall be approved before any surfacing material is placed.

401.04 PLACING MATERIAL. The material shall be deposited directly on the subgrade from vehicles used for hauling. The contractor shall be responsible for placing the required amount of material to obtain the required typical section. The material shall be spread over the entire subgrade when and as directed and in accordance with required typical section. No surface course shall be placed on a muddy, rutted or unsatisfactory subgrade, unless otherwise directed.

401.05 MIXING. When the surface course consists of a combination of different materials, the contractor will be required to thoroughly mix the materials by disking, harrowing, blading or other approved methods.

401.06 SHAPING AND COMPACTING. The material shall be shaped by the use of a blade grader or other suitable means while being compacted. Any ruts formed shall be filled by blading as often as necessary to prevent breaking through the surfacing material into the subgrade. Holes, waves and deficiencies in thickness which may develop and are not filled by blading shall be filled by adding more material. Shaping and compacting shall continue until the surface reasonably conforms to the cross sections shown on the plans and until it is free from ruts, waves and undulations.

On roadways and shoulders 5 feet wide or wider, the contractor will be required to compact the surfacing material by means of 12 passes of a sheepsfoot roller of the following size and type or an approved equal; 5,000 pound single drum of 3 foot 4 inch diameter. In the event the contractor wishes to use a roller of another size the number of passes will be proportionately increased or decreased. Upon the completion of the required number of passes of the sheepsfoot roller, the surface shall be rolled with a pneumatic-tired or steel wheel roller and wetted, if necessary, during blading so as to insure a tight uniform surface.

On shoulders less than 5 feet wide and ramps, the contractor will be required to compact the material by means of a sheepsfoot roller, pneumatic-tired rol-

ler, or by other approved means. During compaction operations the material shall be wetted if necessary, and rolling, wetting and blading shall continue until a tight uniform surface is obtained.

401.07 EQUIPMENT. All equipment for the proper construction of the surface course shall be on the project in good working order and shall be approved before construction begins.

401.08 METHOD OF MEASUREMENT. Surface course material, complete in place and accepted, will be measured by the cubic yard as computed from the dimensions shown on the plans.

Water required for mixing and compaction operations will be considered as incidental to the surface course.

401.09 BASIS OF PAYMENT. The accepted quantity of aggregate surface course, measured as provided above, will be paid for at the contract unit price per cubic yard.

Payment will be made under:

Item No.	Item	Pay Unit
401(1)	Aggregate Surface Course	Cubic Yard

PART V
BITUMINOUS PAVEMENTS

Section 501
Plant Mix Pavements—General

501.01 DESCRIPTION. These specifications include general requirements that are applicable to all types of bituminous pavements of the plant mix type irrespective of gradation of aggregate, kind and amount of bituminous material, or pavement use. Deviations from these general requirements will be indicated in the specific requirements for each type.

This work shall consist of one or more courses of bituminous mixture constructed on the prepared foundation in accordance with these specifications and the specific requirements of the type under contract, and in reasonably close conformity with the lines, grades, thicknesses, and typical cross sections shown on the plans or established by the engineer.

MATERIALS

501.02 COMPOSITION OF MIXTURES. The bituminous plant mix shall be composed of a mixture of aggregate, filler, if required, and bituminous material. The several aggregate fractions shall be sized, graded and combined in such proportions that the resulting mixture meets the gradation requirements of the job-mix formula.

The coarse and fine aggregates to be used in a bituminous mixture will be sampled at the source, prior to hauling the materials to the plant site, and tested in accordance with the test procedures listed in Section 903. Additionally, periodic samples will be tested during stock piling.

The job-mix formula will be established in accordance with the accepted procedures of the Department

as contained in Section I of the LDH Laboratory Manual.

After the job-mix formula is established, all mixtures furnished for the project shall conform thereto within the following ranges of tolerances:

Passing No. 4 and larger sieves	±9.0 percent
Passing No. 10 sieve	±7.0 percent
Passing No. 40 sieve	±6.0 percent
Passing No. 80 sieve	±5.0 percent
Passing No. 200 sieve	±3.0 percent
Asphalt Content	±0.5 percent
Temperature of Mixture	±25°F

These tolerances apply to all types of mixtures. The job-mix formula with the allowable tolerances shall be within the master range specified for the particular type of bituminous concrete.

Should a change in sources of materials be made, a new job-mix formula shall be established before the new material is used. When unsatisfactory results or other conditions make it necessary, the engineer may establish a new job-mix formula.

501.03 AGGREGATES. Aggregates shall meet the requirements of Subsection 903.07.

501.04 FILLER. Filler shall meet the requirements of Subsection 903.07.

501.05 BITUMINOUS MATERIALS. The type and grade of bituminous materials will be specified in the contract.

When Grade AC-3 or Grade AC-5 is specified, the grade may be changed by the engineer from AC-3 to AC-5, or from AC-5 to AC-3, as the case may be, at no change in unit price.

The bituminous material shall meet the applicable requirements of Section 902 Bituminous Materials.

CONSTRUCTION REQUIREMENTS

501.06 WEATHER LIMITATIONS. Bituminous plant mix shall not be applied on a wet surface except that

material in transit, at the time the plant operation is discontinued, may be laid, subject to the end product meeting specifications. Placing of bituminous plant mix shall be discontinued when the descending air temperature in the shade and away from artificial heat falls below 45° F and shall not be resumed until the ascending air temperature in the shade and away from artificial heat reaches 40° F.

501.07 BITUMINOUS MIXING PLANT. The plant may be of either a batch mixing or a continuous mixing type. All plants used by the contractor for the preparation of the bituminous mixture shall conform to all requirements of these specifications.

A. Batch Plants:

1. Uniformity: The plant shall be so designed, coordinated and operated as to produce a mixture within the specified tolerances of the job-mix formula.

2. Equipment for Preparation of Asphalt: Asphalt working tanks shall be capable of heating the material, under effective and positive control at all times, to the temperature requirements set forth in the specifications. The heating system shall provide uniform heating of the entire contents of the tanks. Heating shall be accomplished by steam coils, electricity, or other approved means so that no flame shall come in contact with the heating tank. The circulating system for bituminous material shall be of adequate size to insure proper and continuous circulation during the entire operating period. All pipe lines and fittings shall be steam-jacketed or otherwise properly insulated to minimize heat loss. Working tank capacity shall be sufficient for satisfactory operation. In addition to working tanks, the contractor shall provide adequate storage of asphalt in order that the asphalt may be tested and approved prior to transfer to the working tank. In no event shall such transfer be made until the asphalt has been tested and approved. The contractor shall also provide a calibration chart and a measuring stick for each tank to measure the amount

of asphalt cement actually used during construction.

3. Cold Aggregate Feeder: The plant shall be provided with accurate mechanical means for uniformly feeding the aggregate into the drier to secure a uniform production and a uniform temperature. The feeder or feeders shall be capable of delivering the maximum number of aggregate sizes required in their proper proportion. When more than one cold elevator is used, each shall be fed as a separate unit and the individual controls shall be integrated with a total master control. Mixing on the ground, at the plant site, of the various aggregates will not be permitted at any time.

4. Drier: The plant shall include one or more driers that will continuously agitate the aggregates during the heating and drying process. The equipment shall be capable of heating and drying all aggregates specified in the necessary quantities to supply the mixing unit continuously at its operating capacity and at a satisfactory temperature and moisture content.

5. Screens: Plant screens capable of screening all aggregates to the sizes required for proportioning, and having normal capacity in excess of the full capacity of the mixer or the drier, shall be provided. The contractor shall expose the screens for inspection at the request of the engineer.

6. Bins: The bin sizes shall be adequate for continuous operation of the plant at rated capacity. Bins shall be so arranged to insure separate and adequate storage of appropriate fractions of the aggregate. Adequate dry storage shall be provided for the mineral filler and provisions made for proportioning the filler for each batch of mixture. Each hot bin shall be provided with an overflow pipe or chute (except the mineral filler bin) to prevent contamination of materials. Each size of aggregate, as required, shall be stored in separate bins.

7. Asphalt Control Unit: Satisfactory means of weighing or metering shall be provided to obtain the required percentage of asphalt in the mix within the tolerances specified. Suitable steam-jacketing or other insulation for maintaining the specified temperature of asphalt in pipe lines, weigh buckets, flow lines, or other containers shall be provided. Where the quantity of asphalt is controlled by metering, provisions shall be made whereby the amount of asphalt delivered through the meter may be readily checked by weight when deemed necessary.

8. Thermometric Equipment: An armored thermometer of adequate range shall be fixed in the asphalt feed line at a suitable location near the discharge valve at the mixer unit. The plant shall also be equipped with an approved mercury-actuated thermometer, a recording electric pyrometer or other approved thermometric instrument having an accuracy of $\pm$ 5° F and a sensitivity which will provide an indication of temperature change at the rate of not less than 10° F per minute. It shall be so placed at the discharge chute of the drier to register automatically the temperature of the heated aggregate. The engineer shall have the right to test the efficiency of thermometric instruments for better control of asphalt, aggregate and mix temperatures. The immediate repair or replacement of any defective or unsatisfactory instrument by some approved temperature recording apparatus will be required.

9. Dust Collector: The plant shall be provided with a dust collector, designed to waste, or return uniformly to the hot elevator, all or part of the material collected, as directed. When dust is permitted to be returned to the hot elevator, it shall be accomplished by mechanical means in a constant and uniform flow. All plants shall have mixer covers and such additional housing as may be necesssary to insure the proper collection of dust.

10. Plant Scales: Scales for any weigh box or hopper may be of either the beam or springless

dial type and shall be of a standard make and design, accurate to ½ per cent of the indicated load.

When scales are of the beam type, there shall be a tare beam for balancing the hopper and a separate beam for the aggregate from each hot bin. A "telltale" dial shall be provided that will start to function when the load being applied is within 100 pounds of the weight desired. Each beam shall have a locking device designed and so located that the beam can easily be suspended or thrown into action. Poises shall be designed to be locked in any position to prevent accidental change of position.

Dial scales shall be springless and of standard make. They shall be designed, constructed and installed in such a manner as to be reasonably free from vibration. They shall also be of such size that the numerals on the dial can be read at a reasonable distance. All dials shall be so located as to be plainly visible to the operator at all times. The end of the pointer shall be set close to the face of the dial and shall be free from excessive parallax. The accumulative weights shall be marked on scales.

Scales for the weighing of asphalt shall conform to the requirements for aggregate scales, except that beam scales shall consist of a full capacity beam and a tare beam. The minimum graduation shall be not greater than 2 pounds. Dial scales for weighing the asphalt shall read to the nearest pound. All scales for weighing the asphalt shall have a capacity which will insure accuracy within the tolerances specified elsewhere herein.

Scales shall be satisfactory and shall be tested as often as deemed necessary to insure their accuracy. All weighing equipment shall be substantially constructed and of a design which will permit easy realignment and adjustment. Weighing equipment that easily gets out of adjustment shall be replaced when so ordered. The Department shall provide and have on hand at least ten 50-pound standard weights for frequent testing of all scales.

The test weights shall be kept clean and near the scales. The contractor shall provide for each scale a suitable cradle, or platform, for applying the test load so that the load is uniformly distributed. The contractor shall also provide an approved automatic printer system which will print separately the weights of the aggregate and of the asphalt. The total of the printed weights, delivered to a truck, shall be the verification for issuing haul tickets for each load.

In the event of a breakdown of the printing mechanism, the contractor will be permitted to operate up to a period of 48 hours until it can be repaired. During a breakdown period, the batch weights will be visually observed by an authorized representative of the Department.

11. Weigh Box or Hopper: Equipment shall include a means for accurately weighing each bin size of aggregate in a weigh box or hopper suspended on scales ample in size to hold a full batch without hand raking or running over. The weigh box or hopper shall be supported on a fulcrum; knife edges shall be so constructed that they will not easily be thrown out of alignment. Gates on both bins and hopper shall be so constructed as to prevent leakage when they are closed. Proportioning of aggregates and charging of mixer shall be performed so as to blend the aggregates thoroughly and prevent segregation in the mixer. Automatic plants may proportion and discharge all aggregate sizes simultaneously if provision is made to establish or control individual bin proportions by weight.

12. Asphalt Weighing Equipment: Asphalt measuring equipment provided on the plant shall be capable of accurately measuring into each batch the required amount of asphalt within the tolerance of plus or minus ½ of one per cent of the weight of asphalt.

The asphalt bucket shall be a non-tilting type provided with a loose sheet metal cover. The capacity of the asphalt bucket shall be at least

15 per cent in excess of the weight of asphalt required for a one-batch mix. The plant shall have a steam or hot oil jacketed, quick closing, non-dripping, charging valve. The length of the discharge opening or spray bar shall not be less than ¾ of the length of the mixer and it shall discharge directly into the mixer. The discharge system shall be designed and arranged to deliver the asphalt the full length of the mixer in a thin, uniform sheet or in multiple streams or sprays.

13. Mixer Unit: The plant shall include a batch mixer of an approved twin pugmill type and shall be steam or hot oil jacketed. It shall be capable of producing a uniform mix within the specified tolerances. Deviation in size of batches will be permitted to provide for mixing batches 20 per cent below the rated capacity of the mixer, provided the quality of the mix is not impaired. The rated capacity of the mixer can be exceeded only as long as the paddle tips remain exposed in the material at the top of their periphery during mixing. The clearance of the blades from all fixed and moving parts shall not exceed ¾ inch. The paddles shall be set in such a manner to insure a completely uniform mix. If not enclosed, the mixer box shall be equipped with a dust hood to prevent loss of dust. The mixer shall be so constructed as to prevent leakage of contents until the batch is to be discharged.

14. Control of Mixing Time: The mixer shall have an approved accurate timing device to prevent the entrance of additional material while the mixing operation is in progress and the discharge gates shall be locked to insure proper mixing. The device shall also lock the asphalt bucket throughout the dry mixing period. The dry mixing period is the interval of time between the opening of the weigh box gate and the application of asphalt. The wet mixing period is the interval of time between the start of the application of asphalt and the opening of the mixer gate for discharge.

B. Continuous Mix Plants: It shall be the contractor's responsibility to furnish equipment that will produce a satisfactory paving mix. The plant shall meet the following minimum requirements.

1. General Requirements: The requirements as set forth under paragraphs (1) through (6), (8) and (9) for batch plants shall apply for continuous mixing type plants.

2. Mixer Unit: The plant shall include a continuous mixer of an approved twin pugmill type and be capable of producing a uniform mix within the job-mix tolerances specified. The paddles shall be of a type adjustable for angular position on the shafts and reversible to retard the flow of the mix. The clearance of the blades from all fixed and moving parts shall not exceed ¾ inch. The mixer shall carry a manufacturer's plate giving the net volumetric contents of the mixer at the several heights inscribed on the permanent gauge.

3. Asphalt Control Unit: Means shall be provided to obtain the required percentage of asphalt in the mix within the tolerances specified either by metering or volumetric measurements. Where the quantity of asphalt is controlled by metering, provisions shall be made whereby the amount of asphalt delivered through the meter may be readily checked by weight. Steam jacketing or other insulation which will maintain the specified temperature of asphalt in pipe lines, meters, spray bars, flow lines, or other containers shall be provided. A continuous recording device will be required on the discharge side of the asphalt pump to the pugmill. This device will record the amount of asphalt introduced into the mix.

4. Gradation Control Unit: The plant shall include a means for accurately proportioning each bin size of aggregate by volumetric measurement. The unit shall include a feeder mounted under the bins with each bin compartment having an accurately controlled individual gate to form an orifice for volumetrically measuring the material drawn from it. The orifice shall be rectangular,

with one dimension adjustable by positive mechanical adjustment, and provided with a lock. Indicators shall be provided on each gate to show the gate opening in inches. Mineral filler, if specified, shall be proportioned separately from a hopper equipped with an adjustable feed which may be accurately and conveniently calibrated and which shall be interlocked with the aggregate and asphalt feeds. The feeder equipment for the mineral filler shall meet the approval of the engineer.

5. Weight Calibration of Aggregate Feed: Samples shall be taken and weighed as a means of calibrating gate openings. Material shall be fed out of a bin through the individual orifice and bypassed to an approved test box. The material from each compartment shall be taken separately. The plant shall be equipped to handle conveniently such test samples weighing not less than 200 pounds. An accurate platform scale shall be provided by the contractor to weigh the test samples.

6. Synchronization of Aggregate and Asphalt Feed: Satisfactory means shall be provided to assure positive interlocking control between the flow of aggregate from the bins and the flow of asphalt from the meter or other proportioning device. This shall be accomplished by interlocking mechanical means or by any positive method approved by the engineer. The aggregate bins shall be provided with signal devices and controls which will warn of low levels and which will automatically stop the flow of all aggregate and asphalt to the mixer when the aggregate in any one bin is so low that the feeder will not operate at set capacity. The asphalt storage system shall be provided with signal devices and controls which will warn of low levels of asphalt and which will automatically stop the entire plant operation when the asphalt storage level is lowered to the point of exposing the feed end of the asphalt suction line.

If mineral filler is specified, the plant shall in-

clude separate equipment to accurately proportion the mineral filler sufficiently in advance of the addition of the bitumen to give a proper dry mix time. This equipment shall be of such design as to give a constant flow of the material and shall include a storage bin of sufficient capacity and an adjustable calibrated gate. The filler feed system shall be interlocked with the aggregate control system and feed the material by mechanical means. A gravity type feed will not be permitted.

7. Control of Mixing Time: The plant shall be equipped with a positive means to govern the time of mixing. Mixing time shall not be altered unless so ordered by the engineer.

The determination of mixing time shall be by a weight method under the following formula unless otherwise instructed by the engineer:

$$\text{Mixing time, sec.} = \frac{\text{Pugmill Dead Capacity, Lbs.}}{\text{Pugmill Output, Lbs. per sec.}}$$

The weights shall be determined for the job from tests made by the engineer.

8. Discharge Box: The plant shall be equipped with a discharge box of sufficient size to collect the mix as it comes out of the pugmill to prevent segregation.

9. Truck-platform scales will be furnished by the contractor for the purpose of determining the pay weights of the mix when using a continuous mixing type plant. The scales furnished by the contractor shall be of sufficient length to weigh the entire unit transporting the mix and shall be the product of a reputable manufacturer and of a simple rugged design with the minimum number of adjustments consistent with the accuracy required, all as approved by the engineer. Suitable provisions shall be taken to protect all moving parts and to level the equipment. The scales shall be accurate to ½ of one per cent of the loads applied.

The contractor shall have the scales certified by the State Bureau of Weights and Measures prior to their use and in the event there is cause to believe that the scales are performing incorrectly, he shall furnish additional certification.

The scales shall be equipped with an approved automatic printer system which will print the weight of the unit transporting the mix. The printed weight of the loaded truck less the printed weight of the truck when empty shall be used as a basis for issuing haul tickets for each load.

501.08 HAULING EQUIPMENT. Vehicles used for the transportation of hot mix asphalt from the plant to the site of the work shall have tight metal bottoms and shall be free from dust, screenings, petroleum oils, and volatiles of other mineral spirits which may affect the mix being hauled. The truck beds shall be painted or sprayed at least once a day or as often as required with lime-water, soap solution, or other approved materials. After this operation, the truck bed shall be elevated and thoroughly drained; no excess solution shall be permitted.

The trucks to be used for transportation of the mixture will be of such size that the lay-down machine or the paver being used will be capable of pushing them with ease without affecting the surface smoothness or the edge of the material. Trucks which do not meet these requirements will be required to unload in a satisfactory manner that will not overload the lay-down machine or paver.

Trucks shall be provided with covers of canvas or other material of sufficient size and weight to protect the load from adverse weather conditions. When variations in size, speed, and condition of trucks are such as to interfere with orderly operation, the engineer may order suitable substitutions to be made.

501.09 BITUMINOUS PAVERS. Self-powered spreading and finishing equipment capable of laying hot mix to grade within the tolerances specified with a screed or strike-off assembly shall be used, distributing the mixture either over the entire width or over

such partial width lanes as may be practicable. The assembly shall be adjustable to give the cross section shape as per plan typical section within specified tolerances. When leveling is required by the plans, a blade grader may be used when approval is given by the engineer.

Pavers shall be equipped with hoppers and distributing screws to place the mix evenly in front of adjustable screeds. They shall be equipped with a quick and efficient steering device and shall be capable of traveling both forward and in reverse.

Pavers shall be capable of spreading mixes without segregation or tearing. Pavers shall also be capable of placing courses in thickness of from ½ inch to at least 3 inches.

In shoulder construction, modified spreaders shall be provided as required.

501.10 ROLLERS. Rolling equipment shall consist of 10-ton three-wheel rollers, 10-ton tandem rollers, and high intensity self-propelled pneumatic-tire rollers.

All rollers shall be capable of reversing without backlash. When necessary, additional rollers of an approved design shall be furnished.

Steel wheel rollers shall be equipped with adjustable scrapers to keep the rollers clean and with efficient means of keeping the wheels wet to prevent the mixture from sticking to the rollers. Rollers shall also be free of flat areas, openings or projections which will mar the surface of the pavement.

High intensity pneumatic-tire rollers shall be self-propelled and shall have 2 axles. The roller shall be capable of applying a range of contact or ground pressures from 50 to 90 psi. Operational tire inflation pressure will cover the full range from 60 to 120 psi. Tires will be smooth without any treads. All tires of the same roller shall be of equal size and diameter and shall be arranged in such a manner that the gap between the tires of one axle will be covered by the tires of the other. The pneumatic rollers shall be equipped with cocoa mats or suitable scrapers to

prevent pickup. Suitable devices will also be provided to keep the mats damp at all times. The ply rating of the tires shall be such that they will support the maximum operative wheel load and a maximum tire pressure of 120 psi.

When Type 3 mix is specified in addition to the requirements given above, the high intensity pneumatic-tire rollers shall be capable of exerting a wheel load of 4000 pounds.

501.11 INCIDENTAL EQUIPMENT AND HAND TOOLS. Power revolving brooms or power blowers and distributors shall be provided and maintained in a satisfactory working condition.

Tamping irons used to consolidate the edges of the binder and wearing courses shall be of sufficient weight to compact the edges to the same degree as the body of the pavement. Satisfactory mechanical equipment may be used instead of tamping irons.

The asphalt distributor shall be equipped with pneumatic tires of such width and design so that the load produced on the road surface shall not be detrimental to the previous course. The distributor shall be equipped with suitable manifold and appliance so designed as to distribute evenly heated material within the temperature range specified with positive controlled heat and temperature at all times, including thermometers to indicate the temperature of the material in the tank. The distributor shall be so designed as to maintain a constant and uniform pressure upon the bituminous material as it passes through the nozzles. Sufficient and proper screens shall be installed between the tank and the nozzles and the screens shall be cleaned frequently to prevent clogging of the nozzles. The distributor shall be equipped with devices and charts to provide for accurate and rapid determination and control of the amount of bituminous materials being applied per square yard of surface under the operating conditions, and shall have a tachometer, reading speeds in feet per minute. The distributor shall be so designed as to apply bituminous material at the specified rate.

501.12 CONDITIONING OF EXISTING SURFACE. The

surface to be covered shall be swept clean and free from all dust and dirt, caked clay and loose foreign material by means of revolving brooms or other approved mechanical sweepers supplemented by hand brooms, as directed.

When the bituminous mixture is to be placed on an existing pavement, the contractor shall, in addition to cleaning the surface as required above, remove excess joint filler from the surface. This does not relieve the contractor from maintaining, at his expense, the existing pavement so as to prevent water from reaching the subgrade.

Contact surfaces of curbs, gutters, manholes and other structures shall be painted with a thin uniform coating of tack coat before the bituminous mixture is placed against them.

The condition of the base shall be approved prior to the placing of the mixture.

501.13 PREPARATION OF BITUMINOUS MATERIAL. The bituminous material shall be heated to the specified temperature in a manner that will avoid local overheating and provide a continuous supply of the bituminous material to the mixer at a uniform temperature at all times.

501.14 PREPARATION OF AGGREGATES. The aggregates for the mixture shall be dried and heated to the required temperature. Flames used for drying and heating shall be properly adjusted to avoid damage to the aggregate and to avoid soot or oil coating on the aggregate.

The aggregate, immediately after heating and drying, shall be screened into 2 or more fractions as specified and conveyed into separate compartments ready for batching and mixing with bituminous material.

501.15 MIXING. The dried aggregates shall be combined in the mixer, in the amount of each fraction of aggregates required to meet the job-mix formula. The bituminous material shall be measured or gaged and introduced into the mixer in the amount specified by the job-mix formula.

After the required amounts of aggregate and bituminous material have been introduced into the mixer, the materials shall be mixed until a complete and uniform coating of the particles and a thorough distribution of the bituminous material throughout the aggregate is secured. Dry mixing and wet mixing time shall be controlled by the engineer for each plant and for each type of aggregate used.

501.16 JOINTS. The longitudinal joints in one layer shall offset that in the layer immediately below by approximately 3 inches; however, the joint in the top layer shall be at the centerline of the pavement if the roadway comprises 2 lanes of width, or at lane lines if the roadway is more than 2 lanes.

Transverse joints shall be formed by cutting back on the previous run to expose the full depth of the course. Transverse joints in succeeding courses shall be offset at least 2 feet. When directed, a brush coat of bituminous material shall be used on contact surfaces of transverse joints just before additional mixture is placed against the previously rolled material.

501.17 PAVEMENT SAMPLES. The contractor shall furnish for testing, when required, samples cut from the completed work. The area of pavement so removed shall be replaced with new mixture and refinished. No additional compensation will be allowed for furnishing test samples and replacing the areas with new pavement.

Samples of the finished roadway will be taken by the contractor in presence of the engineer's representative from areas selected by him. Saws or core drills of an approved type will be required. The size of each sample shall be approximately 4 inches x 4 inches square or 4 inches in diameter.

501.18 SURFACE TOLERANCES.

(a) Types 1, 2 and 4 Mixes and Shoulders: The surface will be tested by the engineer, using a 10-foot straightedge at selected locations. The variation of the surface from the testing edge of the straightedge between any 2 contacts with the surface shall at no point exceed 3/16 inch. All humps or depres-

sions exceeding the specified tolerance shall be corrected by removing defective work and replacing it with new material as directed.

(b) Type 3 Mix: Maximum deviation from grade established by the engineer or cross section at any point shall not be more than:

Asphaltic Concrete Base Course (Second and Intermediate Layers)	1/2 inch
Asphaltic Concrete Binder	3/8 inch
Asphaltic Concrete Wearing Course and Each Successive Layer	1/4 inch

Maximum variance, when tested by a 10-foot straightedge or template, parallel or perpendicular to the center line, between any 2 contacts shall at no point exceed the following:

Asphaltic Concrete Base Course (Second and Intermediate Layers)	3/8 inch
Asphaltic Concrete Binder	1/4 inch
Asphaltic Concrete Wearing Course	1/8 inch

When tested longitudinally from a stringline or comparable method applied parallel to the surface on any 25 or 50 foot section, such section shall not vary more than the specified limits given in the following schedule:

Interval	Base, Second and Intermediate Layers	Binder	Wearing
25 feet	1/2 inch	3/8 inch	1/4 inch
50 feet	5/8 inch	1/2 inch	3/8 inch

The intent of these specifications is that 95 per cent of all surface tolerance measurements conform to this specification and that no single surface tolerance measurement exceed the specification requirements by more than ½ of the tolerance specified. Any deviation below the 95 percent tolerance will require correction of all deficient areas.

Any irregularities in the base or any intermediate course may be corrected by either skin patching, featheredging, or full depth patching, where appropriate, and where it can be completed in a satisfactory manner.

To correct the irregularities of the finished surface, skin patching will not be permitted. When the requirements specified above are not met, the contractor, at his expense, will either remove the section in question to a minimum depth of one inch and replace it with additional mixture meeting these requirements or resurface the full length of the project to the full width of the pavement with a minimum of one inch of mixture in accordance with the above requirements. Featheredging at any intermediate point will not be permitted on the pavement except when specified on the plans or in the special provisions.

501.19 METHOD OF MEASUREMENT. Aggregates, inclusive of mineral filler, will be measured by the ton of 2,000 pounds of the type or types actually used in the completed and accepted work.

Asphalt will be measured by the ton of 2,000 pounds of the grade or grades actually used in the completed and accepted work.

When the mixture is produced in a batch plant, measurement of the aggregates and asphalt will be determined from the printed weights as provided in Subsection 501.07, Part A, Paragraph (10).

When the mixture is produced in a continuous mixing plant, measurement of the composite mix will be determined from the printed weights as provided in Subsection 501.07, Part B, Paragraph (9). The weight of the asphalt will be determined by the job-mix formula. By deducting this weight from the total weight of the composite mixture, the weight of the aggregates will be determined.

Haul tickets will be issued for each truck load of material delivered. Material lost, wasted, rejected or applied contrary to these specifications, will not be measured for payment.

Due to the possible variations in the specific gravity of the aggregates, the tonnage used may vary from the proposal quantities and no adjustment in contract unit price will be made because of such variation.

501.20 BASIS OF PAYMENT. Aggregates and asphalt used in plant mix bituminous pavement will be paid for as provided in Subsection 502.12.

Section 502

Asphaltic Concrete Pavement

502.01 DESCRIPTION. This work shall consist of a base course, binder course and a wearing course, or a combination of these courses, each consisting of a mixture of mineral aggregate and bituminous material applied hot on the prepared base, in accordance with these specifications.

The type of mixture furnished shall be as indicated on the plans, or if more than one type is indicated, whichever type the contractor elects, but in any event shall be one of the following 4 types:

Type 1 mix shall be composed of crushed gravel, crushed stone, crushed slag, or a combination of these materials, sand, mineral filler and bituminous material.

Type 2 mix shall be composed of whole clam shell, crushed clam shell, crushed reef shell or a combination thereof, sand, mineral filler (when required) and bituminous material.

Type 3 mix shall be composed of the following:
(a) Wearing Course-crushed stone, sand, mineral filler and bituminous material.

(b) Binder Course-crushed gravel, crushed stone, crushed slag or a combination of these materials, sand, mineral filler and bituminous material.

(c) Base Course-crushed or uncrushed gravel, crushed stone, crushed slag or a combination of these materials, sand, mineral filler and bituminous material.

Type 4 mix shall be composed of expanded clay aggregate, sand, mineral filler (if required) and bituminous material.

The thickness of courses shall be in approximate conformity with the plan typical sections unless otherwise specified. In the event the plans and/or proposal

provides for both binder and wearing courses and Type 1 mixtures are used, the contractor will be permitted, at his option, to substitute wearing course material for binder course material at no change in unit price. Should the contractor elect to make such substitution, the mixture will be laid in layers of such thickness that the compaction and surface requirements are met.

Whenever Type 3 mixture is specified, no substitutions will be allowed.

The mineral aggregate and bituminous material in the mixtures shall be combined in such proportions that the mixture shall meet the following requirements by weight:

Mix	Bitumen, Per Cent	Min. Agg. Per Cent	% Crushed Ret. on #4
Type 1:			
WC	4.5 to 7.0	93.0 to 95.5	75 Min.
BC	3.5 to 6.0	94.0 to 96.5	60 Min.
Type 2:			
WC & BC	4.5 to 7.5	92.5 to 95.5	.....
Type 3:			
WC	3.5 to 7.0	93.0 to 96.5	80 Min.
BC	3.0 to 6.0	94.0 to 97.0	60 Min.
Base	3.0 to 6.0	94.0 to 97.0	As Needed
Type 4:			
WC & BC	5.0 to 10.0	90.0 to 95.0	.....

502.02 MATERIALS. The materials and their use shall conform to the requirements of Subsections 501.02 through 501.05.

CONSTRUCTION REQUIREMENTS

502.03 GENERAL. The construction requirements shall be as prescribed in Subsections 501.06 through 501.18.

502.04 PHYSICAL PROPERTIES OF MIXTURE. The bituminous mixture will be designed with the intent that compacted specimens of the mixture shall con-

form to the following properties when tested in accordance with LDH Designation: TR 305.

After the job-mix formula has been established, if the following requirements are not met, adjustments will be made in the design of the mix or in materials furnished.

Mix & Grade of Asphalt	Marshall Stability @140°F, lbs.	Flow 1/100"
Types 1, 2, & 4:		
AC-3, BC & WC	1200 min.	15 max.
AC-5, BC & WC	1000 min.	15 max.
Type 3:		
AC-3, Base	1200 min.	15 max.
AC-3, Binder	1500 min.	15 max.
AC-3, Wearing	1800 min.	15 max.

Whenever a mixture is to be placed on the shoulders, the following physical properties will be obtained.

SHOULDERS:		
AC-5, Wearing	1000 min.	15 max.

All requirements of this subsection are intended to be the average of all the samples tested for any 3 consecutive days operation for the project. The average for any individual day shall not be less than 200 pounds below the minimum specified above for the different types of mixes.

In any event, the number of samples used for the average shall not be less than 12 for 3 days and 4 for one day.

502.05 HANDLING OF AGGREGATES. Coarse and fine aggregates shall be stored at the plant in such a manner that the separate sizes will not become intermixed. When stockpiling, the material shall be placed in such a manner as to minimize segregation of aggregate sizes.

Blending of aggregates in stock piles or on the ground at the plant site shall not be permitted.

(a) Drying: The aggregate shall be heated and dried to provide a paving mix meeting the requirements of these specifications.

The quantity of material fed through the drier shall, in all cases, be held to an amount which can be adequately heated and dried. The discharge chute of the drier and the discharge end of the asphalt line shall be equipped with pyrometric or thermometric devices, acceptable to the engineer, to assure that proper temperatures are being maintained.

(b) Screening: Aggregates shall be screened into sizes such that they may be recombined into a gradation meeting the requirements of the job-mix formula.

(c) Hot Aggregate Storage: Hot screened aggregate shall be stored in bins as required in Subsection 501.07. Storage shall be accomplished in such a manner as to minimize segregation and loss of temperature of the aggregate.

502.06 PREPARATION OF ASPHALT AND AGGREGATES. The asphalt and aggregate, at the time of mixing, shall be heated to a temperature of not less than 275° F and not more than 350° F.

The asphalt cement Grade AC-3, AC-5 and AC-7 shall be heated to a temperature, as specified, that will give a viscosity of approximately 85 to 100 seconds Saybolt Furol, or as otherwise directed.

Bituminous mixtures, when discharged from the mixer, shall be within plus or minus 25° F of the specified temperature of the asphalt. However, under no circumstances will the discharge temperature of the mixture be less than 275° F.

The dried mineral aggregate for any of the various type mixtures shall be combined in the plant in the proportionate amount of each fraction of aggregate required to meet the job-mix formula. The bituminous material shall be measured and introduced into the mixer in the proportionate amount as determined by the engineer for the particular material being used. Prior to adding bituminous material, the combined mineral aggregate shall be thoroughly mixed dry, after

which the proper amount of asphalt shall be sprayed over the mineral aggregate and mixed to produce a homogeneous mixture in which all particles of the mineral aggregate are uniformly coated. The mixing time shall be determined by the engineer at the time of the job-mix design and suitable locking means shall be provided for this regulation.

Aggregate contaminated with carbon or oil will be rejected.

502.07 TACK COAT. Before constructing each course, a tack coat of the width indicated on the plans shall be applied, if needed, at the rate specified by the engineer, but not to exceed 0.05 gallon per square yard. When the bituminous mixture is placed on an asphalt surface, the tack coat may be eliminated if directed. The responsibility for the protection of the tack coat shall rest with the contractor and spot-patching required shall be made at no extra cost.

The tack coat shall meet the requirements of Section 503.

Asphaltic concrete shall not be applied on the bituminous surfaced or primed base until the surface or tack coat has completely cured to the satisfaction of the engineer.

In the event asphaltic concrete is to be placed on an aggregate type base course, the contractor shall use bituminous primer as described in Section 504, in lieu of the tack coat required herein.

In the event the primer has dried out or is otherwise insufficient prior to laying the asphaltic concrete, the contractor shall, at his expense, re-prime the base as directed; however, in any event, the primed surface shall be completely cured to the satisfaction of the engineer.

502.08 SPREADING AND FINISHING. Bituminous mixtures, heated and prepared as specified, shall be transported from the mixing plant to the site of the work as specified in Subsection 501.08. No loads shall be sent out so late in the day as to prevent completion of the spreading and compaction of the mixture during daylight, unless artificial light is provided. The mix-

ture shall be delivered at a temperature of not more than 25° F below the minimum allowable temperature of the mixture when discharged from the mixer as specified in Subsection 502.06.

The laying operations shall be conducted in the following manner:

(a) Mechanical Spreaders: The base, binder and surface courses shall be spread and struck off with an approved self-powered and propelled mechanical spreading machine, capable of spreading and finishing the mix reasonably true to line, grade and cross section without the use of forms or side supports. Finishing machines shall be operated so that material does not accumulate and remain along the sides of the receiving hopper.

The finishing machine shall be equipped with a positive controlled mechanical screed. The screed shall be equipped with a suitable, controlled heating device to be used when required.

Equipment which leaves tracks or indented areas which cannot be corrected in normal operations, or which produces flushing or other permanent blemishes or fails to produce a satisfactory surface, shall not be used.

Longitudinal joints and edges shall be constructed to reasonably true line markings. Lines shall be established by the engineer parallel to the centerline of the proposed roadway and string lines or other devices will be placed by the contractor for the paver to follow in placing individual lanes. The paver shall be positioned and operated to closely follow the established line. In backing trucks against the spreader, care shall be taken not to jar the finisher out of its proper alignment. Delivery of material to the paver shall be at a uniform rate and in an amount well within the capacity of the paving and compacting equipment.

As soon as the first load of material has been spread, the texture of the unrolled surface shall be checked to determine its uniformity. The adjustment of the screed, tamping bars, feed screws, hop-

per feed, etc., shall be checked frequently to assure uniform spreading of the mix to the proper line and grade and adequate initial compaction. Segregation of materials shall not be permitted. If segregation occurs, the spreading operation shall be immediately suspended until the cause is determined and corrected.

Longitudinal and transverse joints shall be formed as provided in Subsection 501.16.

Any irregularities in alignment left by the paver shall be corrected by trimming directly behind the machine. Immediately after trimming, the edges of the course shall be thoroughly compacted by tamping. Distortion of the pavement during this operation shall be avoided.

Edges against which additional material is to be placed shall be reasonably formed to lines and approximately vertical. Any irregularities in the surface of the pavement course shall be corrected directly behind the paver. Excess material forming high spots shall be removed. Indented areas shall be filled with hot mix and finished reasonably smooth. Casting of material over the surface shall not be permitted whenever wearing course is being laid.

The outside edge of the freshly laid mixture shall be tamped behind the spreader prior to rolling to reasonably vertical edge whenever base or binder courses are being laid, and to approximately 45° beveled edge when the wearing courses are being laid.

(b) Hand Spreading: In small areas where the use of mechanical finishing equipment is not practical, the mix may be spread and finished by hand. Approved wood or steel forms, rigidly supported to assure reasonably correct grade and cross section, may be used. In such instances, measuring blocks and intermediate strips shall be used to aid in obtaining the required cross section. Placing by hand shall be performed carefully; the material shall be distributed uniformly to avoid segregation of the coarse and fine aggregates. During the spreading operation, all material shall be thoroughly

loosened and uniformly distributed. Material that has formed into lumps and does not break down readily shall be rejected. Following placing and before rolling, the surface shall be checked and all irregularities corrected.

502.09 COMPACTION. After spreading and striking off and while still hot, each course shall be thoroughly and uniformly compacted by rolling.

The highest contact pressure that will give the required density will be used for the pneumatic roller. The tire inflation pressure and the wheel load will be designated by the engineer.

The pneumatic-tire roller shall be kept approximately 6 inches from the unsupported center line joint when only one lane is in place. However, when both lanes are down, it shall be overlapped at least 6 inches to get additional sealing of the joint.

Additional rollers may be required as necessary to meet the compaction and smoothness requirements.

Rolling shall be conducted in such sequence and by methods that will obtain the specified density and smoothness requirements. Each roller shall be operated by a competent, experienced operator and, while the work is under way, shall be kept as nearly as practicable in continuous operation.

The motion of the roller at all times shall be slow enough to avoid displacement of the hot mixture. Any displacement occurring as a result of the reversing of the direction of the roller, or from any other causes, shall be immediately corrected. To prevent adhesion of the mixture to the roller, the wheels shall be kept properly moistened, but excess water will not be permitted.

Along forms, curbs, headers and walls and at other places not accessible to the roller, the mixture shall be thoroughly compacted with hot hand tampers or with mechanical tampers to obtain a satisfactory density.

The surface of the mixture, after compaction, shall be smooth and true to the established crown and

grade, within the tolerances specified. Any mixture that becomes loose, broken, contaminated, or in any way defective, shall be removed and replaced with fresh hot mixture, which shall be immediately compacted to conform with the surrounding area.

Rolling shall continue until all roller marks are eliminated and the following average roadway densities are obtained:

Types 1 & 4	Traffic Lanes	95% minimum of Briquette Density
	Shoulders	92% minimum of Briquette Density
Type 2	Traffic Lanes	92% minimum of Briquette Density
	Shoulders	92% minimum of Briquette Density
Type 3	1st Lift of Asphaltic Concrete Base Couse—	95% minimum of Briquette Density
	All additional layers of Asphaltic Concrete Base Course—	97% minimum of Briquette Density
	Asphaltic Concrete Binder and Wearing Course—	97% minimum of Briquette Density
	Shoulders	92% minimum of Briquette Density

The preceding compaction requirements are intended to be the average of all the samples tested for any 3 consecutive days operation for the project. However, the test results of any individual sample tested shall not be outside the specification requirements by more than a numerical difference of 2 per cent. The roadway density shall be determined by LDH Designation: TR 304. Sampling shall be in accordance with LDH Designation: S 202. Briquette Density shall be determined by LDH Designations: TR 304 and TR 305.

502.10 PROTECTION OF PAVEMENT. Sections of

newly finished pavement shall be protected from traffic until the pavement has sufficiently hardened.

502.11 METHOD OF MEASUREMENT. Aggregates and asphalt in asphaltic concrete will be measured as prescribed in Subsection 501.19.

502.12 BASIS OF PAYMENT. The quantities of aggregates and asphalt in the completed and accepted asphaltic concrete pavement will be paid for at the respective contract unit prices per ton.

Payment will be made under:

Item No.	Pay Item	Pay Unit
502(1)	Aggregates	Ton
502(2)	Asphalt	Ton

Section 503
Tack Coat

503.01 DESCRIPTION. This work shall consist of preparing and treating an existing bituminous or concrete surface with bituminous material in accordance with these specifications and in reasonably close conformity with the lines shown on the plans or established by the engineer.

503.02 BITUMINOUS MATERIAL. The tack coat may be either cutback asphalt, Grade RC-70 or RC-250, or emulsified asphalt, Grade RS-1 or RS-2, or asphalt cement, as the contractor elects.

The bituminous material shall meet the applicable requirements of Section 902, Bituminous Materials.

503.03 EQUIPMENT. The contractor shall provide equipment for heating and applying the bituminous material, and for the proper preparation of the surface to be treated. The equipment shall meet the applicable requirements of Subsection 501.11.

CONSTRUCTION REQUIREMENTS

503.04 PREPARATION OF SURFACE TO BE TREATED. The existing surface shall be cleaned by sweeping or by other approved methods. The edges of existing pavements, which are adjacent to the new pavement, shall be cleaned to permit the adhesion of the bituminous material.

503.05 APPLICATION OF BITUMINOUS MATERIAL. The bituminous material shall be uniformly applied with a pressure distributor at a rate not to exceed 0.05 gallon per square yard.

The tack coat shall not be applied on a wet surface or when the temperature is below 40° F, or after sunset. The rate of application, temperature of the bituminous material and the areas to be treated shall be approved prior to application.

The tack coat shall be applied in such a manner as to offer the least inconvenience to traffic.

503.06 METHOD OF MEASUREMENT. The number of gallons of bituminous tack coat placed and accepted will be measured in the distributor by the gallon of 231 cubic inches. Measurement shall be converted to gallonage at 60° F in accordance with Temperature-Volume Correction, Table II, given in Subsection 504.08, or Table III given in Subsection 505.11.

503.07 BASIS OF PAYMENT. The accepted quantities of tack coat will be paid for at the contract unit price per gallon for bituminous material complete in place.

Payment will be made under:

Item No.	Pay Item	Pay Unit
503(1)	Bituminous Tack Coat	Gallon

Section 504
Prime Coat

504.01 DESCRIPTION. This work shall consist of treating a prepared or existing surface with bituminous material in accordance with these specifications and in reasonably close conformity with lines shown on the plans or established by the engineer.

504.02 BITUMINOUS MATERIAL. The bituminous material used as a prime coat shall be Grade MC-30 or Grade MC-70 Cutback Asphalt, as directed. Cutback asphalt used as a prime coat shall meet the applicable requirements of Section 902, Bituminous Material.

CONSTRUCTION REQUIREMENTS

504.03 WEATHER LIMITATIONS. Bituminous materials shall not be applied on a wet base nor when the temperature of the air is less than 60° F in the shade.

504.04 EQUIPMENT. The contractor shall provide equipment for heating and applying the bituminous material. The equipment shall meet the requirements of Subsection 505.05.

504.05 PREPARATION OF SURFACE. The surface to be primed shall be shaped to the required grade and section, shall be free from all ruts, corrugations, segregated material or other irregularities and shall be compacted to the required density.

Delays in priming will necessitate reprocessing or reshaping to provide a smooth compacted surface.

504.06 APPLICATION OF BITUMINOUS MATERIAL. The primer shall be applied to the prepared base and shall extend 6 inches beyond the width of surface treatment shown on the plans. The bituminous primer shall not be applied until the base has been satisfactorily compacted and bonded, and then only when the surface has been properly swept and is firm, compact and dry. The method of application shall be the

same as provided under Subsection 505.07. If the course is to be constructed on an existing pavement, the pavement shall be primed, if so indicated on the plans or directed.

When the prepared base consists of soil cement base or stabilized aggregate base course, and where the protective coating of emulsified asphalt has become worn or is otherwise insufficient, the contractor will be required to spot-prime the base course as directed or the prime coat may be reduced or deleted.

The prime coat shall be maintained intact and, if required, the primed surface shall be thoroughly cleaned prior to the application of the wearing surface.

Where the prime coat has failed or depressions have occurred, the failure shall be swept clean, brush-coated with cutback asphalt and refilled with a satisfactory bituminous mixture. If the prime coat is generally unsatisfactory, the contractor shall be required to reprime the unsatisfactory surface.

The prime coat shall be applied at the rates and temperatures shown in Table I, below. Quantities of bituminous prime shall not vary from that shown in Table I by more than 5 per cent, unless otherwise provided herein.

TABLE I
BITUMINOUS PRIMERS

Prime Application Grade	Primer (Gal. per Sq. Yd.) Min.	Max.	Temperature of Application Min.	Max.
MC-30	0.25	0.3	60° F	120° F
MC-70	0.25	0.3	100° F	180° F

Temperature-Volume data for asphaltic materials shall be taken from tables as contained in Subsection 504.08, Table II.

504.07 PROTECTION. After the prime coat has been applied, and unless it is impractical to detour high-

way traffic, the contractor shall keep all traffic off the road until the bituminous material has properly cured.

In cases where traffic is permitted, the contractor may be required, at his expense, to spread the minimum necessary amount of approved granular material over the bituminous primer.

504.08 METHOD OF MEASUREMENT. The number of gallons of bituminous prime placed and accepted, will be measured by the gallon of 231 cubic inches and shall be measured in the distributor. Measurement shall be converted to gallonage at 60° F in accordance with Temperature-Volume Correction Table II.

TABLE II

TEMPERATURE—VOLUME CORRECTIONS FOR ASPHALTIC MATERIALS

GROUP 1—SPECIFIC GRAVITY AT 60°F OF 0.850 TO 0.966
LEGEND: t = observed temperature in degrees Fahrenheit
M = multiplier for correcting oil volumes to the basis of 60°F

t	M	t	M	t	M	t	M	t	M
0	1.0241	37	1.0092	74	0.9944	111	0.9799	148	0.9655
1	1.0237	38	1.0088	75	0.9940	112	0.9795	149	0.9651
2	1.0233	39	1.0084	76	0.9936	113	0.9791	150	0.9647
3	1.0229	40	1.0080	77	0.9932	114	0.9787	151	0.9643
4	1.0225	41	1.0076	78	0.9929	115	0.9783	152	0.9639
5	1.0221	42	1.0072	79	0.9925	116	0.9779	153	0.9635
6	1.0217	43	1.0068	80	0.9921	117	0.9775	154	0.9632
7	1.0213	44	1.0064	81	0.9917	118	0.9771	155	0.9628
8	1.0209	45	1.0060	82	0.9913	119	0.9767	156	0.9624
9	1.0205	46	1.0056	83	0.9909	120	0.9763	157	0.9620
10	1.0201	47	1.0052	84	0.9905	121	0.9760	158	0.9616
11	1.0197	48	1.0048	85	0.9901	122	0.9756	159	0.9612
12	1.0193	49	1.0044	86	0.9897	123	0.9752	160	0.9609
13	1.0189	50	1.0040	87	0.9893	124	0.9748	161	0.9605
14	1.0185	51	1.0036	88	0.9889	125	0.9744	162	0.9601
15	1.0181	52	1.0032	89	0.9885	126	0.9740	163	0.9597
16	1.0177	53	1.0028	90	0.9881	127	0.9736	164	0.9593
17	1.0173	54	1.0024	91	0.9877	128	0.9732	165	0.9589
18	1.0168	55	1.0020	92	0.9873	129	0.9728	166	0.9585
19	1.0164	56	1.0016	93	0.9869	130	0.9725	167	0.9582
20	1.0160	57	1.0012	94	0.9865	131	0.9721	168	0.9578
21	1.0156	58	1.0008	95	0.9861	132	0.9717	169	0.9574
22	1.0152	59	1.0004	96	0.9857	133	0.9713	170	0.9570
23	1.0148	60	1.0000	97	0.9854	134	0.9709	171	0.9566
24	1.0144	61	0.9996	98	0.9850	135	0.9705	172	0.9562
25	1.0140	62	0.9992	99	0.9846	136	0.9701	173	0.9559
26	1.0136	63	0.9988	100	0.9842	137	0.9697	174	0.9555
27	1.0132	64	0.9984	101	0.9838	138	0.9693	175	0.9551
28	1.0128	65	0.9980	102	0.9834	139	0.9690	176	0.9547
29	1.0124	66	0.9976	103	0.9830	140	0.9686	177	0.9543
30	1.0120	67	0.9972	104	0.9826	141	0.9682	178	0.9539
31	1.0116	68	0.9968	105	0.9822	142	0.9678	179	0.9536
32	1.0112	69	0.9964	106	0.9818	143	0.9674	180	0.9532
33	1.0108	70	0.9960	107	0.9814	144	0.9670	181	0.9528
34	1.0104	71	0.9956	108	0.9810	145	0.9666	182	0.9524
35	1.0100	72	0.9952	109	0.9806	146	0.9662	183	0.9520
36	1.0096	73	0.9948	110	0.9803	147	0.9659	184	0.9517

TABLE II (Continued)

GROUP 1—SPECIFIC GRAVITY AT 60°F OF 0.850 TO 0.966
LEGEND: t = observed temperature in degrees Fahrenheit
M = multiplier for correcting oil volumes to the basis of 60°F

t	M	t	M	t	M	t	M	t	M
185	0.9513	248	0.9275	311	0.9043	374	0.8816	437	0.8595
186	0.9509	249	0.9272	312	0.9039	375	0.8813	438	0.8592
187	0.9505	250	0.9268	313	0.9036	376	0.8809	439	0.8588
188	0.9501	251	0.9264	314	0.9032	377	0.8806	440	0.8585
189	0.9498	252	0.9260	315	0.9029	378	0.8802	441	0.8581
190	0.9494	253	0.9257	316	0.9025	379	0.8799	442	0.8578
191	0.9490	254	0.9253	317	0.9021	380	0.8795	443	0.8574
192	0.9486	255	0.9249	318	0.9018	381	0.8792	444	0.8571
193	0.9482	256	0.9245	319	0.9014	382	0.8788	445	0.8567
194	0.9478	257	0.9242	320	0.9010	383	0.8784	446	0.8564
195	0.9475	258	0.9238	321	0.9007	384	0.8781	447	0.8560
196	0.9471	259	0.9234	322	0.9003	385	0.8777	448	0.8557
197	0.9467	260	0.9231	323	0.9000	386	0.8774	449	0.8554
198	0.9463	261	0.9227	324	0.8996	387	0.8770	450	0.8550
199	0.9460	262	0.9223	325	0.8992	388	0.8767	451	0.8547
200	0.9456	263	0.9219	326	0.8989	389	0.8763	452	0.8543
201	0.9452	264	0.9216	327	0.8985	390	0.8760	453	0.8540
202	0.9448	265	0.9212	328	0.8981	391	0.8756	454	0.8536
203	0.9444	266	0.9208	329	0.8978	392	0.8753	455	0.8533
204	0.9441	267	0.9205	330	0.8974	393	0.8749	456	0.8529
205	0.9437	268	0.9201	331	0.8971	394	0.8746	457	0.8526
206	0.9433	269	0.9197	332	0.8967	395	0.8742	458	0.8522
207	0.9429	270	0.9194	333	0.8963	396	0.8738	459	0.8519
208	0.9425	271	0.9190	334	0.8960	397	0.8735	460	0.8516
209	0.9422	272	0.9186	335	0.8956	398	0.8731	461	0.8512
210	0.9418	273	0.9182	336	0.8952	399	0.8728	462	0.8509
211	0.9414	274	0.9179	337	0.8949	400	0.8724	463	0.8505
212	0.9410	275	0.9175	338	0.8945	401	0.8721	464	0.8502
213	0.9407	276	0.9171	339	0.8942	402	0.8717	465	0.8498
214	0.9403	277	0.9168	340	0.8938	403	0.8714	466	0.8495
215	0.9399	278	0.9164	341	0.8934	404	0.8710	467	0.8492
216	0.9395	279	0.9160	342	0.8931	405	0.8707	468	0.8488
217	0.9391	280	0.9157	343	0.8927	406	0.8703	469	0.8485
218	0.9388	281	0.9153	344	0.8924	407	0.8700	470	0.8481
219	0.9384	282	0.9149	345	0.8920	408	0.8696	471	0.8478
220	0.9380	283	0.9146	346	0.8916	409	0.8693	472	0.8474
221	0.9376	284	0.9142	347	0.8913	410	0.8689	473	0.8471
222	0.9373	285	0.9138	348	0.8909	411	0.8686	474	0.8468
223	0.9369	286	0.9135	349	0.8906	412	0.8682	475	0.8464
224	0.9365	287	0.9131	350	0.8902	413	0.8679	476	0.8461
225	0.9361	288	0.9127	351	0.8899	414	0.8675	477	0.8457
226	0.9358	289	0.9124	352	0.8895	415	0.8672	478	0.8454
227	0.9354	290	0.9120	353	0.8891	416	0.8668	479	0.8451
228	0.9350	291	0.9116	354	0.8888	417	0.8665	480	0.8447
229	0.9346	292	0.9113	355	0.8884	418	0.8661	481	0.8444
230	0.9343	293	0.9109	356	0.8881	419	0.8658	482	0.8440
231	0.9339	294	0.9105	357	0.8877	420	0.8654	483	0.8437
232	0.9335	295	0.9102	358	0.8873	421	0.8651	484	0.8433
233	0.9331	296	0.9098	359	0.8870	422	0.8647	485	0.8430
234	0.9328	297	0.9094	360	0.8866	423	0.8644	486	0.8427
235	0.9324	298	0.9091	361	0.8863	424	0.8640	487	0.8423
236	0.9320	299	0.9087	362	0.8859	425	0.8637	488	0.8420
237	0.9316	300	0.9083	363	0.8856	426	0.8633	489	0.8416
238	0.9313	301	0.9080	364	0.8852	427	0.8630	490	0.8413
239	0.9309	302	0.9076	365	0.8848	428	0.8626	491	0.8410
240	0.9305	303	0.9072	366	0.8845	429	0.8623	492	0.8406
241	0.9301	304	0.9069	367	0.8841	430	0.8619	493	0.8403
242	0.9298	305	0.9065	368	0.8838	431	0.8616	494	0.8399
243	0.9294	306	0.9061	369	0.8834	432	0.8612	495	0.8396
244	0.9290	307	0.9058	370	0.8831	433	0.8609	496	0.8393
245	0.9286	308	0.9054	371	0.8827	434	0.8605	497	0.8389
246	0.9283	309	0.9050	372	0.8823	435	0.8602	498	0.8386
247	0.9279	310	0.9047	373	0.8820	436	0.8599	499	0.8383

504.09 BASIS OF PAYMENT. The accepted quantities

of prime coat will be paid for at the contract price per gallon complete in place.

Payment will be made under:

Item No.	Pay Item	Pay Unit
504(1)	Bituminous Prime Coat	Gallon

Section 505

Bituminous Surface Treatment

505.01 DESCRIPTION. This item shall consist of a wearing surface of mineral aggregate and bituminous materials constructed on a prepared base course or on an existing pavement, as the case may be, in accordance with these specifications and in reasonably close conformity with the lines, grades and typical cross sections shown on the plans or established by the engineer.

Bituminous surface treatment shall consist of the number of applications of each of the specified sizes of mineral aggregate and the specified bituminous material, all as indicated on the plans or in the special provisions.

Bituminous surface treatment shall be either Type I or Type II.

505.02 BITUMINOUS MATERIAL. The bituminous material shall meet the applicable requirements of Section 902 and shall be as specified below for the following types:

Type 1	Asphalt Cement
Type 2	Cationic Emulsified Asphalt

505.03 AGGREGATES. Aggregates shall be uncrushed gravel; crushed aggregate composed of crushed gravel, crushed stone, crushed slag or expanded aggregate. Aggregates shall meet the requirements of Subsection 903.06 for sizes specified. The contractor shall use the same type aggregate in all applications.

CONSTRUCTION REQUIREMENTS

505.04 WEATHER LIMITATIONS. Bituminous materials shall not be applied during the calendar months of December, January and February, unless otherwise approved in writing by the Chief Engineer. When approved, the temperature requirements specified below shall apply.

During the remainder of the year, bituminous materials shall not be applied on a wet base, or when the temperature of the air is less than 60° F in the shade.

505.05 EQUIPMENT. All equipment for the proper construction of this work shall be in first-class working condition and shall have been approved before construction begins. The equipment shall be maintained in a satisfactory working condition.

The equipment outfit used by the contractor shall be made up of the following units:

1. Broom dragging equipment, capable of covering 1/3 to 1/2 the width of the treatment.

2. Power distributor shall be in accordance with Subsection 501.11 of these specifications.

3. Power rollers, weighing not less than 5, nor more than 10 tons.

4. Power revolving broom, or a power blower.

5. Self-propelled aggregate spreader of approved design supported by at least 4 wheels equipped with pneumatic tires on 2 axles. The aggregate spreader shall be equipped with a means of applying the larger cover coat material to the surface ahead of the smaller cover coat material and with positive controls so that the required amount of material will be deposited uniformly over the full width of the bituminous material. Other types of aggregate spreaders may be used provided they accomplish equivalent results and are approved.

All storage tanks, piping, retorts, booster tanks, distributors and other equipment used in delivering, storing or handling bituminous materials shall be kept clean and in good operating condition at all times and shall be operated in such manner as to avoid any possible contamination of the contents with foreign materials.

505.06 QUANTITIES OF MATERIAL. The quantities of materials per square yard, application temperatures and the sequence of application and spreading for

Type I and Type II bituminous surfacing, as specified, shall be as shown in Table I, unless otherwise directed.

TABLE I

QUANTITIES OF MATERIAL PER SQUARE YARD

	Gal. of Asphalt at 60°F		Cubic Yards of Aggregate		
	Asphalt Cement	Cationic Emulsified Asphalt	Size 1 Coarse	Size 2 Fine	Size 3 Seal
First Application	0.24	0.24			
Spreading			.0127		
Second Application	0.36	0.36			
Spreading				.0081	
Third Application	0.18	0.18			
Spreading					.0055
Totals	0.78	0.78	.0127	.0081	.0055

Temperature of Application	Minimum	Maximum
Asphalt Cement (AC-8)	275° F	350° F
Cationic Emulsified Asphalt	130° F	170° F

The quantities shown in Table I are approximate only. The actual quantities used shall be as directed; however, in no case shall the actual quantities used vary from the rates shown by more than the following percentages:

The total quantities of asphalt and aggregate actually used for Type I and Type II bituminous surfacing shall not vary from the quantities shown in Table I by more than plus or minus 10 per cent.

The quantities of bituminous material per square yard of treated surface as shown in Table I are based on a temperature of 60° F. All volumetric measurements shall be converted to this temperature in

accordance with Subsection 505.11, Table II and Table III.

505.07 APPLICATION OF BITUMINOUS MATERIALS. After the prime coat, when required, has been satisfactorily cured, bituminous material and aggregate shall be applied in the amounts and in the sequence herein specified.

Bituminous material for each application shall be applied uniformly for the full width of the treatment unless, due to the impracticability of detouring highway traffic, the engineer directs that the material be applied to ½ of the roadway at one time. If the contractor should be unable to keep the application of bituminous material consistently within 5 per cent of the quantity specified, he shall discontinue operations until he can provide an operator of greater experience or a better distributor, or both, or shall provide such precautions as may be necessary to keep the applications within the allowable variations.

If one or more nozzles should become blocked during the application of the bituminous materials, the distributor shall be stopped immediately and the nozzle, or nozzles, cleaned out. When the engineer directs that application be made over ½ width of the roadway at one time, all of the nozzles, except the one towards the outside of the roadway, shall have the same size opening; and care shall be taken to see that there is a slight longitudinal overlapping of the 2 applications along the center line of the road, so as to assure complete coverage. The distributor shall be operated along a marked edge in order to keep the surface treatment in a straight line.

In order to secure uniform distribution at the junction of 2 applications, the distributor shall be promptly stopped when the uniform flow decreases, indicating the tank is nearly empty. Building paper shall be placed over the end of the previous application and the joining application shall start on the building paper. The building paper so used shall be removed and disposed of in a satisfactory manner; however, burning of the building paper will not be permitted on areas that have been recently seeded or sodded,

or on any other grassy area within the limits of the right of way.

During the application of bituminous material, care shall be taken to prevent spattering adjacent pavements, structures and trees. The distributor shall not be cleaned or discharged into ditches, borrow pits, on the shoulders or along the right of way.

Any excess of bituminous material at the junction between distributor loads shall be removed and corrected in a satisfactory manner, and any parts of the surface to be treated which are not covered with bituminous materials directly from the distributor, shall be covered by means of a hand hose equipped with nozzles or by a hand pouring pot.

The contractor is hereby cautioned to exercise extreme care in heating bituminous material to temperatures above flash points for the various types of asphalt.

505.08 SPREADING COVER MATERIAL. The aggregate shall be spread by the use of power spreaders or trucks equipped to distribute the aggregate, provided such trucks or spreaders do not drive on the uncovered asphalt.

The aggregate shall be uniformly spread after the application of bituminous material. If necessary it shall be dragged to provide uniformity of surface.

505.09 ROLLING COVER MATERIAL. Immediately after spreading and brooming the cover material, the entire surface shall be rolled with a power roller. Rolling shall proceed in a longitudinal direction, beginning at the outer edges of the treatment and progressing toward the center, each trip overlapping the prior trip about ½ the width of the roller. The first rolling shall be completed within ½ hour after the cover material has been spread. During rolling, the previously spread cover material shall be uniformly broomed and placed where necessary in such quantity as to completely cover the bituminous surface. Rolling, brooming, and spotting of additional cover material shall be continued until uniform coverage has been obtained. The remaining courses shall be rolled the same as specified for the first course.

505.10 PROTECTION. Traffic should not be allowed to use the road, unless otherwise provided, until the final application has been placed and thoroughly rolled.

After the application of the cover coat material, the surface, where specified, shall be lightly broomed or otherwise maintained for a period of 4 days or as directed. Maintenance of the surface shall include the distribution of cover coat material over the surface to absorb any free bituminous material and cover any area deficient in cover coat material. The maintenance shall be conducted so as not to displace imbedded material. Excess material shall be swept from the entire surface by means of rotary brooms. The surface shall be swept at the time determined by the engineer.

505.11 METHOD OF MEASUREMENT. The quantities of aggregate and bituminous material incorporated in the completed and accepted bituminous surface treatment will be measured separately. Aggregate will be measured by the cubic yard and bituminous material will be measured by the gallon.

The number of cubic yards of aggregate placed and accepted, shall be determined by measurement in vehicles at the point of placing on the road.

The number of gallons of bituminous material placed and accepted, will be measured by the gallon of 231 cubic inches and shall be measured in the distributor. Measurement shall be made at a temperature of 60° F, or converted to gallonage at 60° F, in accordance with the following tables (Tables II and III).

TABLE II

TEMPERATURE—VOLUME CORRECTIONS FOR ASPHALTIC MATERIALS

GROUP O—SPECIFIC GRAVITY AT 60°F ABOVE 0.966

LEGEND: t = observed temperature in degrees Fahrenheit
M = multiplier for correcting oil volumes to the basis of 60°F

t	M	t	M	t	M	t	M	t	M
0	1.0211	60	1.0000	120	0.9792	180	0.9587	240	0.9385
1	1.0208	61	0.9997	121	0.9788	181	0.9584	241	0.9382
2	1.0204	62	0.9993	122	0.9785	182	0.9580	242	0.9379
3	1.0201	63	0.9990	123	0.9782	183	0.9577	243	0.9375
4	1.0197	64	0.9986	124	0.9778	184	0.9574	244	0.9372
5	1.0194	65	0.9983	125	0.9775	185	0.9570	245	0.9369
6	1.0190	66	0.9979	126	0.9771	186	0.9567	246	0.9365
7	1.0186	67	0.9976	127	0.9768	187	0.9563	247	0.9362
8	1.0183	68	0.9972	128	0.9764	188	0.9560	248	0.9359
9	1.0179	69	0.9969	129	0.9761	189	0.9557	249	0.9356
10	1.0176	70	0.9965	130	0.9758	190	0.9553	250	0.9352
11	1.0172	71	0.9962	131	0.9754	191	0.9550	251	0.9349
12	1.0169	72	0.9958	132	0.9751	192	0.9547	252	0.9346
13	1.0165	73	0.9955	133	0.9747	193	0.9543	253	0.9342
14	1.0162	74	0.9951	134	0.9744	194	0.9540	254	0.9339
15	1.0158	75	0.9948	135	0.9740	195	0.9536	255	0.9336
16	1.0155	76	0.9944	136	0.9737	196	0.9533	256	0.9332
17	1.0151	77	0.9941	137	0.9734	197	0.9530	257	0.9329
18	1.0148	78	0.9937	138	0.9730	198	0.9526	258	0.9326
19	1.0144	79	0.9934	139	0.9727	199	0.9523	259	0.9322
20	1.0141	80	0.9930	140	0.9723	200	0.9520	260	0.9319
21	1.0137	81	0.9927	141	0.9720	201	0.9516	261	0.9316
22	1.0133	82	0.9923	142	0.9716	202	0.9513	262	0.9312
23	1.0130	83	0.9920	143	0.9713	203	0.9509	263	0.9309
24	1.0126	84	0.9916	144	0.9710	204	0.9506	264	0.9306
25	1.0123	85	0.9913	145	0.9706	205	0.9503	265	0.9302
26	1.0119	86	0.9909	146	0.9703	206	0.9499	266	0.9299
27	1.0116	87	0.9906	147	0.9699	207	0.9496	267	0.9296
28	1.0112	88	0.9902	148	0.9696	208	0.9493	268	0.9293
29	1.0109	89	0.9899	149	0.9693	209	0.9489	269	0.9289
30	1.0105	90	0.9896	150	0.9689	210	0.9486	270	0.9286
31	1.0102	91	0.9892	151	0.9686	211	0.9483	271	0.9283
32	1.0098	92	0.9889	152	0.9682	212	0.9479	272	0.9279
33	1.0095	93	0.9885	153	0.9679	213	0.9476	273	0.9276
34	1.0091	94	0.9882	154	0.9675	214	0.9472	274	0.9273
35	1.0088	95	0.9878	155	0.9672	215	0.9469	275	0.9269
36	1.0084	96	0.9875	156	0.9669	216	0.9466	276	0.9266
37	1.0081	97	0.9871	157	0.9665	217	0.9462	277	0.9263
38	1.0077	98	0.9868	158	0.9662	218	0.9459	278	0.9259
39	1.0074	99	0.9864	159	0.9658	219	0.9456	279	0.9256
40	1.0070	100	0.9861	160	0.9655	220	0.9452	280	0.9253
41	1.0067	101	0.9857	161	0.9652	221	0.9449	281	0.9250
42	1.0063	102	0.9854	162	0.9648	222	0.9446	282	0.9246
43	1.0060	103	0.9851	163	0.9645	223	0.9442	283	0.9243
44	1.0056	104	0.9847	164	0.9641	224	0.9439	284	0.9240
45	1.0053	105	0.9844	165	0.9638	225	0.9436	285	0.9236
46	1.0049	106	0.9840	166	0.9635	226	0.9432	286	0.9233
47	1.0046	107	0.9837	167	0.9631	227	0.9429	287	0.9230
48	1.0042	108	0.9833	168	0.9628	228	0.9426	288	0.9227
49	1.0038	109	0.9830	169	0.9624	229	0.9422	289	0.9223
50	1.0035	110	0.9826	170	0.9621	230	0.9419	290	0.9220
51	1.0031	111	0.9823	171	0.9618	231	0.9416	291	0.9217
52	1.0028	112	0.9819	172	0.9614	232	0.9412	292	0.9213
53	1.0024	113	0.9816	173	0.9611	233	0.9409	293	0.9210
54	1.0021	114	0.9813	174	0.9607	234	0.9405	294	0.9207
55	1.0017	115	0.9809	175	0.9604	235	0.9402	295	0.9204
56	1.0014	116	0.9806	176	0.9601	236	0.9399	296	0.9200
57	1.0010	117	0.9802	177	0.9597	237	0.9395	297	0.9197
58	1.0007	118	0.9799	178	0.9594	238	0.9392	298	0.9194
59	1.0003	119	0.9795	179	0.9590	239	0.9389	299	0.9190

TABLE II (Continued)

TEMPERATURE—VOLUME CORRECTIONS FOR ASPHALTIC MATERIALS

GROUP 0—SPECIFIC GRAVITY AT 60°F ABOVE 0.966

LEGEND: t = observed temperature in degrees Fahrenheit
M = multiplier for correcting oil volumes to the basis of 60°F

t	M	t	M	t	M	t	M	t	M
300	0.9187	**340**	0.9057	**380**	0.8928	**420**	0.8800	**460**	0.8674
301	0.9184	**341**	0.9053	**381**	0.8924	**421**	0.8797	**461**	0.8671
302	0.9181	**342**	0.9050	**382**	0.8921	**422**	0.8794	**462**	0.8668
303	0.9177	**343**	0.9047	**383**	0.8918	**423**	0.8791	**463**	0.8665
304	0.9174	**344**	0.9044	**384**	0.8915	**424**	0.8787	**464**	0.8661
305	0.9171	**345**	0.9040	**385**	0.8912	**425**	0.8784	**465**	0.8658
306	0.9167	**346**	0.9037	**386**	0.8908	**426**	0.8781	**466**	0.8655
307	0.9164	**347**	0.9034	**387**	0.8905	**427**	0.8778	**467**	0.8652
308	0.9161	**348**	0.9031	**388**	0.8902	**428**	0.8775	**468**	0.8649
309	0.9158	**349**	0.9028	**389**	0.8899	**429**	0.8772	**469**	0.8646
310	0.9154	**350**	0.9024	**390**	0.8896	**430**	0.8768	**470**	0.8643
311	0.9151	**351**	0.9021	**391**	0.8892	**431**	0.8765	**471**	0.8640
312	0.9148	**352**	0.9018	**392**	0.8889	**432**	0.8762	**472**	0.8636
313	0.9145	**353**	0.9015	**393**	0.8886	**433**	0.8759	**473**	0.8633
314	0.9141	**354**	0.9011	**394**	0.8883	**434**	0.8756	**474**	0.8630
315	0.9138	**355**	0.9008	**395**	0.8880	**435**	0.8753	**475**	0.8627
316	0.9135	**356**	0.9005	**396**	0.8876	**436**	0.8749	**476**	0.8624
317	0.9132	**357**	0.9002	**397**	0.8873	**437**	0.8746	**477**	0.8621
318	0.9128	**358**	0.8998	**398**	0.8870	**438**	0.8743	**478**	0.8618
319	0.9125	**359**	0.8995	**399**	0.8867	**439**	0.8740	**479**	0.8615
320	0.9122	**360**	0.8992	**400**	0.8864	**440**	0.8737	**480**	0.8611
321	0.9118	**361**	0.8989	**401**	0.8861	**441**	0.8734	**481**	0.8608
322	0.9115	**362**	0.8986	**402**	0.8857	**442**	0.8731	**482**	0.8605
323	0.9112	**363**	0.8982	**403**	0.8854	**443**	0.8727	**483**	0.8602
324	0.9109	**364**	0.8979	**404**	0.8851	**444**	0.8724	**484**	0.8599
325	0.9105	**365**	0.8976	**405**	0.8848	**445**	0.8721	**485**	0.8596
326	0.9102	**366**	0.8973	**406**	0.8845	**446**	0.8718	**486**	0.8593
327	0.9099	**367**	0.8969	**407**	0.8841	**447**	0.8715	**487**	0.8590
328	0.9096	**368**	0.8966	**408**	0.8838	**448**	0.8712	**488**	0.8587
329	0.9092	**369**	0.8963	**409**	0.8835	**449**	0.8709	**489**	0.8583
330	0.9089	**370**	0.8960	**410**	0.8832	**450**	0.8705	**490**	0.8580
331	0.9086	**371**	0.8957	**411**	0.8829	**451**	0.8702	**491**	0.8577
332	0.9083	**372**	0.8953	**412**	0.8826	**452**	0.8699	**492**	0.8574
333	0.9079	**373**	0.8950	**413**	0.8822	**453**	0.8696	**493**	0.8571
334	0.9076	**374**	0.8947	**414**	0.8819	**454**	0.8693	**494**	0.8568
335	0.9073	**375**	0.8944	**415**	0.8816	**455**	0.8690	**495**	0.8565
336	0.9070	**376**	0.8941	**416**	0.8813	**456**	0.8687	**496**	0.8562
337	0.9066	**377**	0.8937	**417**	0.8810	**457**	0.8683	**497**	0.8559
338	0.9063	**378**	0.8934	**418**	0.8806	**458**	0.8680	**498**	0.8556
339	0.9060	**379**	0.8931	**419**	0.8803	**459**	0.8677	**499**	0.8552

TABLE III

TEMPERATURE—VOLUME CORRECTIONS FOR EMULSIFIED ASPHALTS

LEGEND: t = observed temperature in degrees Fahrenheit
M = multiplier for correcting volumes to the basis of 60°F

t	M	t	M	t	M
60	1.00000	90	.99250	121	.98475
61	.99975	91	.99225	122	.98450
62	.99950	92	.99200	123	.98425
63	.99925	93	.99175	124	.98400
64	.99900	94	.99150	125	.98375
65	.99875	95	.99125	126	.98350
66	.99850	96	.99100	127	.98325
67	.99825	97	.99075	128	.98300
68	.99800	98	.99050	129	.98275
69	.99775	99	.99025	130	.98250
70	.99750	100	.99000	131	.98225
71	.99725	101	.98975	132	.98200
72	.99700	102	.98950	133	.98175
73	.99675	103	.98925	134	.98150
74	.99650	104	.98900	135	.98125
75	.99625	105	.98875	136	.98100
76	.99600	106	.98850	137	.98075
77	.99575	107	.98825	138	.98050
78	.99550	108	.98800	139	.98025
79	.99525	109	.98775	140	.98000
80	.99500	110	.98750	141	.97975
81	.99475	111	.98725	142	.97950
82	.99450	112	.98700	143	.97925
83	.99425	113	.98675	144	.97900
84	.99400	114	.98650	145	.97875
85	.99375	115	.98625	146	.97850
86	.99350	116	.98600	147	.97825
87	.99325	117	.98575	148	.97800
88	.99300	118	.98550	149	.97775
89	.99275	119	.98525	150	.97750
		120	.98500		

505.12 BASIS OF PAYMENT. The number of cubic yards of aggregate and the number of gallons of bituminous material, measured as provided above, shall be paid for at the contract unit prices for the several items complete in place and accepted.

Payment will be made under:

Item No.	Pay Item	Pay Unit
505(1)	Asphalt Cement	Gallon
505(2)	Cationic Emulsified Asphalt	Gallon
505(3)	Coarse Aggregate (Size 1)	Cubic Yard
505(4)	Fine Aggregate (Size 2)	Cubic Yard
505(5)	Seal Coat Aggregate (Size 3)	Cubic Yard

PART VI
RIGID PAVEMENT

Section 601
Portland Cement Concrete Pavement

601.01 DESCRIPTION. This work shall consist of constructing a pavement composed of Portland cement concrete, with or without reinforcement as specified, on a prepared subgrade or base course in accordance with these specifications and in reasonably close conformity with the lines, grades, thicknesses, and typical cross sections shown on the plans or established by the engineer.

601.02 MATERIALS. Materials shall meet the requirements of the following subsections of Part IX—Materials.

Fine Aggregate	903.02
Coarse Aggregate	903.03
Portland Cement	901.01
Water	915.01
Air Entraining Admixtures	911.03
Water Reducing Admixtures	911.03
Calcium Chloride	915.02
Poured Fillers	905.01
Curing Materials	911.01
Subgrade Paper	911.02
Mesh Reinforcement	909.01
Load Transmission Devices	909.03
Preformed Fillers	905.02
Wood Fillers	905.03

The Portland cement shall be either Type I or Type II unless otherwise specified.

CONSTRUCTION REQUIREMENTS

601.03 PROPORTIONING AND CONSISTENCY. The contractor will be permitted to furnish any of the following types of concrete pavement, however, the

same type pavement shall be used throughout the project, unless otherwise authorized by the engineer in writing.

Type B Concrete Pavement shall be composed of approximately one part of Portland cement and 5 parts of total fine and Grade B coarse aggregate by dry rodded volume, measured separately. The mix will be approximately one part cement, 2 parts fine aggregate and 3 parts of coarse aggregate, by volume.

Type C Concrete Pavement shall be composed of approximately one part of Portland cement and 5.3 parts of total fine and Grade B crushed slag coarse aggregate by dry rodded volume, measured separately. The mix will be approximately one part cement, 2.15 parts fine aggregate and 3.15 parts of crushed slag coarse aggregate, by volume.

Type D Concrete Pavement shall be composed of approximately one part of Portland cement and 5.5 parts of total fine and grade D coarse aggregate by dry rodded volume, measured separately. The mix will be approximately one part cement, 2 parts fine aggregate and 3.5 parts of coarse aggregate, by volume.

Type E Concrete Pavement shall be composed of approximately one part Portland cement and 6.2 parts of total fine and small size and large size grade E coarse aggregate by dry rodded volume, measured separately. The mix will be approximately one part cement, 2 parts fine aggregate and 4.2 parts of coarse aggregate, by volume.

The contractor's attention is directed to the fact that in Type E pavement, the 2 coarse aggregates will reduce in volume approximately 8 per cent when mixed.

Should the contractor desire to use high early strength cement in any part of the work, other than as specifically provided, the engineer may authorize such use. The additional cost involved, if any, shall be assumed by the contractor.

When specified, or approved by the engineer at the request of the contractor, the mixture will contain air

entraining admixture and/or water reducing (normal set or set retarding) admixture meeting the specifications. Air entraining admixtures shall produce 5±2 per cent aid entrainment. Water reducing admixtures shall produce 10 per cent minimum water reduction and the degree of retardation required for the type admixture used. When used at the request of the contractor, the additional cost, if any, shall be assumed by the contractor. Air entrainment will be required when slip form paving is used or when a central mixing plant is used.

After the job materials provided by the contractor have been accepted for use on the project, the engineer will set the job mix in accordance with the above requirements as to total weight of aggregate, designating such relative amounts of fine to coarse aggregate, and such water cement ratio as will produce concrete of the consistency desired within the range of slump as hereinafter limited. During the progress of the work, the ratio of the amount of fine aggregate to the amount of coarse aggregate shall be altered as required by the engineer but the volume of total dry aggregate per bag of cement shall not be altered unless tests made under the authority of the engineer indicate that the specific gravity of either or both of the aggregates has changed. There will be no adjustment of cost of cement. Substitute mixes will not be accepted.

The unit weight of aggregates in a dry and rodded condition shall be determined by the laboratory in accordance with AASHO Designation: T 19 as shown in the LDH Testing Procedures Manual. The unit weight of aggregate, of a given specific gravity, is controlled by the voids and may affect the yield of concrete materially and the contractor's attention is directed to the type and grading requirements of the coarse aggregate hereinbefore specified for the several types of mixes.

The batch weights of aggregates, as given the contractor, will be corrected weights, adjusted by the engineer to compensate for moisture content, and shall be used by the contractor as job condition weights. The amount of water will be adjusted by

the engineer to compensate for moisture content of the aggregates. The contractor shall at once alter his batch whenever directed to conform to an adjusted or altered job mix.

The minimum cement content in barrels per cubic yard of concrete for the various types of mixes shall not be less than indicated in the following table. The maximum water content, including free water in the aggregate, in gallons per bag of cement shall not be greater than the following:

Type of Pavement	Maximum Gallons per Bag	Minimum Barrels per Cu. Yd.
B	6.00	1.45
C	6.00	1.50
D	6.00	1.35
E	6.50	1.25

The cement content indicated above is in each case the minimum permitted, but is not guaranteed by the Department. The cement content obtained for any type mix is dependent upon the gradation of the aggregates and the cement content indicated above is based upon the most ideal combination and gradation of both fine and coarse aggregate for the respective type of pavement shown.

The consistency of the concrete shall be such that the slump of the concrete will be between 1½ and 3 inches, if not vibrated or if hand finishing is required or approved, or between ½ and 2 inches, if vibrated, when determined in accordance with LDH Designation: TR 207. Unless otherwise specified vibratory methods shall be employed for the full width of the pavement.

601.04 EQUIPMENT. Equipment and tools necessary for handling materials and performing all parts of the work must meet with the approval of the engineer as to design, capacity, and mechanical condition. The equipment must be at the job site sufficiently ahead of the start of construction operations to be examined thoroughly for approval.

(a) Batching plant and equipment.

1. General. The batching plant shall include bins,

weighing hoppers, and scales for the fine aggregate and for each size, if more than one, of coarse aggregate. If cement is used in bulk, a bin, hopper and separate scale for cement shall be included. The weighing hopper shall be properly sealed and vented to eliminate as much dusting as possible.

2. Bins and hoppers. Bins with adequate separate compartments for fine aggregate and for each size, if more than one, of coarse aggregate shall be provided in the batching plant.

3. Scales. The scales for weighing aggregates and cement shall be of either the beam type or the springless dial type. They shall be accurate within 0.5 per cent throughout the range of use. When beam type scales are used with manual batching, provision, such as a "tell-tale" dial, shall be made for indicating to the operator that the required load in the weighing hopper is being approached. A device on weighing beams shall indicate critical position clearly. Poises shall be designed to be locked in any position to prevent unauthorized change. The weigh beam and "tell-tale" device shall be in full view of the operator while charging the hopper, and he shall have convenient access to all controls.

The scales will be checked when deemed necessary during intervals when the plant is not in operation, unless there is evidence that the scales are not operating properly, in which case the engineer may order discontinuance of operations so the scales may be checked for accuracy. The Department shall have on hand not less than ten, 50-pound weights for testing of the scales.

(b) Mixers.

1. General. Concrete may be mixed at the site of construction or at a central point or wholly or in part in truck mixers. Each mixer shall have attached, in a prominent place, a manufacturer's plate showing the capacity of the drum in terms of volume of mixed concrete and the speed of rotation of the mixing drum or blades.

2. Mixers at site of construction. Mixing shall be in an approved mixer capable of combining the aggregates, cement, admixtures (when used), and water into a thoroughly mixed and uniform mass within the specified mixing period, and of discharging and distributing the mixture without segregation on the prepared grade. The mixer shall be equipped with an approved timing device which will automatically lock the discharge lever when the drum has been charged and release it at the end of the mixing period. The device shall be equipped with a bell, light, or other suitable warning device adjusted to give a clearly audible or visual signal each time the lock is released. In case of failure of the timing device, the mixer may be used for the balance of the day while it is being repaired, providing that each batch is mixed 90 seconds.

The mixers shall be cleaned at suitable intervals. The pick-up and throw over blades or mixing paddles in the mixing drum or mixing unit shall be replaced when worn beyond wear recommended by the manufacturer or when wear prevents satisfactory mixing. The contractor shall (1) have available at the job site a copy of the manufacturer's design, showing dimensions and arrangements of blades in reference to original height and depth, or (2) provide permanent marks on blades to show points of ¾ inch wear from new conditions. Small holes of ¼ inch diameter near each end and at mid point of each blade are recommended.

3. Truck mixers and truck agitators. Truck mixers and agitators shall conform to the requirements of Subsection 805.09 (b) and (c).

4. Nonagitator trucks. Bodies of nonagitating hauling equipment for concrete shall be smooth, mortartight, metal containers and shall be capable of discharging the concrete at a satisfactory controlled rate without segregation. If discharge of concrete is accomplished by tilting the body, the surface of the load shall be retarded by a suitable baffle if necessary to prevent segregation. Covers shall be provided when needed for protection.

(c) Finishing equipment.

1. Finishing machine. The finishing machine shall be equipped with at least 2 oscillating type transverse screeds, or other type finishing machines, if approved, may be furnished.

2. Vibrators. Vibrators, for full width vibration of concrete paving slabs, may be either the surface pan type or the internal type with either immersed tube or multiple spuds. They may be attached to the spreader, the finishing machine or may be mounted on a separate carriage. They shall not come in contact with joints, load transfer devices, subgrade, or side forms. The frequency of the surface vibrators shall not be less than 3,500 impulses per minute and frequency of the internal type shall not be less than 5,000 impulses per minute for the tube vibrators and not less than 7,000 impulses per minute for spud vibrators.

When spud type internal vibrators, either hand operated or attached to spreaders or finishing machine, are used adjacent to forms, they shall have a frequency of not less than 3,500 impulses per minute.

(d) Concrete saw. When sawing joints is elected or specified, the contractor shall provide sawing equipment adequate in number of units and power to complete the sawing with a water-cooled diamond edge saw blade or an abrasive wheel to the required dimensions. The contractor shall provide at least one stand-by saw in good working order. An ample supply of saw blades shall be maintained at the site of the work at all times during sawing operations. The contractor shall provide adequate artificial lighting facilities for night sawing. All of this equipment shall be on the job both before and continuously during concrete placement.

(e) Forms. Straight side forms shall be made of metal having a thickness of not less than 7/32 inch and shall be furnished in sections not less than 10 feet in length. On long curves, straight forms of shorter lengths will be permitted. Forms shall have a depth not less than the prescribed edge thickness

of the pavement and a base width at least equal to the depth, except as otherwise approved by the engineer. Flexible or curved forms of proper radius shall be used on curves of 100 foot radius or less and shall be of a design acceptable to the engineer. Forms shall be provided with adequate devices for secure setting. Flange braces shall extend outward on the base not less than 2/3 the height of the forms. Forms with battered top surfaces, and bent, twisted or broken forms shall be removed from the work. Repaired forms shall not be used until inspected or approved. When approved by the engineer, built-up forms may be used, however, the build-up shall not exceed 2 inches. No limitation will be made on the use of built-up forms or the amount of build-up where the total area of pavement of any specified thickness on the project is less than 2,000 square yards. The top face of the form shall not vary from a true plane more than ⅛ inch in 10 feet, and the upstanding leg shall not vary more than ¼ inch from the vertical. The forms shall contain provisions for locking the ends of abutting form sections together tightly, and for secure setting.

601.05 PREPARATION OF GRADE. After the roadbed has been graded and compacted, the grade shall be trimmed approximately to correct elevation, extending the work at least 1.0 foot beyond each edge of the proposed concrete pavement and to a greater width as necessary when the slip form paving method is permitted.

Where the subgrade or base course for the concrete pavement is soil cement, stabilized aggregate or other semi-rigid construction, high places in the grade will be cut or planed down. The base course shall be swept, broomed or otherwise cleaned of all loose or surplus material.

601.06 SETTING FORMS.

(a) Base Support. The foundation under the forms shall be firm and true to grade so that the form, when set, will be firmly in contact for its whole length and at the specified grade. Imperfections

or variations in grade shall be corrected as necessary.

(b) Form Setting. Forms shall be set sufficiently in advance of the point where concrete is being placed. After the forms have been set to correct grade, the grade shall be thoroughly tamped, mechanically or by hand, at both the inside and outside edges of the base of the forms. Forms shall be staked into place with not less than 3 pins for each 10-foot section. A pin shall be placed at each side of every joint. Form sections shall be tightly locked, free from play or movement in any direction. Each form section shall not deviate from true line by more than ¼ inch at any point. No excessive settlement or springing of forms under the finishing machine will be tolerated. The face and top of the forms shall be cleaned and oiled prior to the placing of concrete. When setting forms on stabilized base, the contractor will be required to drill holes through the base by approved methods for the placing of pins to hold the forms. Driving of pins through the base will not be permitted. Drilled holes shall not be smaller than the size of the pins.

(c) Grade and Alignment. The alignment and grade elevations of the forms shall be checked and corrections made by the contractor prior to placing the concrete. When any form has been disturbed or any grade has become unstable, the form shall be reset and rechecked.

601.07 CONDITIONING OF SUBGRADE OR BASE COURSE. When side forms have been securely set to grade, the subgrade or base course shall be brought to proper cross section. High areas shall be trimmed to proper elevation. Low areas may be filled and compacted to a condition similar to that of surrounding grade, or filled with concrete integral with the pavement. The finished grade shall be maintained in a smooth and compacted condition until the pavement is placed. No concrete shall be placed until the subgrade or base course has been approved.

Unless waterproof subgrade or base course cover material is specified, the subgrade or base course

shall be uniformly moist when the concrete is placed. If it becomes too dry, the subgrade or base course shall be sprinkled, but the method of sprinkling shall not be such as to form mud or pools of water.

601.08 HANDLING, MEASURING AND BATCHING MATERIALS. The batch plant site, layout, equipment and provisions for transporting material shall be such as to assure a continuous supply of material to the work. Stockpiles shall be built up in layers of not more than 3 feet in thickness. Each layer shall be completely in place before beginning the next, which shall not be allowed to "cone" down over the next lower layer. Aggregates of different grades shall not be stockpiled together. Aggregates of the same grade, regardless of source, whose specific gravities vary by not more than 0.02, may be stockpiled together.

Aggregates shall be handled from stockpiles or other sources to the batching plant in such manner as to secure a uniform grading of the material. Aggregates that have become segregated, or mixed with earth or foreign material, shall not be used. All aggregates produced or handled by hydraulic methods, and washed aggregates, shall be stockpiled or binned for draining at least 12 hours before being batched. Rail shipments requiring more than 12 hours will be accepted as adequate binning only if the car bodies permit free drainage. In case the aggregates contain non-uniform moisture content, storage or stockpile periods in excess of 12 hours may be required by the engineer.

The fine aggregate and each size, if more than one, of coarse aggregate shall be separately weighed into hoppers in the respective amounts set by the engineer in the job mix. Cement shall be measured by the sack or by weight. Separate scales and hoppers shall be used for weighing the cement, with a device to indicate positively the complete discharge of the batch of cement into the batch box or container. Ninety-four pounds of bulk cement shall be considered one sack. Batches involving fractional sacks shall not be allowed, except when bulk cement is used. Batching shall be so conducted as to result in the weights of each material required within a tolerance of one per cent for cement and 2 per cent for aggregates.

When required by the contract, or when permitted, batching plants shall be equipped to proportion aggregates and bulk cement by weight by means of automatic and interlocked proportioning devices of approved type.

When mixing is at the site of the work, materials shall be transported from the batching plant to the mixer in batch boxes, vehicle bodies or other containers of adequate capacity and construction to properly carry the volume required. Partitions separating batches shall be adequate and effective to prevent spilling from one compartment to another while in transit or being dumped. When bulk cement is used, the contractor shall use a suitable method of handling the cement from weighing hopper to transporting container or into the batch itself for transportation to the mixer, with chute, boot, or other approved device, to minimize loss of cement and arranged to provide positive assurance of the actual presence in each batch of the cement content specified.

Bulk cement shall be transported to the mixer in tight compartments carrying the full amount of cement required for the batch or between the fine and coarse aggregate. When cement is placed in contact with the aggregates, batches may be rejected unless mixed within 1½ hours of such contact. Cement in original shipping packages may be transported on top of the aggregates, each batch containing the number of sacks required by the job mix.

Batches shall be delivered to the mixer separate and intact. Each batch shall be dumped into the mixer with minimum loss of cement, and when more than one batch is carried on the truck, without excessive spilling of material from one batch compartment into another.

Water may be measured either by volume or by weight. The accuracy of measuring the water shall be within a range of error of not over one per cent. Unless the water is to be weighed, the water-measuring equipment shall include an auxiliary tank from which the measuring tank shall be filled. The measuring tank shall be equipped with an outside tap and valve to

provide for checking the setting, unless other means are provided for readily and accurately determining the amount of water in the tank. The volume of the auxiliary tank shall be at least equal to that of the measuring tank.

Methods and equipment for adding air-entraining agent or other admixtures into the batch, when required, shall be approved by the engineer. All admixtures shall be measured into the mixer with an accuracy of ± 3 per cent.

601.09 MIXING CONCRETE. The concrete may be mixed at the site of the work, in a central-mix plant, or in truck mixers. The mixer shall be of an approved type and capacity. Mixing time shall be measured from the time all materials, except water, are in the drum. Ready-mixed concrete shall be mixed and delivered in accordance with requirements of Subsection 805.09 of these specifications.

When mixed at the site of the work or in a central mixing plant, the mixing time shall not be less than 50 seconds nor more than 90 seconds. Four seconds shall be added to the specified mixing time if timing starts the instant the skip reaches its maximum raised position. Mixing time ends when the discharge chute opens. Transfer time in multiple drum mixers is included in mixing time. The contents of an individual mixer drum shall be removed before a succeeding batch is emptied therein.

The mixer shall be operated at a drum speed as shown on the manufacturer's name plate on the approved mixer. Any concrete mixed less than the specified time shall be rejected and disposed of by the contractor at his expense. The volume of concrete mixed per batch shall not exceed the mixer's nominal capacity in cubic feet, as shown on the manufacturer's standard rating plate on the mixer; except that an overload up to 10 per cent above the mixer's nominal capacity may be permitted provided concrete test data for strength, segregation, and uniform consistency are satisfactory, and provided no spillage of concrete takes place.

The batch shall be so charged into the drum that a

portion of the mixing water shall enter in advance of the cement and aggregates. The flow of water shall be uniform and all water shall be in the drum by the end of the first 15 seconds of the mixing period. The throat of the drum shall be kept free of such accumulations as may restrict the free flow of materials into the drum.

Mixed concrete from the central-mixing plant shall be transported in truck mixers, truck agitators or nonagitating trucks having approved bodies. The time elapsing from the time water is added to the mix until the concrete is deposited in place at the site of the work shall not exceed 30 minutes when the concrete is hauled in nonagitating trucks, nor 60 minutes when hauled in truck mixers or truck agitators.

Retempering concrete by adding water or by other means will not be permitted. When concrete is delivered in transit mixers or agitators additional water, accurately measured, may be added to the batch materials and additional mixing performed, as provided in Subsection 805.09(b), to increase the slump to meet the specified requirements, provided all these operations are performed within 45 minutes after the initial mixing operation. In no event shall the specified water-cement ratio be exceeded. Concrete that is not within the specified slump limits at time of placement shall not be used. Admixtures for increasing the workability or for accelerating the set will be permitted only when specifically provided for in the contract or authorized in writing by the engineer.

601.10 LIMITATIONS OF MIXING. No concrete shall be mixed, placed, or finished when the natural light is insufficient, unless an adequate and approved artificial lighting system is operated.

Unless authorized in writing by the engineer, mixing and concreting operations shall be discontinued when a descending air temperature in the shade and away from artificial heat reaches 40° F, and not resumed until an ascending air temperature in the shade and away from artificial heat reaches 35° F.

When concreting is authorized during cold weather, the aggregates may be heated by either steam or dry

heat prior to being placed in the mixer. The apparatus used shall heat the mass uniformly and shall be so arranged as to preclude the possible occurrence of overheated areas which might injure the materials. Unless otherwise authorized, the temperature of the mixed concrete during cold weather operations shall be not less than 50° F and not more than 90° F at the time of placing it in the forms.

If the air temperature is 35° F or less at the time of placing concrete, the engineer may require the water or the aggregates to be heated to not less than 70° F nor more than 150° F. No concrete shall be placed on a frozen subgrade nor shall frozen aggregates be used in the concrete.

When the use of calcium chloride is authorized to hasten initial set, it shall be in a solution. The solution shall be prepared by dissolving one 100-pound bag of Type 1 regular calcium chloride or one 80-pound bag of Type 2 concentrated calcium chloride in approximately 15 gallons of water and then adding sufficient water to make 25 gallons of solution. The solution shall not exceed ½ gallon for each sack of cement, and this solution shall be considered as a portion of the mixing water.

601.11 PLACING CONCRETE. The concrete shall be deposited on the grade in such manner as to require as little rehandling as possible. Unless truck mixers, truck agitators, or nonagitating hauling equipment are equipped with means for discharging and placing of concrete without segregation of the materials, the concrete shall be unloaded and mechanically spread with an approved spreading device in such manner as to prevent segregation of the materials. Placing shall be continuous between transverse joints without the use of intermediate bulkheads. Necessary hand spreading shall be done with shovels, not rakes. Workmen shall not be allowed to walk in the freshly mixed concrete with boots or shoes coated with earth or foreign substances.

Where concrete is to be placed adjoining a previously constructed lane of pavement and mechanical equipment will be operated upon the existing lane of

pavement, that lane shall have attained a minimum age of 10 days, or the concrete shall have attained a flexural strength of 600 psi as shown by a test of standard specimens cured under the same climatic and moisture conditions as the slab in accordance with AASHO Designation: T 97 of the Testing Procedures Manual. If only finishing equipment is carried on the existing lane, paving in adjoining lanes may be permitted after 3 days, exclusive of days when the temperature is below 40° F.

Concrete shall be thoroughly consolidated for its full width and against and along the faces of all forms and along the full length and on both sides of all joint assemblies, by means of vibrators inserted in the concrete or other acceptable methods. Vibrators shall not be permitted to come in contact with a joint assembly, the grade or a side form. In no case shall the vibrator be operated longer than 15 seconds in any one location.

Concrete shall be deposited as near to expansion and contraction joints as possible without disturbing them, but shall not be dumped from the discharge bucket or hopper onto a joint assembly unless hopper is well centered on the joint assembly.

601.12 TEST SPECIMENS. The contractor shall, at his expense, furnish the concrete necessary for casting test beams and cylinders. The test specimens shall be made and cured by the method specified in LDH Designation: S 302.

601.13 STRIKE-OFF OF CONCRETE AND PLACEMENT OF REINFORCEMENT. Following the placing of the concrete, it shall be struck off to conform to the cross section shown on the plans and to an elevation such that when the concrete is properly consolidated and finished, the surface of the pavement will be at the established elevation. When reinforced concrete pavement is placed in 2 layers, the entire width of the bottom layer shall be struck off to such length and depth that the sheet of fabric or bar mat may be laid full length on the concrete in its final position without further manipulation. The reinforcement shall then be placed directly upon the concrete, after which

the top layer of the concrete to bring the slab to grade shall be placed as quickly as possible, not to exceed 30 minutes, so that a truly monolithic slab will be attained. When, due to conditions beyond the control of the contractor, more than 30 minutes time has elapsed before the top layer of concrete is placed, but not in excess of one hour, the location by stations, the temperature and other weather conditions, and any other appertaining data will be recorded on the Concrete Inspectors Daily Report. At such locations, core borings will be taken at a later date to determine whether the slab in question is truly monolithic. Any portion of the bottom layer of concrete which has been placed more than one hour before placing the second layer shall be removed and replaced with freshly mixed concrete at the contractor's expense. When the top layer of concrete is placed after the initial 30 minute period and before the expiration of one hour and core borings indicate a true monolith has not been attained, then the engineer may order the concrete to be removed and replaced at the contractor's expense. When reinforced concrete is placed in one layer, the reinforcement may be positioned in advance of concrete placement or it may be placed in plastic concrete, after spreading, by mechanical or vibratory means.

Reinforcing steel shall be free from dirt, oil, paint, grease, mill scale, and loose or thick rust which could impair bond of the steel with the concrete. Thin powdery rust and tight rust is not considered detrimental and need not be removed.

601.14 JOINTS. Joints shall be constructed of the type and dimensions, and at the locations required by the plans or special provisions.

(a) Longitudinal joint. Deformed steel tie bars of the specified length, size, spacing and material shall be placed perpendicular to the longitudinal joints; they shall be placed by approved mechanical equipment or rigidly secured by chairs or other approved supports to prevent displacement. Tie bars shall not be painted or coated with asphalt or other material, or enclosed in tubes or sleeves. When adjacent lanes of pavement are constructed separately, steel side

forms shall be used which will form a keyway along the construction joint. Tie bars may be bent at right angles against the form of the first lane constructed and straightened into final position before the concrete of the adjacent lane is placed, or in lieu of bent tie bars, approved 2-piece connectors may be used.

(1) The groove for the longitudinal joint shall be formed by using a "T" iron, cutting wheel, or any other device that will insure a groove that is true in both vertical and horizontal alignment. All grooves shall be cut to the minimum depth shown on the plans and in such manner that the surface of the freshly placed concrete will not be depressed or otherwise disturbed. Retempering of concrete adjacent to joints will not be permitted.

Strips of approved wood or preformed filler material of the dimensions shown on the plans shall be inserted in the groove. Regardless of the type used, it shall be dusted with limestone dust, or other approved material, prior to installation in the concrete. After insertion, the top edge of the strip shall be flush with the surface or just slightly below. The joint shall then be aligned and the surface of the pavement floated and checked with a straightedge.

The removal of a portion of the strip from the joint shall be accomplished by cutting with a rotary power saw and abrasive blades. The cut shall be 3/8 inch wide and one inch deep. All inserted material must be removed from the sides of the one inch cut. Sawing operations may begin at any time after the concrete has become sufficiently hard to bear the weight of the sawing equipment without damaging the surface or disturbing the adjacent pavement.

(2) In lieu of sawed joints, a flexible joint forming device, of the type or types shown on the plans, may be used. Such joints shall be formed in accordance with plan details and the recommendation of the manufacturer. When the contractor desires to use a joint forming device not shown

on the plans, the device and the method of installation must be approved in writing by the engineer.

(3) The longitudinal joints in monolithic concrete pavement may be formed by placing a continuous strip of plastic or other material which will not react adversely with the chemical constituents of the concrete. The joint insert material shall be of such width and composition that when placed vertically in the concrete it will not bond with concrete and will form an effective weakened plane joint of the required depth as shown on the plans. The joint material shall be inserted with a mechanical device that places the material in a continuous strip, except where intervening structures break the continuity of paving. Splices in the joint material will be permitted providing they are effective in maintaining the continuity of the joint material as placed. The joint material shall be placed in such manner that the top of the strip is not more than 1/8 inch below the finish surface of the concrete. The joint material shall not be deformed from a vertical position, either in the installation or in subsequent finishing operations performed on the concrete. The alignment of the finished joint shall be uniformly parallel with the center line of the pavement and shall be free of any local irregularity which exceeds 3/8 inch, measured by a 10-foot straightedge, except for normal curvature of center line alignment. The mechanical installation device shall vibrate the concrete during placing the strip sufficiently to cause the concrete to flow evenly about the joint material producing homogeneous concrete free of segregation and rock pockets or voids.

(b) Transverse expansion joints. The expansion joint filler shall be continuous from form to form, shaped to the subgrade and to the keyway along the form. Preformed joint filler shall be furnished in lengths equal to the pavement width or equal to the width of one lane. Damaged or repaired joint filler shall not be used unless approved by the engineer.

The expansion joint filler shall be held in a vertical position. An approved installing bar, or other device, shall be used if required to secure preformed expansion joint filler at the proper grade and alignment during placing and finishing of the concrete. Finished joints shall not deviate more than ½ inch in the horizontal alignment from a straight line. If joint fillers are assembled in sections, there shall be no offsets between adjacent units. No plugs of concrete shall be permitted anywhere within the expansion space.

(c) Transverse contraction joints. Tranverse contraction joints shall consist of planes of weakness created in cross section of pavement and shall be formed in the same manner as provided for longitudinal joints hereinbefore under (a) (1) or (a) (2). The joints, when required by the plans, shall include load transfer devices.

(d) Tranverse construction joints. Transverse construction joints shall be constructed when there is an interruption of more than 30 minutes in the concreting operations. No transverse joint shall be constructed within 10 feet of an expansion joint, contraction joint, or plane of weakness. If sufficient concrete has not been mixed at the time of interruption to form a slab at least 10 feet long, the excess concrete back to the last preceding joint shall be removed and disposed of as directed.

(e) Load transfer devices. Load transfer devices may be either dowel assemblies or cantilever type assemblies as shown on the plans. Dowels when used may be held in positions parallel to the surface and centerline by a metal device that is left in the pavement. Each dowel, painted with one coat of paint as provided in Subsection 909.03 (a), shall be thoroughly coated with an approved lubricant to prevent the concrete from bonding to the dowel. An approved sleeve, meeting the requirements contained in Subsection 909.03 (a), shall be furnished with each dowel bar used in expansion joints. The sleeve shall fit the dowel bar tightly and the closed end shall be watertight.

In lieu of using dowel assemblies at contraction

joints, dowel bars may be placed by an approved mechanical device provided satisfactory positioning and alignment is attained.

Cantilever type assemblies, if selected by the contractor, will be in accordance with the type shown on the plans or any approved equal.

601.15 FINAL STRIKE-OFF, CONSOLIDATION AND FINISHING.

(a) Sequence. The sequence of operations shall be the strike-off and consolidation, floating and removal of laitance, straightedging, and final surface finish.

In general, the addition of superficial water to the surface of the concrete to assist in finishing operations will not be permitted. If the application of water to the surface is permitted, it shall be applied as a fog spray by means of approved spray equipment.

(b) Finishing at joints.

1. The concrete adjacent to joints shall be compacted or firmly placed without voids or segregation against the joint material, also under and around all load transfer devices, joint assembly units, and other features designed to extend into the pavement. Concrete adjacent to joints shall be consolidated as required in Subsection 601.11.

2. After the concrete has been placed and vibrated adjacent to the joints as required in Subsection 601.11, the finishing machine shall be brought forward, operating in a manner to avoid damage or misalignment of joints. If uninterrupted operation of the finishing machine, to, over, and beyond the joints causes segregation of concrete, damage to, or misalignment of the joints, the finishing machine shall be stopped when the front screed is approximately 8 inches from the joint. Segregated concrete shall be removed from in front of and off the joint; the front screed shall be lifted and set directly on top of the joint and the forward motion of the finishing machine re-

sumed. When the second screed is close enough to permit the excess mortar in front of it to flow over the joint, it shall be lifted and carried over the joint. Thereafter, the finishing machine may be run over the joint without lifting the screeds, provided there is no segregated concrete immediately between the joint and the screed or on top of the joint.

(c) Machine finishing.

1. Nonvibratory method (when specified). The concrete shall be distributed or spread as soon as placed. As soon as the concrete has been placed, it shall be struck off and screeded by an approved finishing machine. The machine shall go over each area of pavement as many times and at such intervals as necessary to give the proper compaction and to leave a surface of uniform texture. Excessive operation over a given area shall be avoided. The tops of the forms shall be kept clean by an effective device attached to the machine and the travel of the machine on the forms shall be maintained true without lift, wobbling, or other variation tending to affect the precision finish.

During the first pass of the finishing machine, a uniform ridge of concrete shall be maintained ahead of the front screed for its entire length.

2. Vibratory method. Vibrators for full width vibration of concrete paving slabs, shall meet the requirement in Subsection 601.04 (c) 2. In no case shall vibrators be operated longer than 15 seconds in any one location. If uniform and satisfactory density of the concrete is not obtained by the vibratory method at joints, along forms, at structures, and throughout the pavement, the contractor will be required to furnish equipment and methods which will produce pavement conforming to the specifications. All the provisions in (1) above not in conflict with the provisions for the vibratory method shall govern.

(d) Hand finishing. Unless otherwise specified, hand finishing methods will not be permitted except under the following conditions:

In the event of breakdown of the mechanical equipment, hand methods may be used to finish the concrete already deposited on the grade when the breakdown occurs.

Narrow widths or areas of irregular dimensions where operations of the mechanical equipment is impractical may be finished by hand methods.

Concrete, as soon as placed, shall be struck off and screeded. An approved portable screed shall be used. A second screed shall be provided for striking off the bottom layer of concrete if reinforcement is used.

The screed for the surface shall be at least 2 feet longer than the maximum width of the slab to be struck off. It shall be of approved design, sufficiently rigid to retain its shape, and be constructed either of metal or of other suitable material shod with metal.

Consolidation shall be attained by the use of a suitable vibrator or other approved equipment.

In operation the screed shall be moved forward on the forms with a combined longitudinal and transverse shearing motion, moving always in the direction in which the work is progressing and so manipulated that neither end is raised from the side forms during the striking off process. If necessary, this shall be repeated until the surface is of uniform texture, true to grade and cross section, and free from porous areas.

(e) Floating. After the concrete has been struck off and consolidated, it shall be further smoothed, trued, and consolidated by means of a longitudinal float, using one of the following methods as specified or permitted.

1. Mechanical method. The mechanical longitudinal float shall be of a design approved by the engineer, and shall be in good working condition. The tracks from which the float operates shall be accurately adjusted to the required crown. The float shall be accurately adjusted and co-

ordinated with the adjustments of the transverse finishing machine so that a small amount of mortar is carried ahead of the float at all times. The forward speed shall be adjusted so that the float will lap the distance specified by the engineer on each transverse trip. The float shall pass over each area of pavement at least 2 times, but excessive operation over a given area will not be permitted. Any excess water or soupy material shall be wasted over the side forms on each pass.

2. Alternative mechanical method. As an alternative to (1) above, the contractor may use a machine composed of a cutting and smoothing float, or floats, suspended from and guided by a rigid frame. The frame shall be carried by 4 or more visible wheels riding on, and constantly in contact with, the side forms.

If necessary, following one of the preceding methods of floating, long-handled floats having blades not less than 5 feet in length and 6 inches in width may be used to smooth and fill in open-textured areas in the pavement. Long-handled floats shall not be used to float the entire surface of the pavement in lieu of, or supplementing, one of the preceding methods of floating. When strike-off and consolidation are done by the hand method and the crown of the pavement will not permit the use of the longitudinal float, the surface shall be floated transversely by means of the long-handled float. Care shall be taken not to work the crown out of the pavement during the operation. After floating, any excess water and laitance shall be removed from the surface of the pavement by a straight edge 10 feet or more in length. Successive drags shall be lapped ½ the length of the blade.

(f) Straight-edge testing and surface correction. After the floating has been completed and the excess water removed, but while the concrete is still plastic, the surface of the concrete shall be tested for trueness with a 10-foot straightedge. For this purpose the contractor shall furnish and use an accurate 10-foot straightedge swung from handles approximately 3 feet longer than ½ the width of

the slab. The straightedge shall be held in contact with the surface in successive positions parallel to the road center line and the whole area gone over from one side of the slab to the other as necessary. Advance along the road shall be in successive stages of not more than ½ the length of the straightedge. Any depressions found shall be immediately filled with freshly mixed concrete, struck off, consolidated, and refinished. High areas shall be cut down and refinished. Special attention shall be given to assure that the surface across joints meets the requirements for smoothness. Straightedge testing and surface corrections shall continue until the entire surface is found to be free from observable departures from the straightedge and the slab conforms to the required grade and cross section.

(g) Final finish.

Drag finish. Unless otherwise permitted, the final finish shall be a drag finish. To obtain surface texture with a drag finish, a drag shall be used which shall consist of a seamless strip of damp burlap or cotton fabric, which shall produce a uniform surface of gritty texture after dragging it longitudinally along the full width of pavement. For pavement 16 feet or more in width, the drag shall be mounted on a bridge which travels on the forms. The dimensions of the drag shall be such that a strip of burlap or fabric at least 3 feet wide is in contact with the full width of pavement surface while the drag is used. The drag shall consist of not less than 2 layers of burlap with the bottom layer approximately 6 inches wider than the upper layer. The drag shall be maintained in such condition that the resultant surface is of uniform appearance and reasonably free from grooves over 1/16 inch in depth. Drags that cannot be cleaned shall be discarded and new drags substituted.

Belt finish. When permitted or specified, the surface texture shall be a belt finish. When straightedging is complete and water sheen has practically disappeared and just before the concrete becomes nonplastic, the surface shall be belted with a 2-

ply canvas belt not less than 8 inches wide and at least 3 feet longer than the pavement width. Hand belts shall have suitable handles to permit controlled, uniform manipulation. The belt shall be operated with short strokes transverse to the road center line and with a rapid advance parallel to the center line.

Broom finish. When permitted or specified, the surface texture shall be a broom finish. It shall be applied when the water sheen has practically disappeared. The broom shall be drawn from the center to the edge of the pavement with adjacent strokes slightly overlapping. The brooming operation shall be so executed that the corrugations produced in the surface shall be uniform in appearance and not more than 1/16 inch in depth. Brooming shall be completed before the concrete is in such condition that the surface will be torn or unduly roughened by the operation. The surface thus finished shall be free from rough and porous areas, irregularities, and depressions, resulting from improper handling of the broom. Brooms shall be of such quality, size, and construction and be so operated as to produce a surface finish meeting the approval of the engineer. Subject to satisfactory results being obtained the contractor will be permitted to substitute mechanical brooming in lieu of manual brooming as herein described.

(h) Edging at forms and joints. After the final finish, but before the concrete has taken its initial set, the edges of the pavement along each side of each slab, and on each side of transverse expansion joints, formed joints, transverse construction joints, and emergency construction joints shall be worked with an approved tool and rounded to the radius required by the plans. A well-defined and continuous radius shall be produced and a smooth, dense mortar finish obtained. The surface of the slab shall not be unduly disturbed by tilting of the tool during use.

At all joints, any tool marks appearing on the slab adjacent to the joints shall be eliminated by brooming the surface. In doing this, the rounding of the

corner of the slab shall not be disturbed. All concrete on top of the joint filler shall be completely removed.

All joints shall be tested with a straightedge before the concrete has set, and correction made if one side of the joint is higher than the other or if they are higher or lower than the adjacent slabs.

601.16 SURFACE TEST. As soon as the concrete has hardened sufficiently, the pavement surface shall be tested with a 10-foot straightedge or other specified devices. Areas showing high spots of more than 1/8 inch on roadways and 1/4 inch on ramps and connections, but not exceeding 1/2 inch in 10 feet, shall be marked and immediately ground down with an approved grinding tool to an elevation where the area or spot will not show surface deviations in excess of 1/8 inch when tested with a 10-foot straightedge, except deviations of 1/4 inch will be permitted on ramps or connections with radii of 250 feet or less and on ramps with grades of 4 per cent or more. Where the surface deviation in 10 feet exceeds 1/2 inch, the pavement shall be removed and replaced by and at the expense of the contractor.

601.17 CURING. Immediately after the finishing operations have been completed and as soon as marring of the concrete will not occur, the entire surface of the newly placed concrete shall be covered and cured in accordance with one of the following methods. In all cases in which curing requires the use of water, the curing shall have prior right to all water supply or supplies. Failure to provide sufficient cover material of whatever kind the contractor may elect to use, or lack of water to adequately take care of both curing and other requirements, shall be cause for immediate suspension of concreting operations. The concrete shall not be left exposed for more than 1/2 hour between stages of curing or during the curing period.

(a) Cotton or burlap mats. The surface of the pavement shall be entirely covered with mats. The mats used shall be of such length (or width) that as laid they will extend at least twice the thickness of the

pavement beyond the edges of the slab. The mats shall be placed so that the entire surface and both edges of the slab are completely covered. Prior to being placed, the mats shall be saturated thoroughly with water. The mats shall be so placed and weighted down as to cause them to remain in intimate contact with the surface covered, and the covering shall be maintained fully wetted and in position for 72 hours, unless otherwise specified, after the concrete has been placed.

(b) Waterproof paper. The top surface and sides of the pavement shall be entirely covered with waterproofed paper. The units shall be lapped at least 18 inches. The paper shall be so placed and weighted down as to cause it to remain in intimate contact with the surface covered. The paper shall have such dimensions that each unit as laid will extend beyond the edges of the slab at least twice the thickness of the pavement or of pavement width and 2-foot strips of paper for the edges. If laid longitudinally, paper not manufactured in sizes which will provide this width shall be securely sewed or cemented together, the joints being securely sealed in such a manner that they do not open up or separate during the curing period. Unless otherwise specified, the covering shall be maintained in place for 72 hours after the concrete has been placed. The surface of the pavement shall be thoroughly wetted prior to the placing of the paper.

(c) White pigmented impervious membrane. The entire surface of the pavement shall be sprayed uniformly with white pigmented curing compound immediately after the finishing of the surface and before the set of the concrete has taken place. If the pavement is cured initially with jute or cotton mats and the mats are removed prior to expiration of 72 hours, curing compound shall be applied immediately. The curing compound shall not be applied during rainfall.

Curing compound shall be applied under pressure by mechanical sprayers at the rate recommended by the manufacturer but, in no case, greater than 150 square feet per gallon. The spraying equipment

shall be of the fully atomizing type equipped with a tank agitator. At the time of use, the compound shall be in a thoroughly mixed condition with the pigment uniformly dispersed throughout the vehicle. During application the compound shall be stirred continuously by effective mechanical or other approved means. Hand spraying of odd widths or shapes and on concrete surfaces exposed by the removal of forms will be permitted. Curing compound shall not be applied to the inside faces of joints to be sealed.

Should the film become damaged from any cause within the required curing period, the damaged portions shall be repaired immediately with additional compound.

Upon removal of side forms, the sides of the slabs exposed shall be protected immediately to provide a curing treatment equal to that provided for the surface.

(d) White polyethylene sheeting. The top surface and sides of the pavement shall be entirely covered with polyethylene sheeting. The units used shall be lapped at least 18 inches. The sheeting shall be so placed and weighted down as to cause it to remain in intimate contact with the surface covered. The sheeting as prepared for use shall have such dimension that each unit as laid will extend beyond the edges of the slab at least twice the thickness of the pavement. Unless otherwise specified, the covering shall be maintained in place for 72 hours after the concrete has been placed.

(e) Combined burlap and white polyethylene plastic material method. The burlap portion of each sheet shall be thoroughly wet down before use.

After completion of finishing operations and immediately following the disappearance of surface water, the surface of the pavement shall be completely covered with the plastic film side of the material up. The sheets of material shall be so placed and weighted as to cause it to remain in intimate contact with the surface of the pavement and separate sheets shall be lapped at least 6 inches. After re-

moval of side forms, the material shall be folded down over the edges of the pavement and secured by a continuous bank of earth as a seal. The curing shall continue for a period of not less than 72 hours after the concrete has been placed.

(f) Wetted Earth Method. The entire surface and sides of the pavement shall be continuously covered with wetted earth of a thickness not less than 2 inches and so maintained. In no instance shall the earth covering be allowed to become dry within a period of 7 days but the entire surface area and sides of the slab shall be kept thoroughly saturated and intact for that period.

The earth covering shall remain on the pavement after the expiration of the curing period until it is ordered removed.

(g) Curing in Cold Weather. When concrete is being placed and the air temperature may be expected to drop below 35° F, a sufficient supply of straw, hay, grass, or other suitable blanketing material shall be provided along the work, and any time the temperature may be expected to reach the freezing point during the day or night, the material so provided shall be spread over the pavement to a sufficient depth to prevent freezing of the concrete. The contractor shall be responsible for the quality and strength of the concrete placed during cold weather, and any concrete injured by frost action shall be removed and replaced at the contractor's expense.

601.18 REMOVING FORMS. Unless otherwise provided, forms shall not be removed from freshly placed concrete until it has set for at least 12 hours, except auxiliary forms used temporarily in widened areas. Forms shall be removed carefully so as to avoid damage to the pavement. After the forms have been removed, the sides of the slab shall be cured as outlined in one of the methods indicated above. Minor honeycombed areas shall be filled with mortar composed of one part of cement to two parts of fine aggregate. Major honeycombed areas will be considered as defective work and shall be removed and replaced. Any area or section so removed shall not be less than 10

feet in length nor less than the full width of the lane involved. When it is necessary to remove and replace a section of pavement, any remaining portion of the slab adjacent to the joints that is less than 10 feet in length, shall also be removed and replaced.

601.19 SEALING JOINTS. The joints shall be filled with joint sealing material before the pavement is opened to traffic, and as soon after completion of the curing period as is feasible. Just prior to sealing, each joint shall be thoroughly cleaned of all foreign material, including membrane curing compound and the joint faces shall be clean and surface dry when the seal is applied. Material for seal applied hot shall be stirred during heating so that localized overheating does not occur.

The sealing material shall be applied to each joint opening to conform to the details shown on the plans or as directed by the engineer. The sealing shall be done in such a manner that the material will not be spilled on the exposed surfaces of the concrete. Any excess material on the surface of the concrete pavement shall be removed immediately and the pavement surface cleaned. The use of sand or similar material as a cover for the seal will not be permitted. Unless approval is given, poured joint-sealing material shall not be placed when the air temperature in the shade is less than 50° F.

601.20 PROTECTION OF PAVEMENT. The contractor shall protect the pavement and its appurtenances against both public traffic and traffic caused by his own employees and agents. This shall include watchmen to direct traffic and the erection and maintenance of warning signs, lights, pavement bridges, or crossovers, etc., as necessary. The plans or special provisions will indicate the location and type of device or facility required to protect the work and provide adequately for traffic.

Any damage to the pavement, occurring prior to final acceptance, shall be repaired or the pavement replaced.

601.21 SPLIT SLAB CONSTRUCTION. When required

by the plans or in the special provisions, in order to adequately provide for and maintain traffic, the contractor will be required to construct the pavement slab 1/2 width at a time by the split slab construction method.

Longitudinal joints in pavement constructed by the split slab method shall conform to the details shown on the plans and the requirements of Subsection 601.14(a). Pavement constructed by this method shall, in all other respects, conform to these specifications.

601.22 OPENING TO TRAFFIC. The engineer will decide when the pavement shall be opened to traffic. The pavement will not be opened to traffic until specimen beams conforming to the requirements of Subsection 601.12 have attained a flexural strength of 600 psi when tested by the third-point method in accordance with AASHO Designation: T 97 of the Testing Procedures Manual, or a compressive strength of 3,500 psi when tested in accordance with AASHO Designation: T 22 of the Testing Procedures Manual. If such tests are not conducted, the pavement shall not be opened to traffic until 14 days after the concrete has been placed. Prior to opening to traffic, the pavement shall be cleaned.

601.23 CONCRETE PAVEMENT—Slip Form Method. If the contract permits the pavement to be constructed without the use of fixed forms, the following provisions shall apply.

(a) Grade. After the grade or base has been placed and compacted to the required density, the areas which will support the paving machine shall be cut to the proper elevation by means of a properly designed machine. The grade on which the pavement is to be constructed shall then be brought to the proper profile by means of a properly designed machine. If the density of the base is disturbed by the grading operations, it shall be corrected by additional compaction before concrete is placed. The grade shall be constructed sufficiently in advance of the placing of the concrete. If any traffic is allowed to use the prepared grade, the grade

shall be checked and corrected immediately ahead of the placing of the concrete.

(b) Placing concrete. The concrete shall be placed with an approved slip form paver designed to spread, consolidate, screed, and float-finish the freshly placed concrete in one complete pass of the machine in such manner that a minimum of hand finish will be necessary to provide a dense and homogenous pavement in conformance with the plans and specifications. The machine shall vibrate the concrete for the full width and depth of the strip of pavement being placed. Such vibration shall be accomplished with vibrating tubes or arms working in the concrete or with a vibrating screed or pan operating on the surface of the concrete. The sliding forms shall be rigidly held together laterally to prevent spreading of the forms. The forms shall trail behind the paver for such a distance that no appreciable slumping of the concrete will occur.

The concrete shall be held at a uniform consistency, having a slump of not less than 1/2 inch nor more than 2 inches. The slip form paver shall be operated with as nearly a continuous forward movement as possible and all operations of mixing, delivering and spreading concrete shall be so coordinated as to provide uniform progress with stopping and starting of the paver held to a minimum. If, for any reason, it is necessary to stop the forward movement of the paver, the vibratory and tamping elements shall also be stopped immediately. No tractive force shall be applied to the machine, except that which is controlled from the machine.

(c) Finishing. The surface smoothness and texture requirements shall be the same as when fixed forms are used except that the tolerance for the 6 inch width just inside the edge of the pavement shall be 1/4 inch under the 10-foot straightedge except where the edge will be a longitudinal joint in widening the pavement.

(d) Curing. Unless otherwise specified, curing shall be done in accordance with one of the methods included in Subsection 601.17. The curing media

shall be applied at the appropriate time and shall be applied uniformly and completely to all surfaces and edges of the pavement.

(e) Joints. All joints shall be constructed in accordance with Subsection 601.14.

(f) Protection against rain. In order that the concrete may be properly protected against the effects of rain before the concrete is sufficiently hardened, the contractor will be required to have available at all times materials for the protection of the edges and surface of the unhardened concrete. Such protective materials shall consist of standard metal forms or wood plank having a nominal thickness of not less than 2 inches and a nominal width of not less than the thickness of the pavement at its edge for the protection of the pavement edges, and covering material such as burlap or cotton mats, curing paper, or plastic sheeting material for the protection of the surface of the pavement. When rain appears imminent, all paving operations shall stop and all available personnel shall begin placing forms against the sides of the pavement and covering the surface of the unhardened concrete with the protective covering.

601.24 TOLERANCE IN PAVEMENT THICKNESS. The thickness of the pavement will be determined by measurement of cores in accordance with AASHO Designation: T 148 of the Testing Procedures Manual.

For the purpose of establishing an adjusted unit price for pavement, units to be considered separately are defined as 1000 linear feet of pavement in each traffic lane starting at the end of the pavement bearing the smaller station number. The last unit in each lane shall be 1000 feet plus the fractional part of 1000 feet remaining. One core will be taken at random by the Department in each unit. When the measurement of the core from a unit is not deficient more than 0.2 inch from the plan thickness, full payment will be made. When such measurement is deficient more than 0.2 inch and not more than 1.0 inch from the plan thickness, 2 additional cores at intervals not less than 300 feet will be taken and used in the average thick-

ness for that unit. An adjusted unit price as provided in Subsection 601.26(b) will be paid for the unit represented.

Other areas such as intersections, entrances, crossovers, ramps, etc., will be considered as one unit and the thickness of each unit will be determined separately. Small irregular unit areas may be included as part of another unit. At such points as the engineer may select in each unit, one core will be taken for each 1000 square yards of pavement, or fraction thereof, in the unit. If the core so taken is not deficient more than 0.2 inch from the plan thickness, full payment will be made. If the core is deficient in thickness by more than 0.2 inch but not more than 1.0 inch from the plan thickness, 2 additional cores will be taken from the area represented and the average of the 3 cores determined. If the average measurement of these 3 cores is not deficient more than 0.2 inch from the plan thickness, full payment will be made. If the average thickness of the 3 cores is deficient more than 0.2 inch but not more than 1.0 inch from the plan thickness, an adjusted unit price as provided in Subsection 601.26 (b) will be paid for the area represented by these cores.

In calculating the average thickness of the pavement, measurements which are in excess of the specified thickness by more than 0.2 inch will be considered as the specified thickness plus 0.2 inch, and measurements which are less than the specified thickness by more than 1.0 inch will not be included in the average.

When the measurement of any core is less than the plan thickness by more than 1.0 inch, the actual thickness of the pavement in this area will be determined by taking additional cores at not less than 10-foot intervals parallel to the center line in each direction from the affected location until in each direction a core is found which is not deficient by more than 1.0 inch. Areas found deficient in thickness by more than 1.0 inch shall be evaluated by the engineer; and if in his judgment the deficient areas warrant removal, they shall be removed and replaced with concrete of the thickness shown on the plans. Explora-

tory cores for deficient thickness will not be used in averages for adjusted unit price.

601.25 METHOD OF MEASUREMENT. The yardage to be paid for under this item will be the number of square yards of concrete pavement completed and accepted as measured complete in place. The width for measurement will be the width of the pavement shown on the typical cross section of the plans, additional widening where called for, or as otherwise directed in writing. The length will be measured along the surface of the pavement at the centerline of each roadway or ramp.

Split slab construction will be measured by the square yard of pavement constructed by this method. Measurement will be made in the same manner as provided above for the pavement slab.

Reinforcement, other than dowels and other joint material, will be measured by the pound.

601.26 BASIS OF PAYMENT.

(a) General. The accepted quantities of concrete pavement will be paid for at the contract unit price per square yard which price and payment shall be full compensation for furnishing and placing all materials, including any dowels and joint material; provided, however, that for any pavement found deficient in thickness by more than 0.2 inch, but not more than 1.0 inch, only the reduced price stipulated below shall be paid.

No additional payment over the unit contract bid price will be made for any pavement which has an average thickness in excess of that shown on the plans.

Reinforcing steel, other than as mentioned above, will be paid for separately.

Split slab construction will be paid for at the contract unit price per square yard of pavement constructed by this method and accepted. The payment shall constitute full compensation for the additional costs incurred by the contractor for constructing the pavement slab by this method.

Payment will be made under:

Item No.	Pay Item	Pay Unit
601(1)	Portland Cement Concrete Pavement (__" thick)	Square Yard
601(2)	Bar Reinforcing	Pound
601(3)	Fabric Reinforcing	Pound
601(4)	Split Slab Construction	Square Yard

(b) Price Adjustments. Where the average thickness of pavement is deficient in thickness by more than 0.2 inch, but not more than 1.0 inch, payment will be made at an adjusted price as specified in the following table:

CONCRETE PAVEMENT DEFICIENCY

Deficiency in Thickness as Determined by Cores Inches	Proportional Part of Contract Price Allowed
0.00 to 0.20	100 per cent
0.21 to 0.30	90 per cent
0.31 to 0.40	85 per cent
0.41 to 0.50	80 per cent
0.51 to 0.75	70 per cent
0.76 to 1.00	60 per cent

When the thickness of pavement is deficient by more than one inch and the judgment of the engineer is that the area of such deficiency should not be removed and replaced, there will be no payment for the area retained.

PART VII
INCIDENTAL CONSTRUCTION

Section 701
Culverts and Storm Drains

701.01 DESCRIPTION. This work shall consist of the construction or reconstruction of pipe culverts, pipe arches and storm drains in accordance with these specifications and in reasonably close conformity with the lines and grades shown on the plans or established by the engineer.

701.02 MATERIALS. Materials shall meet the requirements specified in the folllowing subsections of Part IX Materials:

Structural Plate Pipe Arches	907.09
Corrugated Metal Pipe and Pipe Arches	907.06
Bituminous Coated Corrugated Metal Pipe and Pipe Arches	907.07
Corrugated Aluminum Pipe and Pipe Arches	907.12
Bituminous Coated Corrugated Aluminum Pipe and Pipe Arches	907.14
Reinforced Concrete Pipe	906.02
Non Reinforced Concrete Pipe	906.01
Reinforced Concrete Arch Culvert Pipe	906.18
Reinforced Concrete Elliptical Culvert Pipe	906.19
Vitrified Clay Pipe	906.08
Asbestos Cement Pipe	906.12
Joint Mortar	905.04
Asbestos Bonded Metal Pipe and Pipe Arches	907.08
Rubber Gasket	905.05
Flexible Plastic Gasket	905.07

When items for "Culvert Pipe" or "Pipe Arch" are included on the plans or in the proposal, the contractor may at his option furnish culvert pipe or pipe arch of reinforced concrete, asbestos bonded corrugated

metal, bituminous coated corrugated metal, or bituminous coated corrugated aluminum, meeting the requirements of these specifications.

When the location of manufacturing plants allows, the plants will be inspected periodically for compliance with specified manufacturing methods, and material samples will be obtained for laboratory testing for compliance with materials quality requirements. This can be the basis for acceptance of manufacturing lots as to quality.

All materials will be subject to inspection for acceptance as to condition at the latest practicable time the engineer has the opportunity to check for compliance prior to or during incorporation of materials in the work.

CONSTRUCTION REQUIREMENTS

701.03 EXCAVATION. Trenches shall be excavated to a width sufficient to allow for proper jointing of the sections of pipe and thorough compaction of the bedding and backfill material under and around the pipe. Where feasible, trench walls shall be approximately vertical.

The completed trench bottom shall be firm for its full length and width. Where required, in the case of cross drains, the trench shall have a longitudinal camber of the magnitude specified.

Where pipe culverts are to be placed in embankment fill, the excavation shall be made after the embankment has been completed to the specified height above the designed grade for those pipe culverts specified on the plans.

701.04 FORMING BED FOR PIPE. The width of trench as required shall be sufficient to permit thorough tamping of the backfill under the haunches and around the pipe.

Unless otherwise specified a Class C bedding shall be provided as follows: The pipe shall be bedded with ordinary care in a loosened soil foundation shaped to fit the lower part of the pipe exterior with reasonable closeness for at least 10 per cent of its overall height.

The shaped foundation shall be loosened soil to a depth of 3 inches. Where rock, in either ledge or boulder formation, is encountered, it shall be removed below grade and replaced with suitable material in such a manner as to provide a compacted earth cushion having a thickness under the pipe of not less than ½ inch per foot height of fill over the top of the pipe with a minimum allowable thickness of 8 inches. Where a suitable foundation is not encountered at the grade established, due to soft, spongy or other unstable soil, unless other special construction methods are called for on plans or in the special provisions, all such unstable soil shall be removed and replaced with a foundation fill consisting of gravel or other approved material properly compacted to provide adequate support for the pipe line. When, in the opinion of the engineer, foundation fill is required, it shall be paid for as "Extra Work."

If pipe is not laid in a trench, a uniformly firm bed shall be made in the same manner as above specified for the preparation of the bottom of the trench.

701.05 LAYING PIPE. The pipe laying shall begin at the downstream end of the line. The lower segment of the pipe shall be reasonably in contact with the foundation throughout its full length. Bell or groove ends of rigid pipe and outside circumferential laps of flexible pipe shall be placed facing upstream. Flexible pipe shall be placed with longitudinal laps or seams at the sides.

701.06 JOINTING PIPE. Rigid pipe may be of bell and spigot or tongue and groove design unless one type is specified. The method of joining pipe sections shall be such that the ends are fully entered and the inner surfaces are reasonably flush and even.

Joints shall be made with (a) Portland cement mortar, (b) extruded joint compound (flexible plastic gasket), (c) rubber gaskets, (d) oakum and mortar, or (e) oakum and joint compound, by a combination of these types, or any one type, as may be specified.

Mortar joints shall be made with an excess of mortar to form a bead around the outside of the joint and finished smooth on the inside. Rubber ring gas-

kets shall be installed so as to form a flexible watertight seal. Where oakum is used the joint shall be calked with this material and then sealed with joint compound.

When Portland cement mixtures are used, the completed joints shall be protected against rapid drying by suitable covering material.

When rubber or rubber type gaskets are used, the rubber cement and lubricant used to facilitate the joining of the pipe shall be that recommended by the manufacturer of the gaskets. The procedure used in joining the pipe shall also be as recommended by the gasket manufacturer.

Flexible pipe shall be firmly joined by coupling bands.

Pipe culverts shall be inspected before any backfill is placed. Any pipe found to be out of alignment, unduly settled, or damaged shall be taken up and relaid or replaced at the contractor's expense.

701.07 RELAYING PIPE. If indicated or directed, old pipe culverts shall be removed and all suitable sections shall be relaid, extended, or renewed in the same manner as specified for new pipe culverts.

701.08 BACKFILLING. After the pipe or pipe-arch is installed, the trench shall be backfilled with selected materials uniformly distributed in layers of not more than 6 inches and thoroughly compacted with approved mechanical compactors to the required density before successive layers are placed.

When the top of the pipe is exposed above the top of the trench, embankment material shall be placed and compacted for a width on each side of the pipe equal to at least twice the horizontal inside diameter of the pipe, or 12 feet, whichever is less. The embankment on each side of the pipe, for a distance equal to the horizontal inside diameter of the pipe, shall be of the same material and compacted in the manner described for backfilling. The remainder of the fill material shall not contain frozen lumps, stone in excess of 3-inch diameter, or other objectionable material. Compaction shall be achieved as provided for backfill or by rolling. The embankment shall be placed

and compacted simultaneously on both sides of the pipe for the full width of the roadbed.

In any event, fill shall be placed as provided above to an elevation of not less than one foot above the top of pipe, or as hereinafter provided for aluminum pipe, before permitting construction equipment to travel over the pipe line. Above such elevation, embankment shall be placed and compacted in the normal manner.

Below natural ground, backfill shall be compacted to the approximate density of the surrounding ground. Above natural ground, the material shall be compacted to 95 per cent of maximum density. Maximum density shall be determined in accordance with LDH Designation: TR 418 and the in-place density determined by LDH Designation: TR 401.

Any pipe which is crushed or damaged during laying, backfilling or by subsequent construction, or by any other cause, shall be removed and replaced in accordance with these specifications at the expense of the contractor.

The thickness of the aluminum pipe and pipe arch furnished by the contractor will be established in accordance with the following fill height table.

NOMINAL SHEET THICKNESS AND HEIGHT OF FILL

Pipe dia. Inches	Min.* cover Inches	Height of fill above top of pipe in feet: 1-10	11-15	16-20	21-25	26-30	31-35	36-40	41-50
		Minimum nominal thickness of metal-inches							
8	6	0.060	0.060	0.060	0.060	0.060	0.060	0.060	0.060
10	7	0.060	0.060	0.060	0.060	0.060	0.060	0.060	0.060
12	8	0.060	0.060	0.060	0.060	0.060	0.060	0.075	0.105
15	8	0.060	0.060	0.060	0.060	0.060	0.075	0.105	
18	8	0.060	0.060	0.060	0.060	0.075	0.105		
21	9	0.060	0.060	0.060	0.075	0.105	0.135		
24	9	0.060	0.075	0.075	0.075	0.105	0.135		
30	10	0.075	0.075	0.075	0.105	0.135	0.164		
36	10	0.075	0.105	0.105	0.135	0.164			
42	12	0.105	0.105	0.135	0.164	0.164			
48	14	0.105	0.105	0.135	0.164				
54	16	0.105	0.105	0.135	0.164				
60	16	0.135	0.164						
66	18	0.135	0.164						
72	18	0.135	0.164						

*In cases where heavy construction equipment will be used over the pipe line, a minimum cover of 2 feet will be required for pipe up to 36" diameter and cover equal to 2/3 of the diameter will be required for pipe greater than 36" diameter.

After completion of hauling operations, the contractor shall remove the excess thickness to the grade shown on the plans. However, the minimum cover requirements shown in the above table will be met at all times.

Note: Unless otherwise specified, aluminum pipe arch of equivalent diameter shall have the same minimum cover and the same minimum nominal thickness of metal for the various fill heights.

701.09 METHOD OF MEASUREMENT. Pipe of the different types and sizes, both new and relaid, will be measured by the linear foot in place. Pipe with sloped or skewed ends will be measured along the invert.

Excavation and backfill for culverts and storm drains will not be measured but the cost of this work will be included in the bid on the respective pipe item except as otherwise specified.

701.10 BASIS OF PAYMENT. The accepted quantities of pipe will be paid for at the contract unit price per linear foot of pipe of the types and sizes specified complete in place.

Payment will be made under:

Item No.	Pay Item	Pay Unit
701(1)	Structural Plate Pipe Arch (Size)	Linear Foot
701(2)	Corrugated Metal Pipe (Size)	Linear Foot
701(3)	Corrugated Metal Pipe Arch (Size)	Linear Foot
701(4)	Bituminous Coated Corrugated Metal Pipe (Size)	Linear Foot
701(5)	Bituminous Coated Corrugated Metal Pipe Arch (Size)	Linear Foot
701(6)	Asbestos Bonded Corrugated Metal Pipe (Size)	Linear Foot
701(7)	Asbestos Bonded Corrugated Metal Pipe Arch (Size)	Linear Foot
701(8)	Corrugated Aluminum Pipe (Size)	Linear Foot
701(9)	Bituminous Coated Corrugated Aluminum Pipe (Size)	Linear Foot

Item No.	Pay Item	Pay Unit
701(10)	Corrugated Aluminum Pipe Arch (Size)	Linear Foot
701(11)	Bituminous Coated Corrugated Aluminum Pipe Arch (Size)	Linear Foot
701(12)	Reinforced Concrete Pipe (Class III) (Size)	Linear Foot
701(13)	Reinforced Concrete Pipe (Class IV) (Size)	Linear Foot
701(14)	Reinforced Concrete Arch Culvert Pipe (Class) (Size)	Linear Foot
701(15)	Reinforced Concrete Horizontal Elliptical Culvert Pipe (Class) (Size)	Linear Foot
701(16)	Reinforced Concrete Vertical Elliptical Culvert Pipe (Class) (Size)	Linear Foot
701(17)	Vitrified Clay Pipe (Size)	Linear Foot
701(18)	Asbestos Cement Pipe (Size)	Linear Foot
701(19)	Culvert Pipe (Size)	Linear Foot
701(20)	Pipe Arch (Size)	Linear Foot
701(21)	Relaying Pipe	Linear Foot

Section 702

Manholes, Inlets and Catch Basins

702.01 DESCRIPTION. This work shall consist of the construction of manholes, inlets, junction boxes and catch basins in accordance with these specifications, and in reasonably close conformity with the lines and grades shown on the plans or established by the engineer.

702.02 MATERIALS. Concrete for these structures shall be Class A meeting the requirements of Section 805—Concrete Masonry. Other materials shall meet the requirements specified in the following subsections of Part IX Materials.

Clay or Shale Brick	904.01
Concrete Brick	904.01
Joint Mortar	905.04
Frames, Grates and Covers, and Ladder Rungs	915.04
Paints	908.09
Reinforcing Steel	909.01
Welding	916.01

When the location of manufacturing plants allows, the plants will be inspected periodically for compliance with specified manufacturing methods, and material samples will be obtained for laboratory testing for compliance with materials quality requirements. This can be the basis for acceptance of manufacturing lots as to quality.

All materials will be subject to inspection for acceptance as to condition at the latest practicable time the engineer has the opportunity to check for compliance prior to or during incorporation of materials in the work.

CONSTRUCTION REQUIREMENTS

702.03 CONSTRUCTION REQUIREMENTS. Concrete construction shall conform to the requirements for concrete masonry. Masonry shall conform to the re-

quirements for the respective type. Joints shall be full mortar joints and shall not be more than ½ inch wide. When specified, the outside face of structures shall be plastered with ½ inch thick cement-sand mortar coat. Unless otherwise provided, exposed surfaces of concrete and masonry shall be cured with wet burlap for a period of not less than 48 hours.

Metal frames shall be set in full mortar bed. Pipe sections shall be flush on the inside of the structure wall and project outside sufficiently for proper connection with the next pipe section. Masonry shall fit neatly and tightly around the pipe.

When grade adjustment of existing structures is specified, the frames, covers and gratings shall be removed and the walls reconstructed as required. The cleaned frames shall be reset at the required elevation. Upon completion, each structure shall be cleaned of any accumulations of silt, debris, or foreign matter of any kind for coating with an approved bituminous varnish and shall be kept clear of such accumulation until final acceptance of the work.

After inspection of the completed structures and when directed, the excavated areas which are not occupied by the structures shall be refilled to the required elevation with suitable material which shall be placed in layers not more than 6 inches in depth when in a loose condition and each layer thoroughly compacted by mechanical tamping. If the backfill material is too dry to satisfactorily compact it shall be watered as directed. Below natural ground, backfill shall be compacted to the approximate density of the surrounding ground. Above natural ground, the material shall be compacted to 95 per cent of maximum density. Maximum density shall be determined in accordance with LDH Designation: TR 418 and the in-place density determined by LDH Designation: TR 401.

702.04 METHOD OF MEASUREMENT. Junction boxes, manholes, inlets and catch basins, both new and reconstructed as applicable, will be measured by the unit. No measurement will be made for excavation or backfill but the cost of this work shall be included in

the price bid on manholes, inlets, catch basins, etc., as the case may be.

702.05 BASIS OF PAYMENT. The accepted quantities of junction boxes, manholes, inlets, and catch basins will be paid for at the contract unit price per each complete in place.

Payment will be made under:

Item No.	Pay Item	Pay Unit
702(1)	Junction Boxes	Each
702(2)	Manholes	Each
702(3)	Inlets	Each
702(4)	Catch Basins	Each
702(5)	Adjusting Manholes, Catch Basins, etc.	Each

Section 703
Underdrains

703.01 DESCRIPTION. This work shall consist of constructing underdrains using pipe and granular filter material and underdrain pipe outlets in accordance with these specifications and in reasonably close conformity with the lines and grades shown on the plans or established by the engineer.

703.02 MATERIALS. Materials shall meet the requirements specified in the following subsections of Part IX Materials.

Perforated Corrugated Metal Pipe	907.10
Perforated Bituminous Coated Corrugated Metal Pipe	907.11
Perforated Concrete Pipe	906.03
Perforated Asbestos Cement Pipe	906.13
Perforated Clay Pipe	906.10
Perforated Corrugated Aluminum Pipe	907.13
Perforated Bituminous Coated Corrugated Aluminum Pipe	907.15
Asbestos Cement Pipe	906.12
Perforated Bituminized Fiber Pipe	906.17
Bituminized Fiber Pipe	906.20

When an item for "Perforated Pipe Underdrains" is included on the plans or in the proposal, the contractor will be permitted to furnish any of the perforated types listed above, except that if corrugated metal or aluminum pipe is furnished, it shall be bituminous coated.

When an item for "Non-perforated Pipe Underdrains" is included on the plans or in the proposal, the contractor will be permitted to furnish any of the non-perforated types of pipe listed above.

Granular material shall meet the requirements for fine aggregate, Subsection 903.02.

When the location of manufacturing plants allows, the plants will be inspected periodically for compli-

ance with specified manufacturing methods, and material samples will be obtained for laboratory testing for compliance with materials quality requirements. This can be the basis for acceptance of manufacturing lots as to quality.

All materials will be subject to inspection for acceptance as to condition at the latest practicable time the engineer has the opportunity to check for compliance prior to or during incorporation of materials in the work.

CONSTRUCTION REQUIREMENTS

703.03 PIPE INSTALLATION. Trenches shall be excavated to the dimensions and grade required by the plans or as directed. A minimum 3-inch bedding layer of granular backfill material shall be placed and compacted in the bottom of the trench for its full width and length.

Subdrainage pipe of the type and size specified shall be embedded firmly in the bedding material.

Perforated pipe shall normally be placed with the perforations down and the pipe sections shall be joined securely with the appropriate coupling fittings or bands.

Non-perforated pipe shall be laid with the bell end upgrade and with open joints, wrapped with suitable material to permit entry of water, or unwrapped as may be specified.

Upgrade ends of all subdrainage pipe installations shall be closed with suitable plug to prevent entry of soil materials.

After the pipe installation has been inspected and approved, granular backfill material shall be placed as shown on the plans or as directed. Care shall be taken not to displace the pipe or the covering at open joints.

703.04 METHOD OF MEASUREMENT. Underdrains will be measured by the linear foot for pipe of the type and size specified.

No measurement will be made for excavation or for

any specified granular material but the cost of this work shall be included in the price bid for the respective pay item for drains of the type and size specified.

703.05 BASIS OF PAYMENT. The accepted quantities of underdrains will be paid for at the contract unit price per linear foot of each kind, and of the types and sizes specified complete in place.

Payment will be made under:

Item No.	Pay Item	Pay Unit
703(1)	Perforated Corrugated Metal Pipe (Size)	Linear Foot
703(2)	Perforated Bituminous Coated Corrugated Metal Pipe (Size)	Linear Foot
703(3)	Perforated Concrete Pipe (Size)	Linear Foot
703(4)	Perforated Asbestos Cement Pipe (Size)	Linear Foot
703(5)	Perforated Corrugated Aluminum Pipe (Size)	Linear Foot
703(6)	Perforated Bituminous Coated Corrugated Aluminum Pipe (Size)	Linear Foot
703(7)	Perforated Bituminized Fiber Pipe (Size)	Linear Foot
703(8)	Bituminized Fiber Pipe (Size)	Linear Foot
703(9)	Perforated Clay Pipe (Size)	Linear Foot
703(10)	Perforated Asbestos Cement Pipe (Size)	Linear Foot
703(11)	Perforated Pipe Underdrains	Linear Foot
703(12)	Non-perforated Pipe Underdrains	Linear Foot

Section 704
Guard Rail

704.01 DESCRIPTION. This work shall consist of the construction of guard rail in accordance with these specifications, and in reasonably close conformity with the lines and grades shown on the plans or established by the engineer.

The type of guard rail furnished shall be Beam Type Guard Rail.

The construction of the guard rail shall include the assembly and erection of all component parts and materials complete at the locations shown on the plans or as directed.

704.02 MATERIALS. Materials shall meet the requirements specified in the following subsections of Part IX Materials.

Metal Beam Rail	910.04
Posts and Spacer Blocks	910.10
Hardware	910.12

When the location of manufacturing plants allows, the plants will be inspected periodically for compliance with specified manufacturing methods, and material samples will be obtained for laboratory testing for compliance with materials quality requirements. This can be the basis for acceptance of manufacturing lots as to quality.

The contractor, at his option, may furnish either galvanized or painted steel guard rail, or aluminum guard rail.

All materials will be subject to inspection for acceptance as to condition at the latest practicable time the engineer has the opportunity to check for compliance prior to or during incorporation of materials in the work.

The manufacturer shall perform tests as specified

in AASHO Designation: M 180 and shall submit 7 certified copies of each report to the Department's Materials and Testing Section for approval and distribution.

CONSTRUCTION REQUIREMENTS

704.03 POSTS. Posts shall be set plumb, in hand or mechanically dug holes, unless driving is permitted. In the latter case the manner of driving shall be such as to avoid battering or distorting of posts. Post holes shall be backfilled with acceptable material placed in layers and thoroughly compacted.

704.04 RAIL ELEMENTS. Rail elements shall be erected in a manner resulting in a smooth, continuous installation. All bolts, except adjustment bolts, shall be drawn tight. Bolts shall be of sufficient length to extend beyond the nuts.

Holes for special details may be field-drilled or punched when approved by the engineer.

When painted guard rail is furnished, any damage to the shop coat of paint shall be corrected by an application or an approved inhibitive primer prior to other painting. Any surfaces inaccessible to painting after erection shall be field painted before erection. The railing component shall be given the specified number of coats of paint uniformly applied by thorough brushing or by approved pressure spray as specified. Painting shall conform to the requirements of Subsections 811.02 and 811.03.

Galvanized surfaces which have been abraded so that the base metal is exposed, threaded portions of all fittings and fasteners and cut ends of bolts shall be protected by cleaning and painting with 2 coats of zinc dust-zinc oxide paint in a manner as may be specified or directed.

704.05 METHOD OF MEASUREMENT. Guard rail (including regular terminal end sections but exclusive of terminal anchor sections) will be measured by the linear foot along the face of the rail except in cases where end connections are made to masonry or steel structures where measurement is to be made only to

the face of such structures. The measurement shall be exclusive of any openings in each line of railing between railing posts.

Each terminal anchor section of the type and size specified on the plans will be counted as a complete unit.

The guard rail (doubled face) shall be measured as described herein except that measurement will be made along the center line of posts within the limits shown on the plans.

704.06 BASIS OF PAYMENT. The accepted quantities of guard rail and terminal anchor sections will be paid for at the respective contract unit prices per linear foot and per each for the type specified complete in place.

Payment will be made under:

Item No.	Pay Item	Pay Unit
704(1)	Deep Beam Highway Guard Rail	Linear Foot
704(2)	Deep Beam Blocked Out Highway Guard Rail	Linear Foot
704(3)	Guardrail Terminal Anchor Sections	Each
704(4)	Deep Beam Highway Guard Rail (Double Faced).	Linear Foot
704(5)	Deep Beam Blocked Out Highway Guard Rail (Double Faced)	Linear Foot

Section 705

Fences

705.01 DESCRIPTION. This work shall consist of the construction of fences and gates in accordance with these specifications and in reasonably close conformity with the lines and grades shown on the plans or established by the engineer.

705.02 MATERIALS. Materials shall meet the requirements specified in the following subsections of Part IX Materials.

Mesh Wire	910.02
Barbed Wire	910.01
Chain Link Fence and Gates	910.03
Fence Posts	910.06
Gates	910.11
Wire Staples	910.08
Braces	910.07
Metal Fasteners for Steel Posts	910.09

When the location of manufacturing plants allows, the plants will be inspected periodically for compliance with specified manufacturing methods, and material samples will be obtained for laboratory testing for compliance with materials quality requirements. This can be the basis for acceptance of manufacturing lots as to quality.

All materials will be subject to inspection for acceptance as to condition at the latest practicable time the engineer has the opportunity to check for compliance prior to or during incorporation of materials in the work.

CONSTRUCTION REQUIREMENTS

705.03 CONSTRUCTION REQUIREMENTS. Unless the plans include an item or items for clearing and grubbing, the contractor shall perform such clearing and grubbing as may be necessary to construct the fence to the required grade and alignment.

At locations where breaks in a run of fencing are required, or at intersections with existing fences, appropriate adjustment in post spacing shall be made to conform to the requirements for the type of closure indicated.

When the plans require that posts, braces or anchors be embedded in concrete, the contractor shall install temporary guys, or braces as may be required to hold the posts in proper position until such time as the concrete has set sufficiently to hold the posts. Unless otherwise permitted, no materials shall be installed on posts or strain placed on guys and bracing set in concrete until 3 days have elapsed from the time of placing of the concrete.

The tops of all posts shall be set to approximately the required grade and alignment. Cutting of the tops of the posts will be allowed only with the approval of the engineer and under the conditions specified by him.

Wire or fencing of the size and type required shall be firmly attached in the manner indicated to the posts and braces. All wire shall be stretched taut and be installed to the approximate required elevations. Barbed wire and mesh and barbed wire fence, new or rebuilt, shall be grounded in areas where electrical lines cross the fence in accordance with the details shown on the plans.

705.04 REBUILT FENCE. Where indicated on the plans or directed, the contractor will be required to take down, move back and rebuild existing fence. The fence shall be rebuilt in the same manner as specified for new fence. Rebuilt ornamental fence, picket fence or other special types of fence shall be equal in all respects to the existing fence.

705.05 GATES. Design of metal gates shown on the plans is of a type acceptable to the Department. Gates of any other design may be furnished if prior approval is obtained from the Department.

All gates shall be of rigid construction, and after erection shall not show any sag or warp.

705.06 CHAIN LINK FENCE AND GATES. The contractor's activities and operations shall be confined to the area immediately adjacent to the right of way lines and within the right of way.

(a) Concrete Post Anchorage and Concrete Apron: Posts shall be anchored in cast-in-place concrete footings. A concrete apron shall be placed under the fence as shown on the plans. All concrete for footings and aprons shall be Class R or better and may be with or without air entrainment at the option of the contractor.

Hand mixing of concrete will be permitted for cast-in-place concrete where small quantities are to be mixed and when done to the satisfaction of the engineer. No hand mixed batch shall exceed ½ of a cubic yard. All batches exceeding ½ of a cubic yard shall be machine mixed.

Concrete footings shall be carried down to at least the depth, and shall be not less than the dimensions, shown on the plans. The top of all footings and aprons shall extend slightly above the ground line and shall be steel troweled to a smooth finish with slope to drain away from the post as shown on the plans. Posts, braces, and other units shall be approximately centered in their footings.

Concrete shall be placed promptly, expeditiously, and without segregation after mixing. The contractor shall be required to consolidate and compact the concrete satisfactorily by tamping or vibrating. Exposed edges shall be tooled. All excess excavation from footings and aprons shall be disposed of in a manner satisfactory to the engineer.

(b) Erection of Chain Link Fence: The fence shall be erected to the established lines and grades. The fence shall be approximately true to lines, taut and shall comply with the best practice for fence construction of this type.

Posts shall be spaced in line of fence not further apart than 10-foot centers, with a tolerance of minus 2 feet. At locations where breaks in a run of fencing are required, or at intersections with existing

fencing, appropriate adjustments in post spacing shall be made to conform to the requirements for the type of closure indicated. Each post shall be erected plumb and the posts shall line up longitudinally with the specified alignment with no perceptible variation.

Pull posts, as defined above, shall be placed approximately 330 feet apart in straight runs and at each vertical angle point of 20° or more, all as directed. Corner posts shall be placed at each horizontal angle or point of 20° or more. Corner and pull posts shall have a horizontal brace and a tie rod on each side of the posts, extending and connected to the adjacent line posts.

Posts shall be permanently positioned and anchorages firmly set before fabric is placed. The top rail shall also be secured to all posts in a satisfactory manner before fabric is placed. The ends of the fabric shall be secured by the use of stretcher bars threaded through the loops of the fabric and secured to the posts by means of clamps with bolts and nuts. The number of clamps shall be as called for on the plans.

The fabric shall be placed by securing one end and applying sufficient tension to remove all slack before making attachments elsewhere. The degree of tensioning shall be commensurate with air temperatures at the time of installation to prevent undue sagging or tensioning of the mesh because of changing temperatures. The fabric shall be fastened to each line post at approximately equal spaces and to the top rail and bottom tension wire with tie wires or bands as called for on the plans or as directed.

(c) Erection of Gates: The gate installation shall include gate frames, stretcher bars, filler fabric, latches, stops, locking device, padlocks, hinges, gate posts with braces, tie rods, turnbuckles, caps and all fittings and details for gates and gate posts, all as specified and as shown on the plans and as required to make a complete installation.

All gates shall be carefully aligned with posts verti-

cal. Where clamps are used for attaching hardware, they shall be made up tight. The bottom of each gate shall clear the ground by at least 3 inches at all points in its swing. The contractor shall modify the existing grade within the area of swing, if necessary, to meet this requirement when directed. Direction of swing and location of gates will be as indicated on the plans or as otherwise directed. Stops with latches, or other approved means for holding the gate open, shall be provided for all gates and so placed as to prevent damage to the gate or fence by overswing. Unless otherwise instructed stops shall be provided also to arrest the swing of a closed gate at the centerline of the fence.

(d) Paints and Painting: Metal parts which are protected by galvanizing are not to be painted. After erection is completed, all construction under this item will be inspected, and all parts of fences, gates, etc., (including bolts and nuts) from which the galvanizing has been abraded so that the base metal is exposed, shall be spot-painted with an approved paint. Painting of aluminum surfaces will not be required.

(e) Electrical Grounds: The fence shall be grounded by a Copperweld rod 8 feet long and a minimum of 5/8 inch in diameter, driven vertically until the top of it is approximately 6 inches below the top of ground. A No. 6 solid copper conductor shall be firmly attached to the rod and to the fence in such a manner that each element of the fence is grounded. Where a power line passes over the fence, a ground shall be installed immediately below the point of crossing. Otherwise, grounds shall be spaced along the fence at intervals of 500 feet (maximum).

No special payment will be made for electrical grounds, and the cost thereof shall be included in the prices bid for fences and gates under these items.

705.07 METHOD OF MEASUREMENT. Fence will be measured by the station of 100 feet. Measurement will be along the bottom of the fence on its roadside face

from outside to outside of end posts, exclusive of gates, for each continuous run of fence.

Gates will be measured as complete units of the size and type specified.

No measurement will be made for new posts but the cost of new posts required for new fence, rebuilt fence and gates will be included in the respective item.

705.08 BASIS OF PAYMENT. The accepted quantities of fence and gates will be paid for at the contract unit price per station for fence and per each for gates of the types and sizes specified complete in place.

Payment will be made under:

Item No.	Pay Item	Pay Unit
705(1)	New Barbed Wire Fence	Station
705(2)	New Combination Mesh & Barbed Wire Fence	Station
705(3)	Single Swinging Walk Gates	Each
705(4)	Single Swinging Driveway Gates	Each
705(5)	Double Swinging Driveway Gates	Double Gate
705(6)	Chain Link Fence, _____ foot height	Linear Foot
705(7)	_____Gates, _____foot height, for chain link fence	_____Gate
705(8)	Rebuilt Fence	Station

Section 706
Sidewalks

706.01 DESCRIPTION. This work shall consist of the construction of concrete sidewalks, in accordance with these specifications and in reasonably close conformity with the lines and grades shown on the plans or established by the engineer.

706.02 MATERIALS. Materials shall meet the requirements specified in the following subsections of Section IX Materials.

Joint Filler	905.02
Reinforcing Steel	909.01

Concrete for sidewalks shall be Class A meeting the requirements of Section 805 Concrete Masonry.

Concrete will be subject to inspection and tests at the mixing plants for compliance with quality requirements.

All materials will be subject to inspection for acceptance as to condition at the latest practicable time the engineer has the opportunity to check for compliance prior to or during incorporation of materials in the work.

CONSTRUCTION REQUIREMENTS

706.03 CONCRETE SIDEWALKS.

(a) Excavation. Excavation shall be made to the required depth and to a width that will permit the installation and bracing of the forms. The subgrade shall be shaped and compacted to a firm even surface conforming to the section shown on the plans. All soft and yielding material shall be removed and replaced with approved material.

(b) Forms. Forms shall be of wood or metal and shall extend for the full depth of the concrete. All forms shall be straight, clean, free from warp and of sufficient strength to resist the pressure of the

concrete without springing. Bracing and staking of forms shall be such that the forms remain in both horizontal and vertical alignment until their removal.

(c) Subgrade. The subgrade shall be thoroughly moistened immediately prior to the placing of the concrete.

(d) Depositing and Finishing. The concrete shall be deposited between the forms on the moist subgrade, struck off and compacted to the required thickness. It shall be tamped sufficiently to bring the mortar to the surface. The surface shall be finished with a wood float or steel trowel, provided that the surface is finally brushed in order to leave a slightly rough finish. All joints and edges shall be rounded with an edging tool having a ¼ inch radius.

(e) Joints. Expansion joints shall be of the dimensions specified, and shall be filled with premoulded expansion joint filler. The sidewalk shall be divided into sections by dummy joints formed by a jointing tool or other acceptable means as directed. The dummy joints shall extend into the concrete for at least ¼ of the depth and shall be approximately ⅛ inch wide.

Construction joints shall be formed around all appurtenances such as manholes, utility poles, etc., extending into and through the sidewalk. One-fourth inch premoulded expansion joint filler shall be installed in these joints. Expansion joint filler of the thickness indicated shall be installed between concrete sidewalks and any fixed structure such as a building or bridge. This expansion joint material shall extend for the full depth of the walk.

(f) Curing. Concrete shall be cured for at least 72 hours. Curing shall be by means of moist burlap or mats or by other approved methods. During the curing period, all traffic, both pedestrian and vehicular, shall be excluded. Vehicular traffic shall be excluded for such additional time as the engineer may direct.

706.04 METHOD OF MEASUREMENT. Concrete side-

walks will be measured by the square yard of finished surface.

Reinforcement, if required, will not be measured, but the cost will be included in the price bid on concrete sidewalk.

Excavation, backfill, expansion joint material and other related miscellaneous items will not be paid for separately but the cost thereof shall be included in the cost of the sidewalk.

706.05 BASIS OF PAYMENT. The accepted quantities of sidewalk will be paid for at the contract unit price per square yard for concrete sidewalk.

Payment will be made under:

Item No.	Pay Item	Pay Unit
706(1)	Concrete Sidewalk (__" Thick)	Square Yard

Section 707
Curbs and Gutters

707.01 DESCRIPTION. This work shall consist of the construction of any of the types of curbs and gutters included in the following list in accordance with these specifications and in reasonably close conformity with the lines, grades, dimensions and typical sections shown on the plans or established by the engineer.

Plain Concrete Curb
Plain Concrete Gutter
Combination Curb and Gutter
Integral Concrete Curb
Integral Concrete Lip Curb
Bituminous Curbing
Combination Lip Curb and Gutter

707.02 MATERIALS. Except as provided below the materials shall meet the requirements of the following subsections of Part IX Materials.

Joint Filler	905.01
Premoulded Joint Filler	905.02

(a) Integral Types: All concrete for these items shall be the same as provided for the roadway slab of which it shall form an integral part.

(b) All Types Except Integral: All concrete for these items shall be Class A meeting the applicable requirements of Section 805.

(c) Bituminous Curbing: The bituminous mixture in this item shall be of the type shown on the plans and shall meet the requirements of asphaltic concrete pavement (wearing course) as provided in Part V of these specifications. All materials will be subject to inspection for acceptance as to condition at the latest practicable time the engineer has the opportunity to check for compliance prior to or during incorporation of materials in the work.

CONSTRUCTION REQUIREMENTS

707.03 SUBGRADE. The subgrade shall be shaped to the required depth below the finished surface in accordance with the dimensions shown on the plans and shall be compacted to a firm, even surface. When possible, the subgrade shall be shaped and compacted at the same time and in the same manner as the subgrade for the pavement slab. All soft and yielding spots or any unstable material encountered shall be removed and replaced with suitable material and thoroughly compacted. When foundation underdrains are to be placed under curbing and gutter, the excavation and backfilling for same shall be completed and compacted before subgrade for curbing and gutter is prepared.

707.04 FORMS. The forms for the curbing or gutter shall be of wood or metal, straight, free from warp and of sufficient strength when staked to resist the pressure of the concrete without springing. All forms shall be cleaned thoroughly and greased or soaped before concrete is placed against them. Forms which have become worn, bent or broken shall not be used until satisfactorily repaired and straightened. Repaired forms shall not be used until inspected and approved by the engineer. An approved mechanical curb forming machine may be used without forms.

707.05 JOINTS. Joints shall be formed in the curbing to correspond with "Dummy Joints" and other transverse joints in the pavement slab. All expansion joints shall extend entirely through the curb section and shall be finished and filled with premoulded filler.

All Types Except Integral: One-quarter inch joints shall be provided at intervals of 20 feet, unless otherwise indicated on the plans, except where shorter sections are necessary for closures. The separation shall be effected by using steel plates ¼ inch in thickness, cut to true section, and set vertically in the forms until the concrete has set sufficiently to permit withdrawal of the plates.

707.06 DEPOSITING CONCRETE.

Integral Types: After concrete pavement has been

struck off, the curb form shall be clamped or otherwise securely fastened in place upon the slab form and the additional concrete for the curb shall then be deposited and thoroughly tamped. The additional concrete shall be placed within 30 minutes after the pavement slab has been finished and care shall be taken to secure monolithic construction. All concrete shall be spaded or vibrated sufficiently to eliminate all voids and shall be tamped to bring the mortar to the surface, after which it shall be finished smooth and even with a wooden float. All edges shall be rounded with an approved finishing tool to the radius shown on the plans.

When authorized, curb shown on the plans to be integral type may be placed after completion of the pavement provided dowels are placed in the pavement of the size, type and spacing shown on the plans. No additional cost to the Department shall result from placing the curb by this method.

All Types Except Integral: The concrete shall be placed on the prepared subgrade, struck off, and compacted to the required thickness. All concrete shall be spaded or vibrated sufficiently to eliminate all voids and shall be tamped to bring the mortar to the surface, after which it shall be finished smooth and even with a wooden float. All edges shall be rounded with an approved finishing tool to the radius shown on the plans.

707.07 FINISHING. The forms shall be removed within 24 hours after the concrete has been placed and honeycombed areas and other minor defects shall be filled with mortar composed of Portland cement and sand, mixed in the same proportion as provided for the concrete. Plastering will not be permitted on the faces of the curbing or gutter and all rejected curb or gutter shall be removed and replaced without additional compensation. The top and face of the curb or gutter shall be finished while the concrete is still green, by the use of wood float, brush and water.

707.08 BITUMINOUS CURBING. This item shall consist of furnishing extruded bituminous curb to the section shown on the plans by the use of an approved

machine. The contractor shall furnish and apply a tack coat as indicated on the plans, cost of which shall be included in the price bid on this item.

707.09 CURING (Except Bituminous Curbing). After finishing, the curb or gutter shall be cured in the same manner and by one of the methods prescribed for Portland cement concrete pavement—Section 601 of these specifications.

707.10 BACKFILLING. After the curb or gutter has set sufficiently, the contractor shall backfill adjacent to the curb or gutter with approved material. This material shall be thoroughly tamped in layers not over 6 inches in depth.

707.11 METHOD OF MEASUREMENT. All curb, combination curb and gutter, and gutter under this item will be measured by the linear foot measured along the face of the curb or as otherwise indicated on the plans. Excavation, backfill, expansion joint material and other miscellaneous materials will not be paid for separately but shall be included in the cost of the curb and gutter.

707.12 BASIS OF PAYMENT. Curb and gutter placed and accepted, measured as provided above, will be paid for at the respective contract unit price per linear foot.

Payment will be made under:

Item No.	Pay Item	Pay Unit
707(1)	Plain Concrete Curb	Linear Foot
707(2)	Plain Concrete Gutter	Linear Foot
707(3)	Combination Curb and Gutter	Linear Foot
707(4)	Combination Lip Curb and Gutter	Linear Foot
707(5)	Integral Concrete Curb	Linear Foot
707(6)	Integral Concrete Lip Curb	Linear Foot
707(7)	Bituminous Curbing	Linear Foot

Section 708
Right of Way Markers

708.01 DESCRIPTION. This work shall consist of furnishing and erecting right of way markers in conformity with the design, dimensions and elevations shown on the plans.

708.02 MATERIALS. Concrete shall be Class A or Class X conforming to the applicable requirements of Section 805.

Reinforcing steel shall be deformed bars conforming to applicable requirements of Section 806.

Bronze marker plates, when required, shall contain not less than 85 per cent copper and shall be true to pattern in form and dimensions.

CONSTRUCTION REQUIREMENTS

708.03 MARKERS. The markers shall consist of either precast reinforced concrete posts or bronze plates as indicated on the plans. The markers shall be installed on right of way lines at points designated on the plans or directed.

(a) Marker Posts. The concrete posts shall be cast, finished and cured in the following manner.

1. The concrete posts shall be cast in mortar-tight forms: Special care shall be exercised to puddle and tamp the concrete around the reinforcing steel and to avoid the formation of stone pockets. Concrete shall be placed continuously in each post.

2. Finishing: Forms shall be removed as soon as the concrete has hardened sufficiently to permit. All holes and voids shall then be filled with sand cement mortar of the same mix as used in the body of the posts and the entire surface of the posts brought to a smooth, neat appearance by rubbing off the rough spots with a carborundum block.

3. Curing: As soon as finished, the posts shall be covered with wet burlap and kept continuously wet for a period of not less than 3 days.

(b) Bronze Markers: Bronze markers shall be furnished and installed in concrete at locations indicated on the plans in a neat and workmanlike manner as directed.

708.04 BACKFILLING. All posts shall be set to the depth indicated on the plans or as directed. Post holes shall be backfilled and thoroughly tamped as directed.

708.05 METHOD OF MEASUREMENT. Right of way markers will be measured by the marker and the number placed and accepted shall be counted.

708.06 BASIS OF PAYMENT. The number of markers placed and accepted shall be paid for at the contract unit price complete in place.

Payment will be made under:

Item No.	Pay Item	Pay Unit
708(1)	Right of Way Marker (Concrete Posts)	Each
708(2)	Right of Way Marker (Bronze)	Each

Section 709

Steel Rail Cattle Guards

709.01 DESCRIPTION. This work shall consist of the construction of welded steel rail cattle guards at the locations and conforming to the details shown on the plans, and in accordance with these specifications.

These specifications cover portable steel rail cattle guards that can be set in place on the reinforced concrete walls or footings. The plans show types of crossings that are acceptable to the Department. Cattle guards of other types may be furnished if prior approval is obtained from the engineer. If bids are submitted on some other type, it will be necessary to include, with the bid, manufacturer's drawings and specifications for the type the bidder contemplates furnishing for approval by the Department.

709.02 MATERIALS. Steel rails shall be of the unit weight specified on the plans.

Pipe wings shall be standard strength black or galvanized iron pipe, 2 inch diameter or as otherwise specified on the plans. If black pipe is furnished it shall receive, in the shop, one coat of primer and one coat aluminum paint. Paint and its application shall conform to the applicable requirements of Section 811. Galvanized pipe will not require painting.

Concrete shall be Class A meeting the applicable requirements of Section 805.

Reinforcing steel shall be deformed bars meeting the applicable requirements of Section 806.

Treated timber where required shall be creosoted pine or Douglas fir and shall be Dense No. 1 structural meeting the applicable subsection of Section 812.

Hardware shall be standard quality of the size and dimensions recommended by the fabricator of the cattle guard and acceptable to the engineer.

CONSTRUCTION REQUIREMENTS

709.03 EXCAVATION AND BACKFILL. A trench of

sufficient width, shall be excavated to the line and grade indicated on the plans or directed. Excavation shall extend a minimum of one foot outside the neat lines of the concrete walls or footings.

The backfill shall be deposited in layers not exceeding 8 inches loose thickness and each layer shall be thoroughly compacted with approved mechanical tampers.

709.04 REINFORCED CONCRETE. Class A concrete and reinforcing steel shall be placed in accordance with the plans and applicable requirements of these specifications. The reinforcing steel shall be securely fastened in an approved manner so as not to be displaced during the placing of the concrete.

709.05 PLACING TIMBERS. When timbers are required they shall be placed as shown on the plans.

709.06 RAILS AND PIPE WINGS. Rails shall be placed in accordance with the details shown on the plans, welded together in an approved manner, and the completed guard rail shall be substantial in every respect.

Pipe wings shall be in accordance with the plan details.

709.07 METHOD OF MEASUREMENT. Steel rail cattle guards, of the type and dimensions shown on the plans or in the proposal, will be measured, complete in place and accepted, and each completed cattle guard will be counted.

Excavation or backfill will not be measured but the cost of this work will be included in the unit price bid on Steel Rail Cattle Guard.

709.08 BASIS OF PAYMENT. The number of cattle guards completed and accepted as provided above, shall be paid for at the contract price per unit for "Steel Rail Cattle Guards," and shall include all work and materials for the complete installation.

Payment will be made under:

Item No.	Pay Item	Pay Unit
709(1)	Steel Rail Cattle Guard	Each

Section 710
Removal and Relocation of Buildings and Miscellaneous Structures, Moving of Buildings and Miscellaneous Structures and Demolishing Buildings or Structures

710.01 DESCRIPTION. The removing and relocation of buildings and miscellaneous structures shall consist of the removal, preparation for moving and relocation of buildings or structures of all types, together with all existing service connections, appurtenances and accessories; reconstruction of all foundations and appurtenances, all in accordance with the plans and these specifications.

Moving of buildings and miscellaneous structures shall consist of moving units specified under the item "Removal and Relocation of Buildings and Miscellaneous Structures" from the original location to the final location. This item shall include the extension of existing water, gas, sewer and other service lines and utilities and all materials necessary therefor.

Demolishing buildings or structures shall consist of demolishing and disposing of all parts of the building or structure indicated on the plans, including foundations, basements, cisterns, underground tanks, walks, driveways or other artifacts.

CONSTRUCTION REQUIREMENTS

710.02 GENERAL. The Department reserves the right to eliminate from the work to be done by the contractor, the removal of any or all of the buildings, structures, etc., itemized under these items, if deemed advisable by the engineer. Such elimination shall not affect the unit prices bid on the remaining buildings, structures, etc., to be moved, or the unit prices bid

on the other items of the contract and the contractor will not be entitled to any compensation due to such elimination.

In performing work in connection with the removal and relocation of buildings and miscellaneous structures, the contractor's attention is specifically directed to the requirements of Section 107 of these specifications.

710.03 REMOVAL AND RELOCATION OF BUILDINGS AND MISCELLANEOUS STRUCTURES. Buildings or structures shall be prepared for moving, removed and placed in their new locations, as shown on the plans or as designated, and left plumb and level and in as good condition in all respects as originally found. All units removed and relocated shall be placed on foundations of the same type and character as the original foundations.

Steps, outside stairways, canopies, porches, block or post supports, sills, chimneys on brackets and other appurtenances forming an integral part of the building are to be considered as part of the building and removed and relocated accordingly. Cellars, cellar steps, concrete or masonry porches, concrete floors, solid or semi-solid concrete and masonry foundations and supports, septic tanks, fireplaces and chimneys standing on the ground, and other appurtenances attached or connected to the building but not movable as an integral part of the building, shall be removed, relocated and/or replaced with foundations or appurtenances of the same size, type and character as existed before the building was moved.

Wherever sanitary sewers, water, gas, electric, or telephone service lines are connected to the buildings being removed and relocated, the same shall be disconnected without unnecessarily discommoding the occupants of the building being moved. The contractor shall be responsible for all notices to the public utility companies and for all fees charged by them.

All privies, wash houses, garages, and other outbuildings, cisterns, wells, septic tanks and other appurtenances used in conjunction with a building or structure shall be removed and relocated. The contractor

shall also remove and rebuild existing yard fences, driveways and walks and extend same as necessary Existing shrubbery shall be removed and replanted a new locations as designated. All of the above sha be considered as appurtenances and appliances t the buildings or structures indicated on the plans t be removed and relocated.

Relocated wells shall conform to the Sanitary Code of the State of Louisiana as prepared and promulgated by the Louisiana State Board of Health.

The removal and relocation of a building, any part of which is used as a filling station, unless otherwise noted on the plans, shall include the removal and relocation of all gasoline pumps, tanks, pipes, signs, and other accessories appurtenant to the filling station. Tanks shall be placed the same depth below the ground as existed before moving.

Material in the existing foundations, concrete or masonry floors, chimneys and other appurtenances, where not used in the reconstruction of the appurtenances shall be removed and disposed of as directed.

All new material required by the contractor in performing any of the above operations shall be furnished by the contractor at his expense.

The contents of all buildings or structures shall be removed and relocated along with the building or structure to its new site. In the event that it is not feasible or possible to remove the building or structures together with the contents therein, the contents shall be removed from the building or structure at its original location and same replaced in the relocated building or structure. Such precautions as necessary shall be taken to prevent damage or loss of any kind to the contents thereof.

Removal and relocation of miscellaneous structures. Cattle pens, cane derricks, cattle guards or other similar type structures, detailed under this item, shall be removed and relocated or reconstructed on or beyond the rights of way line as directed. Materials in the existing structures, which are considered suitable for

re-use, may be utilized in their reconstruction. All new materials required shall be similar in kind to that in place and shall be furnished by the contractor at his expense.

Removal and/or relocation of liquefied petroleum gas tanks (Butane tanks). Prior to the removal and/or relocation of butane tanks, the contractor shall notify and obtain approval of the Louisiana Liquefied Petroleum Gas Commission, Baton Rouge, Louisiana, in order that said Commission may have a representative present at time of removal should they desire. Should their representative be present and should he require that a new tank be furnished, the contractor shall replace the old tank with such new tank as required. The contractor will be reimbursed for the actual cost of the new tank furnished upon presentation of the original receipted bill, which payment will be in addition to the price bid under this item. If the removed tank is not to be re-used on this project, it shall be destroyed by the contractor, but in doing so, the contractor is warned of danger from accumulated gas in the old tank. A suggested method is first filling the tank with water and cutting off the neck; however, the Department will not be liable for any damage or loss from such operations. Said operations shall be the full responsibility of the contractor.

The contractor shall furnish the Department with a certificate of release from each property owner, and in the event of separate ownership of building and property, a certificate of release from each owner shall be furnished. This certificate shall state that the buildings or structures removed and relocated are in an acceptable condition and that said owner waives all claims for damages to his property and buildings or structures removed.

710.04 MOVING OF BUILDINGS AND MISCELLANEOUS STRUCTURES. The limits of moving of a building unit shall be the distance from the center of the principal building or structure in its original location, measured along the shortest practical route of moving to the center of the principal building or structure in its new location. Appurtenances to the principal building or structure will not be considered in the measure-

ment, but shall be moved with the principal building or structure as a unit and re-established at the new location.

710.05 DEMOLISHING BUILDINGS OR STRUCTURES. Unless otherwise specifically provided all materials in the designated building or structure shall become the property of the contractor. All portions of the building or structure shall be removed from the right of way and disposed of by the contractor.

710.06 METHOD OF MEASUREMENT. Removal and relocation of buildings and structures will be measured by the building or structure designated on the plans and each principal building or structure will be designated on the plans and in the contract by its station number and for the purpose of measurement, each principal building or structure, together with its appurtenances and appliances will be considered a complete and separate unit.

The moving of a building unit shall be measured in units of principal building or structure moved one foot which shall be designated a "Building foot."

Demolishing buildings or structures shall be measured by the unit and shall include appurtenances, foundations, etc.

710.07 BASIS OF PAYMENT. Buildings removed, moved, relocated and accepted, measured as provided above, shall be paid for at the contract unit price for "Removal and Relocation of Buildings and Miscellaneous Structures," "Moving of Buildings and Miscellaneous Structures" and "Demolishing Buildings or Structures."

Payment will be made under:

Item No.	Pay Item	Pay Unit
710(1)	Removal and Relocation of Buildings and Miscellaneous Structures	Per Unit
710(2)	Moving Buildings and Miscellaneous Structures	Per Building Ft.
710(3)	Demolishing Buildings or Structures	Per Unit

Section 711
Riprap

711.01 DESCRIPTION. This work shall consist of furnishing and placing riprap in accordance with these specifications and in reasonably close conformity to the lines, grades and thickness shown on the plans or directed by the engineer. Riprap shall be Random Riprap, Handplaced Riprap or Grouted Riprap.

711.02 MATERIALS. Riprap may be stone, waste concrete or broken concrete. Stone shall be durable field or quarry stone, dense, resistent to the action of air and water, and suitable in all respects for riprap purposes. Stone used for hand-placed riprap and grouted riprap shall be approximately rectangular in shape. The volume of the individual stones, except those used for chinking, shall be not less than ¼ of a cubic foot.

Waste concrete or broken concrete may be used for riprap provided it is sound and meets the size requirements for stone.

711.03 RANDOM RIPRAP. Random riprap shall be dumped or rolled into place in such a manner that the smaller stones will be uniformly distributed throughout the mass. Sufficient hand work shall be done to procure a neat and uniform surface and the depth shown on the plans or otherwise specified.

711.04 HAND-PLACED RIPRAP. The area over which the hand-placed riprap is to be placed shall be shaped to conform reasonably to the cross section shown on the plans or otherwise designated. All trees, brush or stumps shall be removed to the elevation of the bed of the riprap and all loose material shall be thoroughly compacted by approved methods. When the riprap is to be laid on a slope a trench of the required dimension shall be excavated at the toe of the slope and the stone firmly embedded in the trench at the toe thereof, with the axis of each stone most nearly approximating the specified thickness of the riprap, laid perpendicular to the slope. All stones shall be

laid in such a manner as to break joints with adjacent stone and shall be laid with the minimum practicable amount of space between them. After the stones have been laid, all spaces between them shall be chinked with small stones or spalls rammed firmly into place. The finished face of the riprap shall be as smooth and true to the line, grade and section as the material will permit. Unless otherwise specified, the riprap, in place, shall have a minimum thickness of 6 inches, measured at right angles to the face of the riprap.

711.05 GROUTED RIPRAP. Grouted riprap shall conform to the requirements of hand-placed riprap and in addition all interstices in the stones shall be completely filled with grout throughout the entire thickness of the riprap, after which the surface shall be swept with a stiff broom. The grout shall consist of one part by volume of Portland cement, 3 parts by volume of dry sand and sufficient water to produce the desired consistency. Preformed ¼ inch thick expansion material, meeting the requirements of Subsection 905.02, shall be placed around piles, columns, etc., and all costs of furnished and placing preformed filler shall be borne by the contractor.

711.06 METHOD OF MEASUREMENT. Random riprap will be measured by the cubic yard of stone in vehicles at the point of delivery on the project.

Hand-placed and grouted riprap will be measured by the square yard in place.

No measurement will be made for any necessary excavation or backfilling but the cost of this work will be included in the unit price bid on the riprap item.

711.07 BASIS OF PAYMENT. The quantity of riprap placed and accepted, measured as provided above, will be paid for at the contract price per unit for "Random Riprap," "Hand-placed Riprap" or "Grouted Riprap," as the case may be.

Payment will be made under:

Item No.	Pay Item	Pay Unit
711(1)	Random Riprap	Cubic Yard
711(2)	Hand-placed Riprap	Square Yard
711(3)	Grouted Riprap	Square Yard

Section 712

Revetments

712.01 DESCRIPTION. This work shall consist of constructing revetments as specified on the plans and in the proposal. The revetment shall be placed against the embankments and along the slopes and bottoms of streams of channels at bridge ends or at other points to be protected as shown on the plans or directed and shall be in accordance with these specifications and in reasonably close conformity with the grades or lines shown on the plans or as directed. Revetments will be Grouted Concrete Block, Cast-in-place Concrete, or Pneumatically Applied Mortar Revetment.

712.02 MATERIALS. Materials shall meet the requirements of the following subsections of Part IX Materials.

Portland Cement	901.01
Fine Aggregate	903.02
Mesh Reinforcement	909.01

712.03 PROPORTIONING AND MIXING. Grouted concrete block and concrete cast-in-place revetments shall be Class R concrete or better, proportioned and mixed as set forth in Section 805.

The proportions of cement to sand for pneumatically applied mortar shall be based on dry and loose volumes and shall not be less than one part Portland cement to 4.5 parts sand. The water content shall be maintained at a practicable minimum and shall not exceed 3 gallons per sack of cement. The cement and sand shall be thoroughly mixed before being charged into the machine. The sand shall contain not less than 3 nor more than 6 per cent moisture by weight.

CONSTRUCTION REQUIREMENTS

712.04 PLACING. All revetment will be placed in the dry unless otherwise directed.

(a) Grouted Concrete Block Revetment. Blocks shall be of precast concrete, 12" x 24", and of the thickness shown on the plans. The placing of concrete blocks shall commence in a trench as shown on the plans, below the toe of the slope and shall progress upward.

Each block shall be laid by hand perpendicular to the slope, shall be firmly bedded against the slope and against adjoining blocks, and shall be laid with broken joints.

All concrete blocks shall be grouted into place. Grout shall be applied in such a manner as to insure filling all joints and crevices. Grout used shall be of the same material, proportions and consistency as provided for grouted riprap in Subsection 711.05.

(b) Concrete Cast-in-place Revetments. The cast-in-place revetments shall be within reasonably close conformity of the thickness shown on the plans. The placing of cast-in-place revetments shall commence in a trench below the toe of the slope and casting shall progress upward.

(c) Pneumatically Applied Mortar Revetments.

1. Pneumatically applied mortar shall be a premixed sand and cement pneumatically applied by a suitable mechanism and competent operators, and to which the water is added immediately previous to its expulsion from the nozzle.

2. The type of machine the contractor furnishes for pneumatic placement of mortar shall be adequate for the purpose and acceptable to the engineer.

3. Mesh reinforcement, if required, shall be placed in accordance with the plan details. The mortar shall be placed in one layer in reasonably close conformity with the thickness shown on the plans. Pneumatically applied mortar shall not be applied when the air temperature is less than 50° F.

(d) After placement, the surface of the revetments,

other than concrete block, shall be kept moist for a period of not less than 3 days.

(e) Before placement, preformed ¼ inch thick expansion material, meeting the requirements of Subsection 905.02, shall be placed around piles, columns, etc. All costs of furnishing and placing preformed filler shall be borne by the contractor.

712.05 METHOD OF MEASUREMENT. Revetments will be measured by the square yard in place. No measurement will be made for any necessary preparation of the embankment slopes, excavation, or backfilling but the cost of this work will be included in the price bid on the respective type of revetment.

712.06 BASIS OF PAYMENT. The quantity of revetment placed and accepted, measured as provided above, shall be paid for at the contract price for "Grouted Concrete Block Revetment," "Concrete Cast-in-place Revetments," or "Pneumatically Applied Mortar Revetment," as the case may be.

Payment will be made under:

Item No.	Pay Item	Pay Unit
712(1)	Grouted Concrete Block Revetment (" Thick)	Square Yard
712(2)	Concrete Cast-in-place Revetment (" Thick)	Square Yard
712(3)	Pneumatically Applied Mortar Revetment (" Thick)	Square Yard

Section 713

Signs and Barricades

713.01 DESCRIPTION. This item shall consist of furnishing, installing and maintaining all barricades, suitable lights, danger signals, and signs; providing watchmen; and complying with all other requirements regarding the protection of the work, workmen and safety of the public. It shall also include furnishing and placing such other signs as may be required by the plans. Signs and barricades shall conform to the details and specifications shown on the plans and these specifications.

Signs and barricades, and the arrangements thereof, as shown on the plans, are minimum requirements of the Department. Special conditions shall be treated as such and appropriate signs shall be furnished and installed as directed. Requirements as to proper signs and barricades, or other safety precautions as may be promulgated by the contractor's insurers, are not negated by these specifications. In no wise shall these specifications be construed as relieving the contractor of any of his responsibilities for the safety of the traveling public, for any liability in connection therewith or compliance with State and local laws or ordinances.

713.02 SIGNS, BARRICADES, ETC. Materials for use in signs, barricades, etc., shall conform to the requirements of the plans.

CONSTRUCTION REQUIREMENTS

713.03 GENERAL. Signs, barricades, etc., will be required during such time as the contractor's work is in progress on the portion, or portions, of the work covered by the work order (partial or full), or when his operations are suspended but the traveled portion of the road is not in such condition as to be safe for the traveling public. During such times that barricades are not in place, appropriate regulatory signs shall be erected and maintained by the contractor.

In the event a partial work order is issued, the contractor shall immediately begin the erection of signs and barricades over the affected portion, or portions, of the project to the extent necessary to comply with the requirements herein set forth, or herein referred to. When the full work order is issued, barricades shall be erected at the beginning and end of the project, and signing throughout the remainder of the project shall be completed.

In the event a full work order is issued, the contractor shall immediately begin the erection of appropriate signs and barricades over the entire project.

In any event, the erection of signs and barricades shall be completed within 10 days after issuance of the work order, or partial work order, as the case may be, over the entire project, or over the portion, or portions, affected by the partial work order.

In no event shall construction work under this contract begin until signs and barricades, as provided above, have been erected and approved.

When all signs to be furnished and erected by the contractor are in place and approved, the Department's District forces will remove any standard highway departmental signs. The engineer shall cooperate with the contractor's representatives in placing of signs, as well as the representative of the Department's District Engineer charged with removing departmental signs. The work shall be performed in an orderly manner so that at all times an adequate number of appropriate signs are in place.

Signing, as required by the contract, shall be in accordance with the plans and the Louisiana Manual on Uniform Traffic Control Devices, and shall remain in place and shall be maintained by the contractor and supplemented by additional signs as may be required throughout the life of the contract.

Signs placed by the contractor shall not be removed until the contract is finally completed and, in no event, until Department's forces have properly re-erected standard highway department signs along the project. However, it shall be the sole responsibility of the en-

gineer to see that all departmental signs are in place, upon completion and acceptance of the project.

Signs, barricades, etc., furnished and placed by the contractor, shall, upon removal, become his property.

On projects where the surface course is constructed with bituminous concrete, or with Portland cement concrete pavement, the centerline striping shall be completed by the Department's forces prior to the removal of barricades.

713.04 METHOD OF MEASUREMENT. Signs, barricades, etc., will be measured by the lump and the measurement shall include furnishing and erecting of all signs, barricades, lights and all other items necessary for the protection of the public. It shall also include the removal of all signs and barricades upon completion of the project.

713.05 BASIS OF PAYMENT. Signs, barricades, etc., measured as provided above, will be paid for at the lump sum contract price for "Signs and Barricades."

Payment will be made under:

Item No.	Pay Item	Pay Unit
713(1)	Signs and Barricades	Lump Sum

Section 714
Slab Sodding

714.01 DESCRIPTION. This work shall consist of furnishing, hauling, planting, fertilizing if required, rolling, watering and maintaining live bermuda grass sod, live carpet grass sod or any other approved grass sod which is native to the area, at locations shown on the plans or designated by the engineer.

714.02 MATERIALS. Slab sod shall be composed of bermuda grass, carpet grass or other approved grass which is native to the locality of the work.

Sod furnished shall be free from noxious weeds and other vegetation and shall be planted as provided in these specifications.

Sod shall be cut to a minimum depth of 2½ inches and to a satisfactory and fairly uniform width. Sod shall be cut in convenient lengths for handling. Fertilizer shall meet the requirements of Subsection 915.08.

Water may be obtained from any available source except brackish or oily water shall not be used.

CONSTRUCTION REQUIREMENTS

714.03 DIGGING. Slab sod shall be cut with approved sod cutters. Bare areas that may produce inferior sod will not be accepted. Any watering required to facilitate digging the sod or for other reasons in connection with digging, storing or hauling shall not be paid for.

714.04 HAULING. After sod is cut in the field, it shall be placed flat, grass side up on boards of convenient lengths and hauled to the planting site with soil still intact. Only one layer of sod shall be placed on each board and such boards shall be of sufficient thickness to prevent unreasonable bending and of sufficient width that the slabs of sod shall not hang over the edges. The slabs shall be placed closely without leaving unreasonable spaces between them. In no case

shall slab sod be loaded in bulk on vehicles or dumped in bulk on the planting site. Sod which has been cut more than 48 hours, before placing, shall not be used.

714.05 PLANTING. All areas to receive slab sod shall be thoroughly scarified and pulverized to a depth of approximately 3 inches and dressed to a reasonable grade. If an item for fertilizer is included in the contract, approximately 90 per cent shall be broadcast over the entire area to receive the slab sodding, the remaining 10 per cent shall be broadcast over the sod after placing and rolling. Upon delivery to the planting site, the slab sod shall be transferred from the boards onto the surface of the soil. The area to be sodded shall be watered as directed. The slabs of sod shall be placed closely, leaving a minimum amount of space between slabs. Slabs which do not fit closely shall be pulled together with suitable tools. In no case shall sod be handled by hand except when used as fillers for small cracks or at locations where it would be impracticable to use boards.

714.06 ROLLING. All slab sod shall be rolled as soon after planting as practicable with plain rollers or cultipackers. Where rolling is impracticable, the sod shall be tamped by approved hand methods.

714.07 WATERING. All slab sodding shall be watered as necessary.

714.08 EQUIPMENT. All equipment shall be on the work and in working condition before starting operations.

Equipment shall consist of the following:

(a) Approved smooth wheeled drum type sod roller.

(b) plows, disks, scarifiers, rollers and harrows as needed.

(c) Sod cutting machine, either self powered type or pull type from tractor.

(d) Required blades, drags and other necessary tools to complete the work.

(e) Approved water wagons or tanks of sufficient capacity, or other sprinkling devices.

714.09 METHOD OF MEASUREMENT. Slab sodding will be measured by the square yard and the area to be included in the measurement shall be the actual area sodded as authorized. Water will be measured by the 1000 gallons in tanks used by contractor. Fertilizer, if required, will be measured and paid for as provided in Subsections 718.05 and 718.06.

714.10 BASIS OF PAYMENT. Sodding planted and accepted, measured as provided above, shall be paid for at the contract unit price.

Water will be paid for at contract unit price.

Payment will be made under:

Item No.	Pay Item	Pay Unit
714(1)	Slab Sodding	Square Yard
714(2)	Water	M Gallons

Section 715
Mulch Sodding

715.01 DESCRIPTION. This work shall consist of furnishing, hauling, spreading, fertilizing if required, rolling, watering and maintaining live bermuda or bahia grass roots and topsoil.

715.02 MATERIALS. Mulch sod shall consist of a natural or approved artificial combination of grass roots and topsoil. Mulch sod supplied shall predominate in bermuda grass or bahia grass roots and be reasonably free of weeds and debris. Topsoil shall consist of good loamy topsoil from fields, creek banks, woods or other approved sources and shall be reasonably free of roots, rocks, weeds, trash and other debris.

Fertilizer shall meet the requirements of Subsection 915.08.

Water shall conform to the applicable requirements of Subsection 714.02.

CONSTRUCTION REQUIREMENTS

Natural Combination

715.03 DIGGING. The approved source of mulch sod shall be mowed, raked and disked if necessary. The mulch sod shall then be plowed up into rows; the depth of removal not to exceed 6 inches unless otherwise directed; it will then be bladed into windrows or otherwise stockpiled for convenience in loading. The contractor shall not be allowed to disk, plow, windrow or otherwise stockpile the mulch sod on any source area too large for early removal. Mulch sod stockpiled over 48 hours shall not be used.

Mulch sod shall not be contaminated with tree roots, tops, branches or other debris and such foreign material shall be dug up, cleared and removed before sod is loaded or stockpiled.

Any watering required to facilitate digging the sod

or for other reasons in connection with digging, storing or hauling, shall not be paid for.

715.04 HAULING. Mulch sod shall be loaded with suitable equipment, hauled and dumped on the areas as designated by the plans.

715.05 SPREADING. After dumping, the mulch sod shall be uniformly spread to a depth of approximately 6 inches. The mulch sod shall be spread in such a manner that a minimum amount of roots will be exposed. In no case shall spike tooth harrows or drags be used to spread mulch sod.

All areas to receive mulch sod shall be thoroughly scarified and pulverized to a depth of approximately 3 inches and dressed to grade.

If an item for fertilizer is included in the contract, it shall be broadcast over the entire area to be mulch sodded before sod is placed.

715.06 ROLLING. After spreading, the mulch sod shall be rolled with a cultipacker or soil pulverizer until the surface presents a level appearance. In inaccessible places and locations where rolling with the above equipment is impracticable, the soil shall be tamped by suitable hand methods.

CONSTRUCTION REQUIREMENTS

Artificial Combination

715.07 GENERAL. Where a natural combination of suitable grass roots and topsoil is unavailable the contractor may substitute a combination of approved grass roots and topsoil in lieu of mulch sodding.

715.08 SPREADING. All areas to receive topsoil shall be thoroughly scarified, pulverized and uniformly dressed. Topsoil shall be uniformly spread to the depth specified in the proposal or on the plans over the areas to be sodded. Where no depth is specified, the depth will be approximately 6 inches.

Topsoil shall be thoroughly disked and all stiff clods, lumps, stones, roots, litter or other foreign matter shall be removed.

Bermuda roots and tops shall be broadcast over all areas where topsoil has been spread. The roots and tops shall be placed closely together on the surface so as to completely cover the ground. All bermuda roots and tops shall be kept moist from the time of digging to that of spreading at the expense of the contractor. All dried out roots will be rejected.

Immediatetly after spreading, the roots and tops shall be thoroughly disked into the surface so they will be chopped and covered without disturbing the uniform distribution.

After disking, the area thus sodded shall be rolled with a cultipacker or soil pulverizer until the surface presents a level appearance. In inaccessible places and locations where rolling is impracticable, the contractor shall hand tamp such areas in a satisfactory manner. Toothed harrows, rakes, drags with spikes, and other implements which would tend to tear out the grass roots and tops shall not be used.

The contractor shall have the right to strip suitable topsoil from surface areas within the limits of construction. The topsoil shall be stockpiled in windrows, or otherwise, for ultimate respreading on areas to be sodded. No topsoil shall be stripped from any areas within the limits of the right of way outside the limits of actual construction. All topsoil stripped as described above shall be replaced with acceptable material from sources beyond the project limits at the contractor's expense.

If an item for fertilizer is included in the contract it shall be broadcast over the entire area of topsoil prior to placing bermuda roots and tops.

715.09 WATERING. All mulch sod whether natural or artificial mix shall be watered and kept moist as long as necessary to establish a satisfactory growth.

715.10 EQUIPMENT. All equipment shall be on the work and in working condition before starting the mulch sodding operations.

Equipment shall consist of the following:

(a) A soil roller or cultipacker weighing not less

than 500 pounds and not more than 1500 pounds, either a single or double type.

(b) Necessary plows, disks, scarifiers, rollers and harrows.

(c) Required bulldozers, blades, drags and other tools to complete the work.

(d) Approved water wagons or tanks of sufficient capacity or other sprinkling devices.

715.11 METHOD OF MEASUREMENT. Mulch sod will be measured by the cubic yard in vehicles at the point of delivery on the project. When an artificial mix is used only the top soil shall be measured. Furnishing the bermuda roots and tops will be considered incidental. Water will be measured and paid for as provided in Subsections 714.09 and 714.10. Fertilizer, if required, will be measured and paid for as provided in Subsections 718.05 and 718.06.

715.12 BASIS OF PAYMENT. Mulch sod placed and acccepted as provided above shall be paid for at the contract unit price.

Payment will be made under:

Item No.	Pay Item	Pay Unit
715(1)	Mulch Sodding	Cubic Yard

Section 716

Vegetative Mulch

716.01 DESCRIPTION. This work shall consist of furnishing and placing an asphalt tacked mulch of straw or hay on areas that have been seeded or mulch sodded.

The intent of these specifications is to insure that all seeding, mulch sodding or a combination thereof are protected against erosion.

716.02 MATERIALS.

(a) Types of Mulches. Mulch shall be vegetative in character and shall consist of either stalks or stems of oats, rye, rice, wheat or other approved straw, or hay obtained from various legumes or grasses, such as lespediza, clover, vetch, soybeans, bermuda, carpet sedge, bahia fescue or other approved legumes or grasses, or a combination thereof.

Straw of hay shall be dry and reasonably free from Johnson grass or obnoxious weeds. Contractor shall notify the engineer at least 7 days in advance of operations as to the source of the mulch supply so that the straw or hay can be inspected. The mulch shall be approved before being used.

(b) Storage of Materials. Mulching material shall be delivered to the project in bales of uniform size. If stockpiling of the bales is necessary they may be stored on the right of way. Stockpiling will not be permitted in close proximity to any residence or other building occupying private lands adjacent to the right of way. If the contractor desires to stockpile mulching materials on private propetry and/or in buildings off the right of way, he shall furnish the engineer with a copy of agreement signed by property owner. Stockpiles shall be suitably protected from the weather.

(c) Asphalt. Asphalt used as a part of the mulching process shall be Emulsified Asphalt Grade EA-4 meeting the requirements in Subsection 902.03.

CONSTRUCTION REQUIREMENTS

716.03 GENERAL. Mulching shall closely follow ground preparation, fertilizing, seeding or mulch sodding, or a combination thereof. All mulch shall be placed with mechanical equipment of a conventional type which will distribute the mulch uniformly by blowing it onto the area. The equipment shall be provided with jet nozzles spaced in the muzzle of the blower through which the asphalt is ejected simultaneously with the mulch, thus coating the mulch uniformly with a spray of asphalt as the mulch is blown through the muzzle.

Spreading the mulch manually and after spraying with asphalt will be permitted only in areas which are inaccessible to the equipment.

716.04 SPREADING RATES. Mulch shall be applied at an approximate rate of 1½ to 2 tons per acre simultaneously with the emulsified asphalt at an approximate rate of 75 to 150 gallons per ton of mulch.

When required, the emulsified asphalt shall be diluted with water in such proportions as is designated; however, only the emulsified asphalt used shall be measured and paid for.

The specific rates of application of mulch and asphalt may vary within the job limits and be contingent on the type areas to be covered and the character of the mulching materials furnished. The rates for these areas shall be specified by the engineer.

716.05 MANUAL SPREADING. Where manual spreading is permitted, the mulch shall be placed in such a manner that a loose, shredded and fluffy condition will prevail, after which the emulsified asphalt shall be sprayed over the surface of the mulch. The rates shall be the same as described in the mechanical operation.

716.06 MULCHING OPERATIONS. Mulching operations shall begin within 24 to 36 hours after completion of seeding and/or mulch sodding, even for the smallest areas, in order to protect such areas from erosion.

In its final position, the asphalt-tacked mulch shall be loose enough to allow air to circulate, but compact enough to partially shade the ground and to reduce the impact of rainfall on the surface of the soil. Mulching shall begin at the top of slopes and extend downward. Particular attention shall be given to the top of slopes so that such areas will be covered at the junction with the natural ground. Extensions to the blower pipe shall be supplied where high slopes are encountered that cannot be reached by the blower under normal conditions. Windy conditions will have an effect on the uniformity of final mulch placement and the contractor will be required to make adjustments in his operations to obtain uniform spreading.

716.07 EQUIPMENT. Equipment shall consist of the following:

(a) Mulch blowing machine equipped as provided above.

(b) Asphalt tank attached to or accompanying blowing machine.

(c) All rakes, pitchforks and other tools necessary to perform the work.

716.08 METHOD OF MEASUREMENT. Vegetative mulch will be measured by the ton, complete in place and accepted. The weight for measurement will be the product of the number of bales used and the average weight per bale as determined on certified scales provided by the contractor.

Emulsified asphalt placed and accepted will be measured by the gallon at a temperature of 60° F (Table III, Subsection 505.11).

716.09 BASIS OF PAYMENT. The number of tons of vegetative mulch and the number of gallons of emulsified asphalt measured as provided above shall be paid for at the contract unit prices for the items complete in place and accepted.

Payment will be made under:

Item No.	Pay Item	Pay Unit
716(1)	Vegetative Mulch	Ton
716(2)	Emulsified Asphalt (EA-4)	Gallon

Section 717
Seeding

717.01 DESCRIPTION. This work shall consist of preparing seed bed, fertilizing and watering if required, furnishing and sowing grass seed on the areas designated on the plans or as directed.

717.02 MATERIALS. All seed furnished shall conform to the requirements of Subsection 915.09.

Fertilizer shall meet the requirements of Subsection 915.08.

Water shall conform to the applicable requirements of Subsection 714.02.

CONSTRUCTION REQUIREMENTS

717.03 SELECTION OF SEED. Prior to planting time the engineer shall contact the Roadside Development Section in order to select the variety or varieties of seed to be used on the project as shown in Table I. The contractor shall abide strictly to this selection and furnish seed in accordance therewith.

717.04 SOIL AREAS. The seed shall be selected for planting on the basis of 5 general soil areas shown as follows:

(1) Alluvial soils of the Mississippi and Red River bottoms.

(2) Mississippi terraces and loessial hill soils.

(3) Coastal plain soils (rolling, hilly and flatwoods areas in central, northern and eastern part of the State).

(4) Coastal prairie soils.

(5) Ouachita valley cone (lying between the Ouachita River bottom on the west and Boeuf River bottom on the east).

TABLE I

Mixture	Seed to Mix	Approx. Pounds per Acre	Preferable Soil Areas	Preferable Planting Dates
A	Hulled Bermuda Carpet Grass	10 20 30	(2)(3)(4)(5)	Feb. 15 thru Sept.
B	Hulled Bermuda Pensacola Bahia	15 15 30	(1)(2)(3)(5)	Feb. 15 thru Sept.
C	Hulled Bermuda Common or Kobe Lespedeza*	10 20 30	(1)(2)(3)(5)	Feb. 15 thru April
D	Hulled Bermuda Carpet Grass Common or Kobe Lespedeza*	6 10 14 30	(2)(3)(4)(5)	Feb. 15 thru April
E	Hulled Bermuda La. White Dutch Clover*	10 20 30	(1)(2)(5)	Feb. 15 thru April
F	Hulled Bermuda Dixie Crimson Clover*	10 20 30	(1)(2)(3)(5)	Feb. 15 thru March
G	Alta or Kentucky 31 Fescue Dixie Crimson Clover*	30 10 40	(1)(2)(3)(4)(5)	Sept. thru January
H	Alta or Kentucky 31 Fescue Pensacola Bahia	30 10 40	(1)(2)(3)(5)	Sept. thru January

TABLE I (Continued)

Mixture	Seed to Mix	Approx. Pounds per Acre	Preferable Soil Areas	Preferable Planting Dates
I	Alta or Kentucky 31 Fescue	20	(1)(2)(3)(5)	Sept. thru January
	Dixie Crimson Clover*	10		
	Pensacola Bahia	10		
		40		
	WHEN ONLY ONE VARIETY OF GRASS IS TO BE PLANTED IN CONNECTION WITH MULCH SOD THE FOLLOWING WILL APPLY			
J	Hulled Bermuda	15	(1)(2)(3)(4)(5)	Feb. 15 thru Sept.
K	Dixie Crimson Clover*	30	(1)(2)(3)(5)	Sept. thru January
L	Alta or Kentucky 31 Fescue	30	(1)(2)(3)(4)(5)	Sept. thru Jan.
M	La. White Dutch Clover*	15	(1)(2)(3)(5)	Feb. 15 thru April Sept. thru November

*All clovers and lespedezas shall be inoculated with the proper culture before planting.

717.05 PREPARATION OF SEED BED (Bare Areas). The seed bed shall be prepared by breaking, disking, harrowing, blading, dragging or other approved methods. The soil shall be thoroughly pulverized to a minimum depth of approximately 3 inches and leveled as directed. The surface soil shall be firmed by lightly rolling the area with a cultipacker. If natural firming by rain has occurred, the rolling may be eliminated. All sticks, debris, and other foreign matter must be removed and the soil left in a suitable horticultural condition to receive the seed. If mulch sod, fertilizer or other materials is required by the specific terms of the contract, such material shall be spread over the areas and incorporated into the soil during the preparation of the seed bed. When required by the plans, newly seeded areas shall be protected against

erosion by the placement of vegetative mulch as provided in Section 716.

717.06 PREPARATION OF SEED BED (Grassy Areas). Where seed is to be sown on areas partly covered by grass which has grown during construction, such areas shall be lightly disked or scarified and rolled with a cultipacker as directed.

717.07 SEEDING. Immediately prior to planting, all clovers and lespedezas shall be inoculated with the proper culture for each variety of seed. The inoculated clovers or lespedezas shall then be mixed with other seed in the proportion designated for the various mixtures. If the seed is not planted on the date of inoculation, the inoculation shall be repeated.

All seed shall be planted in the proper season and in the amounts shown in Table I unless written permission is granted for earlier or later plantings. Seed shall be sown with rotary or other mechanical seeders. All seeded areas shall be lightly rolled immediately after seeding so as to press the seed firmly into the soil to prevent drifting.

717.08 WATERING. After the seed has been planted the area shall be watered immediately with approved watering tanks unless in the opinion of the engineer there is sufficient moisture to eliminate watering. After the first watering operation, other waterings will follow as directed. These watering operations will continue as necessary until the project is finally accepted. The water for seeding purposes shall be obtained from an approved source.

717.09 EQUIPMENT. Equipment shall be the same as required in Subsection 714.08.

717.10 METHOD OF MEASUREMENT. Seed will be measured by the pound and the quantity to be measured shall be that actually used on the project. For the purposes of measurement, no differentiation will be made for different types or combinations of types of seed furnished. Water will be measured and paid for as provided in Subsections 714.09 and 714.10. Fertilizer, if required, will be measured and paid for as provided in Subsections 718.05 and 718.06.

717.11 BASIS OF PAYMENT. The number of pounds of seed sowed and accepted shall be paid for at the contract unit price.

Payment will be made under:

Item No.	Pay Item	Pay Unit
717(1)	Seeding	Pound

Section 718

Fertilizer

718.01 DESCRIPTION. This work shall consist of furnishing and applying fertilizer at the locations shown on the plans in accordance with these specifications and as directed.

718.02 MATERIALS. Fertilizer shall be an approved brand conforming to the requirements of the Louisiana Department of Agriculture, Fertilizer Division. Fertilizer furnished may be either 8-8-8, 9-9-9, 10-10-10, 12-12-12, 13-13-13, 14-14-14, 15-15-15 or 16-16-16 at the option of the contractor.

CONSTRUCTION REQUIREMENTS

718.03 APPLICATION. Fertilizer shall be uniformly broadcast over the area to be fertilized either by hand or machine methods. Unless otherwise provided, the approximate rate of broadcast fertilizer per acre shall be as follows:

Type	Pounds Per Acre
8-8-8	1,000
9-9-9	889
10-10-10	800
12-12-12	667
13-13-13	615
14-14-14	571
15-15-15	533
16-16-16	500

The rate per acre may be increased or decreased as directed.

Fertilizer shall be applied as indicated in Subsections 714.05, 715.08 or 717.05, or as directed.

When fertilizer is applied following surface dressing, it shall be thoroughly incorporated in the soil by light disking or harrowing. Fertilizer may be applied just before final disking or harrowing during the

process of surface dressing or if dressed by hand it may be applied just before final raking and leveling.

718.04 EQUIPMENT. Required mechanical or hand spreaders, harrows and disks.

718.05 METHOD OF MEASUREMENT. Fertilizer will be measured by the pound and the quantity to be measured shall be that actually used on the project. The estimated quantity shown on the plans and in the proposal is based on the use of type 8-8-8 fertilizer.

Should the contractor elect to use any of the other types shown herein, the quantity actually used shall be measured and such quantity multiplied by the factor given below for the type used to obtain the quantity for payment.

Type	Factor
9-9-9	1.125
10-10-10	1.25
12-12-12	1.5
13-13-13	1.625
14-14-14	1.75
15-15-15	1.875
16-16-16	2.0

718.06 BASIS OF PAYMENT. The number of pounds of fertilizer placed and accepted, measured as provided above, shall be paid for at the contract unit price.

Payment will be made under:

Item No.	Pay Item	Pay Unit
718(1)	Fertilizer	Pound

Section 719
Jute Matting

719.01 DESCRIPTION. This work shall consist of furnishing and installing jute matting for stabilization of soils on slopes and ditches where shown on the plans.

719.02 MATERIALS. Materials shall meet the requirements of the following Subsections of Part IX Materials.

Jute Matting	915.15
Staples	915.16

CONSTRUCTION REQUIREMENTS

719.03 GENERAL. The jute matting shall be placed immediately after seeding and mulch sodding operations have been completed except for final rolling.

Beginning at the upgrade end, the matting shall be laid out flat, parallel to, and in the direction of the flow of water. When more than one strip is required to cover the area, they shall overlap on the sides at least 4 inches and the ends shall overlap at least 12 inches with the upslope sections on top.

The matting shall be spread evenly and smoothly and shall be in contact with the soil or mulch sod at all points.

The upgrade end of each strip shall be buried to a depth of not less than 6 inches in a slot perpendicular to the ground with the soil tamped firmly against it.

In ditches and on slopes, check slots or junction slots shall occur at 50 foot intervals as shown on the plans or as otherwise directed. Edges of jute matting shall be buried around the edges of catch basins and other structures by placing a tight fold of the matting at least 6 inches vertically into the soil.

719.04 STAPLING. Matting shall be tightly held to the ground by vertically driven staples. Furnishing and

installing staples shall be included in price bid on jute matting. Staples shall be spaced not more than 3 feet apart in 3 rows for each strip, with one row along each edge and one row alternately spaced in the center. On the overlapping edges of parallel strips, staples shall be spaced not more than 2 feet apart. At all anchor slots, junction slots, and check slots, staples shall be spaced not more than 6 inches apart.

719.05 ROLLING. After installation is complete, the jute matting shall be firmly embedded in the soil or mulch sod surface by tamping or rolling with an approved roller. Rolling shall be accomplished without damage to the matting and the established grades. Matting shall be pressed firmly into the soil or mulch sod and be nearly flush with the ground surface over the entire area.

719.06 WATERING. Following the placement of the matting, the area shall be watered as necessary.

719.07 MAINTENANCE AND REPAIRS. Jute matting shall be repaired immediately if damaged. Soil in any damaged area shall be restored to original grade and shall be re-fertilized or re-sodded or re-seeded as originally specified. No payment shall be made for such areas repaired.

719.08 EQUIPMENT. Equipment shall include the following:

(a) Approved smooth wheel hand sod roller.

(b) Necessary hammers, rakes and other hand tools.

719.09 METHOD OF MEASUREMENT. The quantity of jute matting shall be measured by the square yard complete in place.

719.10 BASIS OF PAYMENT. Jute matting placed and accepted shall be paid for at the contract unit price.

Payment will be made under:

Item No.	Pay Item	Pay Unit
719(1)	Jute Matting	Square Yard

Section 720
Field Laboratories

720.01 DESCRIPTION. This work shall consist of furnishing laboratory buildings for the exclusive use of the engineer during construction of embankments, base courses, asphaltic concrete, Portland cement concrete pavement or other phases of the work, as may be required by the plans or directed by the engineer.

720.02 GENERAL. Field laboratories shall be constructed of wood or metal of an approved type and shall be furnished for the purpose of housing and using testing equipment, keeping records of tests made and making reports. Buildings furnished shall meet the following minimum requirements.

(a) Field Laboratory for Asphaltic Pavement. The laboratory shall consist of a building or room at the plant site, at an acceptable location, and shall have a minimum floor space of 140 square feet. The laboratory shall be suitably weather proofed, heated and ventilated, shall contain a sink with running water and shall be provided with electric lights and power outlets as directed. The building or room shall be equipped with sturdily constructed benches and tables as required, shall have at least one outside door, and its contents shall be secured by suitable locks and catches. All keys shall be under the control of the engineer.

(b) Field Laboratory for General Use. Laboratories for use in connection with other construction phases shall be small buildings of the movable type which can be placed near the area of construction. Each building shall have a minimum floor space of 120 square feet. Each building shall be equipped with at least 2 tables or work benches having a minimum size of 30 inches by 48 inches, or as directed. Each building shall have at least one outside door and sufficient windows to provide satisfactory light in the daytime. If the contractor's operations are car-

ried on at night, adequate artificial lighting shall be provided. Roof, floor and walls shall be weather-tight.

(c) Buildings shall be adequately maintained during their use.

(d) Laboratory buildings shall become the property of the contractor and be disposed of by him upon completion of the project.

(e) Buildings furnished by the supplier at the plant site in connection with the furnishing of asphaltic concrete or Portland cement concrete will not be measured or paid for.

(f) Buildings may be used for successive phases of the project without additional compensation.

720.03 METHOD OF MEASUREMENT. Laboratory buildings furnished and accepted will be measured as complete units of the size and type specified. The measurement shall include all required furnishings and utilities such as electricity, heating, etc., adequate maintenance and removal upon completion of the project.

720.04 BASIS OF PAYMENT. The accepted number of laboratory buildings will be paid for at contract unit price per building of the size and type specified.

Payment will be made under:

Item No.	Pay Item	Pay Unit
720(1)	Field Laboratory for Asphaltic Pavement	Building
720(2)	Field Laboratory for General Use	Building

PART VIII
STRUCTURES

Section 801
General

801.01 DESCRIPTION. This section includes the items of work, the specifications and construction requirements for all types of bridges and related structures, and for all combinations of types of structures, all of which shall be built in reasonably close conformity with the lines, profile grades, dimensions and designs shown on the plans, and in compliance with the specifications set forth herein, and other specifications, or contract items, which are to contribute to, and constitute the complete structure, substructure, or superstructure in each case.

801.02 BORINGS. Soil borings and other subsoil investigations and soil analyses, will be made by the Department for development of subsurface information for bridge foundations. These data, made and developed by experienced personnel, will be included in the plans for informational purposes. Soil samples may not be available for inspection and bidders should make such additional investigations as they consider necessary to determine the subsoil conditions. No additional compensation, other than contract prices on pay items, will be allowed the contractor, should it develop during construction of a project, that the subsoil material is of a different character from that shown on the plans.

801.03 SHOP DRAWINGS AND WORKING DRAWINGS. The contractor shall be required to submit shop drawings and working drawings for approval as hereinafter described. No additional payment will be made for shop and working drawings, as the cost thereof shall be considered as included in the prices bid for the various contract items.

(a) Falsework. The contractor shall prepare and submit to the project engineer, for approval, plans for falsework proposed to be used for construction of all items of work requiring temporary supports usually classified as falsework. This requirement shall, also, apply to falsework required for changes in an existing structure necessary for maintenance of traffic. The term "falsework" shall be defined to mean a temporary construction work on which a main work is wholly or partly built and supported until it is strong enough to support itself; a temporary framework used to support a part or all of a structure during demolition.

Approval of falsework drawings shall in no way relieve the contractor of his responsibility under the contract.

(b) Steel Fabrication and Erection. Detail drawings shall be furnished by the contractor for approval as follows:

(1) Shop Drawings: The contractor shall furnish the Bridge Design Engineer shop drawings for all steel work for approval and no fabrication shall be started prior to final approval of these plans. These details must conform to the general drawings, stress sheets and specifications, and no deviations from the approved shop plans will be allowed without the written consent of the engineer. The contractor shall be responsible for the correctness of the drawings and for shop fits and field connections, even though the drawings have been approved.

Shop drawings shall be 22-inches by 36-inches in size. Two copies shall be submitted to the Bridge Design Engineer of the Department of Highways, in Baton Rouge, for checking, one of which will be returned with either approval or required revisions noted thereon. When changes on submitted drawings are requested and the contractor makes additional changes, other than those expressly requested, he shall direct attention to them on the next copies submitted by underscoring with colored crayon, or other suitable means. For final

approval, the contractor shall submit 9 copies. Upon completion of fabrication, the original tracings, in ink on cloth, shall be delivered to the Bridge Design Engineer of the Department of Highways in Baton Rouge. The contractor will be permitted to deliver photographic reproductions on translucent .004 inch polyester film which incorporates a wet process, silver halide emulsion of a permanent type, from which satisfactory prints can be made. Shop drawing reproductions made with material not of a silver halide photographic nature will be deemed unsatisfactory and therefore unacceptable. If the contractor elects to deliver photographic reproductions, the original tracings and working intermediates may be made in any manner the contractor prefers, providing satisfactory reproductions as specified can be made from the original tracings and working intermediates. All tracings and subsequent reproductions shall be size 23 inches by 37 inches and shall include a trim line at 1/2 inch from each edge to facilitate trimming of prints to 22 inches by 36 inches. In all cases, the type of reproductions proposed shall be submitted to the Bridge Design Engineer of the Louisiana Department of Highways for approval. The final estimate will not be approved for payment until the original tracings, or reproductions of a permanent type, have been delivered to the Bridge Design Engineer.

If the structural steel on the project consists only of expansion dams and bearing assemblies, the contractor will not be required to deliver the original tracings or reproductions.

(2) Erection Drawings: Before starting the work of steel erection, the contractor shall inform the engineer fully as to the method of erection he proposes to follow, and the amount and character of the equipment he proposes to use, which shall be subject to approval. He shall prepare and submit for approval, a key erection diagram and detail erection drawings for the work, all with dimensions and erection marks as appropriate to properly coordinate the erection drawings with the shop drawings for the work.

Approval of the methods, procedures and erection drawings shall in no way relieve the contractor of his responsibility under the contract.

The type, size and procedures for submittal and approval of erection drawings and delivery of original tracings of these drawings shall be the same as described and required for Shop Drawings described in (1) above.

(3) Shipping Statements and Shop Bills: The contractor shall furnish the engineer 6 copies of shipping statements, or notices, as each shipment of structural steel is made to the project. The weights of individual members shall be shown on the shipping statements. He shall, also, at the appropriate time during the project construction, furnish the engineer with 3 copies of the final shop bills for the structural steel item, which bills shall show the name, piece-mark, heat number and calculated weight for each member. These bills shall include a summary of the weights of structural steel for the project by grades.

(c) Movable Bridges. Detail drawings shall be furnished by the contractor for approval as follows:

(1) Shop Drawings and Erection Drawings: The contractor shall furnish a complete conduit and wire layout, elementary wiring diagram, detailed working drawings of the switchboard, control desk, junction boxes, machinery houses, operating house, counterweights, including calculations, and machinery and traffic barrier parts, and assembly layouts of all items he is to furnish. Certified dimension sheets of motors, brakes, generators, gasoline engines, limit switches, traffic gates, and all other such equipment shall be submitted to the Bridge Design Engineer for approval as soon as practicable after the award of the contract so that the engineer and the fabricator will have the information necessary to determine the details of associated parts. Certified dimension sheets shall show complete specifications for the equipment furnished.

All equipment and apparatus shall be as shown on

the plans, or the approved equal. The contractor shall submit 9 copies of certified dimension sheets and detailed manufacturer's description of each piece of equipment and apparatus, that he proposes to furnish, to the Bridge Design Engineer, one of which will be returned approved, or with the required revisions noted thereon. If any revisions are required on the original submittal, the contractor shall submit 9 corrected copies for final approval. The name of the project, project number, and Parish in which the project is located, shall be shown on each sheet of every submittal.

Except as otherwise provided herein, the contractor will not be required to furnish samples of the various types of wire and cable, but shall be required to furnish 8 copies of detailed manufacturer's description of each of the various types and sizes of wires and cables to the Bridge Design Engineer. The descriptions shall be full and complete, and shall include the manufacturer's name, the size of conductor, the type of stranding, the thickness and type of insulation, the thickness and type of jacket, the identification markings of the jacket, and the overall diameter of the wire.

In addition to the above, the description for cables shall include a construction layout sketch, the size and number of conductors, the type and thickness of sheath, the type and size of armor, the type and thickness of jacket, the diameter of the core, the diameter under jute bedding, and the overall diameter of the cable. The above descriptions shall be shown on the shipping tags of the various wires and cables delivered to the bridge site. If the information on the shipping tags does not conform to the description approved by the Bridge Design Engineer, or if there is reason to believe that the construction and materials of the wires and cables do not conform to the approved descriptions, the engineer reserves the right to obtain samples of the wires and cables delivered at the bridge site, and have these samples tested.

The conduit and wire layout shall show the size and approximate length of all conduits, and the

number, size, type and identification of all conductors in each conduit run. Identification of the conductors shall be with the same symbols used in the elementary wiring diagram.

The drawings for the control desk and switchboard shall be complete, and shall include cabinet dimensions, layout of equipment, nomenclature of equipment, the rating, description, catalog number, and name of manufacturer of all equipment and complete wiring diagrams.

The sizes of all conductors larger than #12 AWG shall be shown on all drawings, and each conductor and piece of equipment shall be identified with the same symbol wherever shown.

The drawings for the operating house shall include a layout, to scale, showing the location of all apparatus in the house and description of doors, windows, and hardware.

The drawings for the counterweights shall show all dimensions, reinforcing, method of contruction and all necessary calculations.

A detailed list of all electrical equipment and devices, and all commercial machinery and traffic barrier parts installed on the bridge shall be included in the shop drawings. The list shall be complete, and shall include an item number that is the same as that shown on all drawings, and the name, ratings, description, service, manufacturer, type, model, catalog and serial number of each item.

The type, size and procedures for submittal and approval of shop drawings and erection drawings and delivery of original tracings of these drawings shall be the same as described and required in (b) (1) above.

(2) Maintenance and Operation Instruction Booklets: The contractor shall furnish 6 bound copies of a booklet 8½″ x 11″ in size, containing descriptive leaflets and drawings covering all items of the electrical equipment, with catalog numbers

indicated, printed or typewritten statements prepared by the manufacturers of the equipment covering the proper method of adjusting, lubricating, and otherwise maintaining each item, a concise statement of the necessary operating functions in proper sequence, a detailed description of the functions of each item in connection with the various operating steps, reduced copies of all conduit and wiring diagrams and drawings of the control desk and switchboard. The booklet shall contain a table of contents and shall designate each wire and item of equipment by the numbers and symbols used on the drawings.

The contractor shall also furnish 6 bound copies of a similar booklet for the mechanical and traffic barrier equipment, which shall include lubricating charts showing the locations of all lubricating fittings and other points of lubrication, as well as the recommended types of lubricant and frequency of application and changing of lubricants.

The booklet shall also include reduced prints of the machinery and traffic barrier shop drawings.

No additional payment will be made for these booklets, the cost thereof shall be considered as included in the prices bid for the various items.

(d) Precast—Prestressed Concrete Girder Spans. The contractor shall furnish complete fabrication drawings and erection diagrams, and no girders shall be cast prior to final approval of these plans.

Fabrication drawings shall include complete details and dimensions of the girders, details of the proposed casting bed layout and stressing data, and, in pretensioned members, the method of holding draped strands in place, and the method and schedule of release of hold-downs and cable strands.

If the girders are detailed so completely that the design drawings may serve as working drawings, the contractor will not be required to submit drawings for that part of the work, provided he notifies the Bridge Design Engineer that the work is to be done as shown on the design drawings. However, the

contractor shall submit corrections to plan dimensions due to elastic shortening, shrinkage, girder slope and other causes, and the use of such design drawings will not relieve him of any responsibility placed on him by his contract.

Erection diagrams shall show the location of each girder in each of the prestressed girder spans and shall be coordinated with identifying marks on the girders. Identifying girder marks, showing location and span for which the girder is cast, and the date of casting, shall be shown on one end of each girder.

801.04 BRIDGES OVER NAVIGABLE WATERWAYS.

(a) Relationship with the U. S. Corps of Engineers. The Department will obtain a permit, or instrument, from the Corps of Engineers, Department of the Army, approving the plans and authorizing construction of the permanent work to remain in the permanent structure in a navigable waterway. The contractor will be furnished a copy of the permit, or instrument, on request. The contractor shall conduct his work in conformity with the permit provisions, so as not to unreasonably interfere with navigation.

The contractor shall prepare, on tracing cloth, drawings which comply with the Corps of Engineers' standards, showing falsework construction, test piles, or other temporary pile driving and operation of equipment, etc. in the stream. He shall submit these drawings to the Bridge Design Engineer, Department of Highways, for review and approval and for his transmittal to the Corps of Engineers for approval, with respect to navigational requirements.

Construction of falsework, driving test piles, or operation of any construction equipment within the navigable channel limits, shall not be commenced until approval of these drawings is received from the Corps of Engineers.

All operations in connection with the work shall be in accordance with the permits, instruments of approval and rules and regulations of the Corps of Engineers, Department of the Army, and any devia-

tion therefrom shall be only by special permission which the contractor himself must obtain. Failure of the contractor to familiarize himself with all of the terms and conditions of permits, instruments of approval, rules and regulations of the Corps of Engineers, applicable to the work, shall not relieve the contractor of his responsibility under the contract.

Should the contractor, during the progress of the work, sink, lose or throw overboard any material, plant, machinery, or equipment which may be dangerous to, or obstruct navigation, he shall forthwith recover, or remove, such obstructions. The contractor shall give immediate notice to the proper authorities of such obstructions and, if required, he shall, under the direction of the proper authorities, mark, or buoy such obstructions until they are removed.

(b) Relationship with the U. S. Coast Guard. The contractor will be required to display lights on his equipment operating, or berthed, or moored in a navigable stream and to provide temporary navigation lights on all temporary construction in the channel, in a manner as directed by the U. S. Coast Guard. The contractor shall prepare, on tracing cloth, drawings complying with U. S. Coast Guard standards, showing all temporary lighting proposed to be installed on the work for the protection of marine navigation. These drawings shall be submitted to the Bridge Design Engineer for review and transmittal to the U. S. Coast Guard for approval. Performance of any work in the navigable channel limits shall not be commenced until approval of such drawings by the U. S. Coast Guard has been received. All operations in connection with the work shall be in accordance with the approved drawings and applicable regulations of the U. S. Coast Guard, and any deviation therefrom must be by special permission, which the contractor himself must obtain. Failure of the contractor to familiarize himself with all applicable rules and regulations of the U.S. Coast Guard will not relieve the contractor of his responsibility under the contract.

801.05 AIR NAVIGATION. In the event there are

structures, or a structure, included in the work classified as a hazard to aerial navigation, the contractor shall prepare, on tracing cloth, drawings complying with the Federal Aviation Agency's current requirements for temporary lighting for the protection of aerial navigation. These drawings shall be submitted to the Bridge Design Engineer of the Department for review and transmittal to the Federal Aviation Agency for approval. All operations in connection with the work, for protection of aerial navigation shall be in accordance with the approved drawings and applicable Federal regulations. Failure of the contractor to familiarize himself with all applicable rules and regulations of the Federal Aviation Agency will not relieve the contractor of his responsibility under the contract.

801.06 HAZARD ZONES. In the event any portion of the work is determined to be within a hazard zone, because of aerial navigation, or because of a high voltage powerline which is to remain, or because of any other permanent facility deemed to constitute a similar hazard in performance of the work, the presence of such hazards will be noted on the plans, or in the special provisions, to the extent that definite information can be obtained on these situations. The contractor shall arrange his operations as necessary to perform the work with these hazards in place, unless he can make his own arrangements with the agencies involved to make any temporary adjustments he desires, which shall be without responsibility, or expense, to the Department. Failure of the Department to determine the presence of any and all hazards and to so note on the plans or in the special provisions, shall not relieve the contractor of performing the work in accordance with the project requirements and at contract unit prices.

Section 802

Structural Excavation and Backfill

802.01 DESCRIPTION. This work shall consist of the removal of all materials, of whatever nature, necessary for the construction of retaining walls, foundations, and substructures. It shall include the furnishing of all necessary equipment and the construction of all cribs, cofferdams, caissons, unwatering, etc., which may be necessary for the execution of the work. It shall also include the subsequent removal of cofferdams and cribs and the placement of all necessary backfill as hereinafter specified. It shall also include the wasting of excavated material, which is not required for backfill, in a manner and in locations so as not to affect the carrying capacity of the channel and not be unsightly. All work shall be performed in accordance with these specifications and in reasonably close conformity to the lines, grades and dimensions shown on plans or established by the engineer.

CONSTRUCTION REQUIREMENTS

802.02 GENERAL. Compensation for all clearing and grubbing contained within the area defined by lines connecting the extremities of the substructure units, regardless of whether or not excavation is involved, shall, unless an item or items for clearing and grubbing are included in the contract, be included in the unit price bid for structural excavation.

All substructures, where practicable, shall be constructed in open excavation and, where necessary, the excavation shall be shored, braced or protected by cofferdams in accordance with approved methods. When footings can be placed in the dry without the use of cribs or cofferdams, backforms may be omitted with the approval of the engineer and the entire excavation filled with concrete to the required elevation of the top of the footing. The additional concrete required shall be placed at the expense of the contractor.

802.03 PRESERVATION OF CHANNEL. Unless otherwise specified or permitted, no excavation shall be made outside of caissons, cribs, cofferdams, steel piling or sheeting, and the natural stream bed adjacent to the structure shall not be disturbed. If any excavation or dredging is made at the site of the structure before caissons, cribs or cofferdams are sunk or in place, the contractor shall, without extra charge, after the foundation base is in place, backfill all such excavation to the original ground surface or river bed with satisfactory material. Material deposited within the stream area from foundation or other excavation or from the filling of cofferdams shall be removed and the stream area freed from obstruction thereby.

802.04 DEPTH OF FOOTINGS. The elevation of the bottoms of footings, as shown on the plans, shall be considered as approximate only and the engineer may order in writing, such changes in dimensions or elevation of footings as may be necessary to secure a satisfactory foundation.

802.05 PREPARATION OF FOUNDATIONS FOR FOOTINGS. All rock or other hard foundation material shall be freed from all loose material, cleaned and cut to a firm surface, either level, stepped, or roughened, as directed. All seams shall be cleaned out and filled with concrete, mortar or grout.

When masonry is to rest on an excavated surface other than rock, special care shall be taken not to disturb the bottom of the excavation and the final removal of the foundation material to grade shall not be made until just before the masonry is to be placed.

802.06 COFFERDAMS AND CRIBS.

(a) General. Cofferdams and cribs for foundation construction shall be carried to adequate depths and heights, be safely designed and constructed, and be made as water tight as is necessary for the proper performance of the work which must be done inside them. In general, the interior dimensions of cofferdams and cribs shall be such as to give sufficient clearance for the construction of forms

and the inspection of their exteriors, and to permit pumping outside of the forms. Cofferdams or cribs which are tilted or moved laterally during the process of sinking shall be righted, reset or enlarged so as to provide the necessary clearance and this shall be at the sole expense of the contractor.

When conditions are encountered which render it impracticable to unwater the foundation before placing masonry, the engineer may require the construction of a concrete foundation seal of such dimensions as may be necessary. The foundation shall then be pumped out and the balance of the masonry placed in the dry. When weighted cribs are employed and the weight is utilized to partially overcome the hydrostatic pressure acting against the bottom of the foundation seal, special anchorages such as dowels or keys shall be provided to transfer the entire weight of the crib into the foundation seal. During the placing of a foundation seal, the elevation of the water inside the cofferdam shall be controlled to prevent any flow through the seal and if the cofferdam is to remain in place, it shall be vented or ported at low water level.

(b) Protection of Concrete. Cofferdams or cribs shall be constructed so as to protect green concrete against damage from a sudden rising of the stream and to prevent damage to the foundation by erosion. No timber or bracing shall be left in cofferdams or cribs in such a way as to extend into the substructure masonry, without written permission.

(c) Drawings Required. Drawings for substructure work shall be furnished in accordance with Subsection 801.03.

(d) Removal. Unless otherwise provided, cofferdams or cribs with all sheeting and bracing shall be removed after the completion of the substructure, care being taken not to disturb or otherwise injure the finished masonry.

802.07 PUMPING. Pumping from the interior of any foundation enclosure shall be done in such manner as to preclude the possibility of the movement of

water through any fresh concrete. No pumping will be permitted during the placing of concrete or for a period of at least 24 hours thereafter, unless it be done from a suitable sump separated from the concrete work by a water tight wall or other effective means.

Pumping to unwater a sealed cofferdam shall not commence until the seal has set sufficiently to withstand the hydrostatic pressure.

802.08 INSPECTION. After each excavation is completed, the contractor shall notify the engineer, and no masonry shall be placed until the engineer has approved the depth of the excavation and the character of the foundation material.

802.09 BACKFILL. All material used for backfill shall be of acceptable quality and shall be free from large or frozen lumps, wood, or other extraneous material.

(a) For backfilling in cofferdams and cribs, all spaces excavated and not occupied by abutments, piers or other permanent work shall be refilled with earth up to the surface elevation of the surrounding ground in such a manner as to maintain approximately the same elevation on each side so as to avoid unbalanced pressure on the structure.

(b) The backfill around structures other than (a), above, shall be deposited in horizontal layers not to exceed 9 inches in thickness (loose measurement) and compacted to the approximate density of the adjacent natural ground. The backfill in front of such units shall be placed first to prevent the possibility of forward movement. Special precautions shall be taken to prevent any wedging action against the masonry, and the slope bounding the excavation shall be destroyed by stepping or roughening to prevent wedge action. Jetting of the backfill behind abutments and wing walls will not be permitted.

(c) No backfill shall be placed against any masonry abutment, wing wall or culvert until permission shall have been given and preferably not until the ma-

sonry has been in place 14 days, or until test cylinders show the strength to be twice the working stress used in the design.

Backfilling of sectional plate pipes and arches shall be done in accordance with Subsection 701.08.

802.10 FILLED SPANDREL ARCHES. For filled spandrel arches, the filling shall be carefully placed in such manner as to load the ring uniformly and symmetrically. The filling material shall be acceptable and shall be placed in horizontal layers, not to exceed 9 inches in thickness (loose measurement), carefully tamped and brought up simultaneously from both haunches. Wedge shaped sections of filling material against spandrels, wings or abutments will not be permitted.

802.11 APPROACH EMBANKMENTS. When the contract for any bridge structure requires the placement of approach embankments, they shall be constructed and paid for in accordance with the applicable requirements of Section 203.

802.12 CLASSIFICATION OF STRUCTURAL EXCAVATION. Classification, if any, will be indicated on the plans and set forth in the proposal.

802.13 METHOD OF MEASUREMENT. The quantity of structural excavation to be paid for shall be the actual number of cubic yards, measured in its original position, of the material acceptably excavated in conformity with the plans or as directed. No yardage shall be included in the measurement for payment which is outside of a volume bounded by vertical planes 18 inches outside of and parallel to the neat lines of the footing. The cross-sectional area measured shall not include water or other liquids, but shall include mud, muck, and other similar semi-solids. Measurement for intermediate bents or pier footings will be made on the basis of the depth taken from the elevation of the completed section or natural ground line, whichever is lower, for the pier or bent in question to the bottom of the footing; however, no payment will be made for material not actually excavated.

When it is necessary to carry the foundations below

the elevations shown on the plans, the excavation for the first 2 feet of additional depth shall be included in the quantity for which payment will be made at the contract unit price for this item. Excavation below this additional 2 foot depth will be paid for at a price to be determined by multiplying the contract unit price for the item, by the following factors:

For footings or portions thereof lowered more than 2 feet but not more than 4 feet	1.25
For footings or portions thereof lowered more than 4 feet and not more than 6 feet	1.50
For footings or portions thereof lowered more than 6 feet and not more than 8 feet	1.75
For footings or portions thereof lowered more than 8 feet and not more than 10 feet	2.00

For footings lowered more than 10 feet, the quantities below such depth will be paid for as extra work.

802.14 BASIS OF PAYMENT. The accepted quantities of structural excavation will be paid for at the contract unit price per cubic yard. It shall include the cost of construction and removing cribs and cofferdams, unless otherwise provided and of removing any surplus material which may have been thrown up during the process of excavation, and shall include all backfilling.

No payment will be made under this item for excavation for culverts or end bents of bridges; the cost of same unless otherwise provided on the plans shall be included in contract unit prices for the items that constitute the structure.

Payment will be made under:

Item No.	Pay Item	Pay Unit
802(1)	Structural Excavation	Cubic Yard
802(2)	Structural Excavation for Intermediate Bents	Cubic Yard
802(3)	Structural Excavation for Piers (Dry)	Cubic Yard
802(4)	Structural Excavation for Piers (Wet)	Cubic Yard

Section 803
Sheet Piles

803.01 DESCRIPTION. This work shall consist of furnishing and driving sheet piling of the type shown on the plans or in the special provisions and covers only sheet piling designated on the plans, or ordered by the engineer to be left in place to eventually become a part of the finished structure.

Sheet piling shall be one of the following types:

Timber Sheet Piles (Untreated)
Timber Sheet Piles (Treated)
Concrete Sheet Piles (Reinforced)
Concrete Sheet Piles (Prestressed)
Steel Sheet Piles

MATERIALS

803.02 TIMBER SHEET PILES.

(a) General. Timber sheet piles shall be untreated unless the plans or special provisions specifically provide for the use of treated timber. The piles shall be of the thickness specified or as directed and shall be provided with tongues and grooves of ample proportions, either cut from the solid material or made by building up the piles of 3 planks securely fastened together. The piles shall be drift sharpened at their lower ends so as to wedge the adjacent piles tightly together during driving.

Hardware furnished shall be in accordance with the requirements of Section 812 and shall be galvanized unless otherwise indicated on the plans or in the special provisions.

(b) Untreated Timber Sheet Pile. The timber, unless otherwise definitely noted upon the plans or in the special provisions, to be in accordance with Section 812, may consist of any species which will satisfactorily stand driving. It shall be sawn or hewn with square corners and shall be free from worm

holes, loose knots, wind shakes, decayed or unsound portions, and other defects which might impair its strength or tightness.

(c) Treated Timber Sheet Piles. Treated timber may be either Southern Pine or Douglas Fir, meeting the applicable requirements of Section 812. Timber shall be treated with creosote oil in conformity with the applicable requirements of Sections 812 and 914.

All cuts in treated timber, and all abrasions, after having been carefully trimmed, shall be covered with 2 applications of a mixture of 60 per cent creosote oil and 40 per cent roofing pitch or brush coated with at least 2 applications of hot creosote oil and covered with hot roofing pitch.

803.03 CONCRETE SHEET PILES.

(a) General. Where conventionally reinforced or prestressed concrete sheet piles are required, they shall be in strict accordance with the detailed design. The requirements governing the manufacture and installation of concrete sheet piling shall conform, in general, to those governing precast or precast-prestressed concrete bearing piles in Sections 804 and 805.

(b) Concrete. Concrete shall meet applicable requirements of Section 805.

(c) Reinforcing Steel. Reinforcing steel shall be "Deformed Reinforcing Steel" meeting the applicable requirements of Section 806.

803.04 STEEL SHEET PILES. Steel sheet piles shall be of the type and weight indicated on the plans or designated in the special provisions conforming to the requirements of Subsection 913.12. All piling shall conform in other respects (tests, specimens, number of tests, finish, marking and inspection) to the requirements of Section 807.

803.05 PAINT. Any paint required for sheet pile shall conform to applicable requirements of Sections 811 and 908.

CONSTRUCTION REQUIREMENTS

803.06 DRIVING SHEET PILES. Sheet piles shall be

driven with adequate hammers as necessary to drive the piles to the required depth in satisfactory condition.

In order to maintain satisfactory alignment, the sheet piles shall be driven in such increments of penetration as may be found necessary to prevent distortion, twisting out of position or pulling apart at the interlocks. To facilitate closure, it may be advantageous to set up the piles for a complete length of wall before initial driving; the piles thus set up, then can be progressively driven in short increments of penetration.

803.07 JETTING SHEET PILES.

(a) The use of jets will not be permitted at locations where the stability of embankments or other improvements would be endangered.

(b) In case it is necessary to obtain the penetration desired, the contractor may supply and operate one or more high pressure water jetting systems to erode the material adjacent to the pile and thereby facilitate driving the sheet piles. The pumping capacity provided shall deliver a minimum of 150 psi pressure at each jet nozzle.

(c) The jetting may be done ahead of the actual driving operation or simultaneously with the driving operation. If jets and hammer are used simultaneously, the jets shall be withdrawn and the final penetration of the sheet pile obtained by driving with the hammer alone for at least the last foot of penetration.

(d) Payment for jetting sheet piles will not be made unless so designated on the plans or in the proposal.

803.08 CUT-OFFS.

(a) The tops of sheet piling shall be cut off, or driven down to a straight line at the elevation indicated on the plans or as directed.

(b) If the heads of the sheet piles are appreciably distorted or otherwise damaged below cut-off level, the damaged portions shall be removed and replaced at the contractor's expense.

(c) The tops of all timber sheet piles after cut-off shall be brush coated with 2 applications of a mixture of 60 per cent creosote oil and 40 percent roofing pitch after which a cover of 20 gage galvanized iron sheeting, 6 inches wider than the overall thickness of the sheet piles, shall be bent down at least 3 inches on each side and nailed to the vertical surface of the sheet piles with large headed galvanized roofing nails.

(d) Any sheet pile damaged during driving by reason of internal defects or improper driving or which is driven either out of its proper position or below cut-off elevation, shall be withdrawn and replaced with a new pile at the contractor's expense.

803.09 PAINTING. Before driving, the surfaces of steel sheet piling to be backfilled or immersed shall have both the immersed and backfilled surfaces satisfactorily cleaned and painted with 2 coats of approved bitumastic paint from a point 10 feet below stream bed to a point 2 feet below cut-off level for backfilled areas and 2 feet above low water or higher at the discretion of the engineer for those areas to be immersed. However, after driving, the entire surface of the sheet piling exposed to view in bulkheads and retaining walls from a point 2 feet above low water or from a point 2 feet below ground surface to cut-off level or bottom of concrete cap, as the case may be, shall be satisfactorily cleaned and given the first and second field coats of red lead paint along with the third field coat of aluminum paint.

803.10 METHOD OF MEASUREMENT. Timber, concrete and steel sheet pile wall shall be measured by the square foot of wall complete in place and accepted.

803.11 BASIS OF PAYMENT. The number of square feet of timber, concrete or steel sheet pile wall, shall be paid for at the contract unit price complete in place.

Payment will be made under:

Item No.	Pay Item	Pay Unit
803(1)	Untreated Timber Sheet Pile Wall	Square Foot
803(2)	Treated Timber Sheet Pile Wall	Square Foot
803(3)	Concrete Sheet Pile Wall	Square Foot
803(4)	Steel Sheet Pile Wall	Square Foot

Section 804
Bearing Piles

804.01 DESCRIPTION. This work shall consist of furnishing and driving bearing piles of the kind and size designated to the required penetration in accordance with these specifications and in reasonably close conformity with the lines and spacings shown on the plans or established by the engineer.

804.02 MATERIALS.

(a) Precast Concrete Piles. Materials for precast concrete piles shall conform to the applicable requirements of Sections 805 and 806.

(b) Timber Piles. Timber piles, treated or untreated, shall conform to the applicable requirements of Section 914.

(c) Steel Bearing Piles. Steel bearing piles shall consist of structural steel shapes of the section specified. The steel shall conform to the applicable requirements of Section 913.

(d) Cast-In-Place Concrete Piles. The steel in the shell or pipe shall conform to the requirements of Subsection 907.05, or other shell as shown on the plans or in the special provisions. Concrete for cast-in-place concrete piles shall be Class "A", conforming with the applicable requirements of Section 805. Reinforcing steel shall conform to the applicable requirements of Section 806.

CONSTRUCTION REQUIREMENTS

804.03 PREPARATION FOR DRIVING.

(a) Excavation. In general, piles shall not be driven until after the excavation is complete. Any material forced up between the piles shall be removed to correct elevation without cost to the Department before masonry for the foundation is placed.

(b) Embankment. Unless otherwise specified or

shown on the plans, the embankment at bridge ends shall be constructed and thoroughly compacted as provided for in Subsection 203.10, prior to driving piles affected.

(c) Caps. The heads of all concrete piles, and the heads of timber piles, when the nature of the driving is such as to unduly injure them, shall be protected by caps of approved design, preferably having a rope or other suitable cushion next to the pile head and fitting into a casting which in turn supports a timber shock block. When the area of the head of any timber pile is greater than that of the face of the hammer, a suitable cap shall be provided to distribute the blow of the hammer throughout the cross section of the pile and thus avoid, as far as possible, the tendency to split or shatter the pile.

For special types of piling, driving heads, mandrels, or other devices in accordance with the manufacturer's recommendation shall be provided so that the pile may be driven without injury.

For steel piling, the heads shall be cut squarely and a driving cap shall be provided to hold the axis of the pile in line with the axis of the hammer.

(d) Collars. Collars, bands, or other devices, to protect timber piles against splitting and brooming shall be provided where necessary.

(e) Pointing. Timber piles or steel bearing piles shall be pointed where soil conditions require it.

(f) Splicing Piles.

1. Precast concrete piles shall be furnished and driven in full lengths.

2. Steel bearing piles shall be furnished and driven in full lengths unless splices are specified or authorized. When authorized, splices shall be limited to not more than 2 per pile. Splicing of steel bearing piles shall be made by welding in accordance with the applicable requirements of Section 807.

3. Cast-in-place concrete pile shells may be field spliced, but sections, which in the opinion of the engineer are too short, shall not be used. Field splices of shell sections shall be made in accordance with the manufacturer's recommendations and to the satisfaction of the engineer. Welding, where used, shall conform to the applicable requirements of Section 807.

4. Timber piles shall be furnished and driven full length where practicable. Splicing of timber piles may be made only by written permission of the engineer and in accordance with the splice detail furnished by him.

(g) Painting of Piling. Unless otherwise specified, foundation piling, either of steel or the steel shells of cast-in-place concrete piles, shall not be painted.

When steel piles or the steel shells of cast-in-place concrete piles extend above the ground surface, they shall be protected with 2 coats of an approved bitumastic paint. Before driving, all exterior surfaces of the steel pile or steel shell shall be satisfactorily cleaned and painted from a point 10 feet below the ground line or stream bed, as the case may be, to the top of the exposed steel.

(h) Transportation of Precast Concrete Piling.

1. Conventionally reinforced precast concrete piles may be transported provided the piling is fully supported. Supports shall be of timber having a minimum width of 5 inches and shall be spaced at intervals not exceeding 3 feet. The maximum projection at either end of the piling without support shall be 4 feet. Such piling shall be wetted at the point of delivery and visually inspected for cracks prior to driving.

2. Precast-prestressed concrete piles may be transported, provided the piles are supported in a horizontal position with supports at each of the pick-up points as shown on the plans for the particular lengths of piling. In no case shall the supports be more than one foot from the theoretical position, nor shall the distance between

2 supports be more than one foot from the theoretical required distance between supports.

804.04 METHODS OF DRIVING.

(a) Description. Piles may be driven with an approved type hammer that will obtain the required penetration without damaging the piles. The minimum energy to be developed by the hammer used shall be as shown for the various types of piles listed hereunder. One of the conditions of approval for a type of hammer proposed shall be that the pile capacity can be determined under the hammer by an acceptable formula.

(b) Supporting Holes for Piles. Piles for pile bents may be set in pre-dug or pre-drilled supporting holes, but in no case shall the depth of the holes be more than 20 per cent of the designated penetration of the piles. If additional support is required, templates or falsework above the ground shall be furnished. After the piles are driven, such supporting holes shall be backfilled to the level of the finished ground or base of footing, as the case may be, with an approved granular material.

(c) Hammers for Timber and Steel Piles. When timber or steel piles are driven with steam, air, or diesel hammers, either single or double acting, the following hammer energies shall be provided unless otherwise specified or authorized:

1. Timber Piles	6000 foot pounds minimum 9500 foot pounds maximum
2. Steel Piles	7000 foot pounds minimum

(d) Hammers for Concrete Piles. Unless otherwise provided, precast concrete piles, or shells for cast-in-place concrete piles, shall be driven with an approved hammer which shall develop an energy, at each full stroke of the piston, of not less than one foot-pound for each pound of weight driven, up to 30,225 foot-pounds. In no case shall the total energy developed by the hammer be less than 6,000 foot-pounds per blow.

(e) Additional Equipment. In case the required pene-

tration is not obtained by the use of a hammer complying with the above requirements, the contractor shall, with written permission, resort to one or both of the following listed methods in combination with the hammer.

1. Use pilot holes.
2. Use water jets.

Unless specifically provided for on the plans or in the special provisions, the contractor will provide the additional equipment and materials that may be required for the above listed methods at his own expense.

(f) Leads, Templates or a Combination Thereof. Equipment shall be constructed in such manner as to afford freedom of movement of the hammer and to drive piles to the tolerances specified without injury to the piles. Either fixed leads or swinging leads may be used. Swinging leads, when used, shall be in combination with rigid templates.

Inclined leads shall be used in driving battered piles.

(g) Followers and Underwater Hammers. The use of followers or underwater hammers for driving piling shall be avoided and shall be done under written permission of the engineer. When a follower or underwater hammer is used, one pile in each group of 10 shall be furnished sufficiently long to permit being driven without a follower or underwater hammer and shall be used as a test pile to determine the average bearing power of the group. Test piles so designated will not be classified as such nor will any payment be made for load tests.

(h) Pilot Holes. Pilot holes, required or permitted, shall be bored or dug to sufficient size and depth to permit pile penetration into hard soil. In general, pilot holes shall have a diameter equal to 2/3 the face width of a square pile or average diameter of a round pile, but shall, however, be of a size which will provide the desired results. The pile will then be driven to the required penetration and bearing capacity. Should the pilot hole have a diameter

greater than the pile, the annular space around the pile shall be filled with sand or pea gravel at the contractor's expense.

(i) Pilot Holes in Embankments. Where specified, pilot holes shall be used in embankments. In general, pilot holes shall have a diameter 4 inches greater than the diagonal of a square piling and 6 inches greater than the diameter of a round piling. The depth of the pilot hole shall be equal to the embankment height. The pile will then be placed within the pilot hole and driven to the required penetration and bearing capacity. The annular space around the pile shall be filled with sand or pea gravel at the contractor's expense.

(j) Water Jets. When water jets are used, the number of jets and the volume and pressure of water at the jet nozzles shall be sufficient to freely erode the material adjacent to the pile. The plant shall have sufficient capacity to deliver at all times at least 100 pounds per square inch pressure at two 3/4-inch jet nozzles. Before the desired penetration is reached, the jets shall be withdrawn and the piles shall be driven with the hammer to secure the final penetration. The use of jets where the stability of embankments or other improvements would be endangered will not be permitted.

(k) Accuracy of Driving. Piles shall be driven with a variation of not more than 1/4 inch per foot from the vertical or from the batter shown on the plans, except that piles for trestle bents shall be so driven that the cap may be placed in its proper location without inducing excessive stresses in the piles, and foundation piles shall not be out of the position shown on the plans more than 6 inches after driving.

(l) Interrupted Driving. When driving is interrupted before final penetration is reached, the record for penetration shall not be taken until after at least 12 inches penetration has been obtained upon resumption of driving.

(m) Extent of Driving. Driving shall be continued until plan cut-off is reached or until a satisfactory

rate of penetration is obtained. If proper resistance to driving is not obtained at cut-off, the driving shall be continued and the additional length of pile required shall be supplied by splicing.

804.05 CAST-IN-PLACE CONCRETE PILES. Cast-in-place concrete piles shall be steel encased. Steel casings or shells shall be of the diameter and type shown on the plans or in the special provisions. After the shells are driven to the required penetration and reinforcing steel is placed if required, the shells shall be filled with concrete, subsequent to their inspection and approval. The contractor shall provide a suitable light for the inspection of each shell after it has been driven to the penetration required. The shell shall be cleaned of all debris and pumped dry before placing concrete.

Class A Concrete conforming to the requirements of Section 805 shall be placed in the shell immediately after mixing and in no case shall concrete be used which does not reach its final position in the shell within 60 minutes after water is first added to the mix. The concrete shall be handled by an approved method and in such a manner as to prevent segregation of aggregate in the mix. All piles shall be filled with concrete to the cut-off level. Reinforcing steel, when required, shall be of the size and spacing shown on the plans, and shall be securely fastened together so as to form a rigid cage. Care shall be taken to hold the reinforcement in true position in the shell when pouring concrete. Concrete blocks or other suitable devices may be used to prevent the displacement of the reinforcement cage. Concrete in the shell shall be vibrated from the lower end of the reinforcing cage to the top of the pile. When reinforcing steel is not required, concrete in the top 10 feet of the shell shall be vibrated. Driving of additional piles within a radius of 10 feet of a completed pile will not be permitted until the concrete has set for at least 36 hours.

The shells for the cast-in-place concrete piles shall be of sufficient thickness and strength so that the shell will hold its original form and show no harmful distortion after it has been driven, and the driving

core, if any, has withdrawn. It shall be the contractor's responsibility to determine the thickness of shell required.

804.06 DEFECTIVE PILES. The procedure incident to the driving of piles shall not subject them to excessive and undue abuse producing cracking, crushing or spalling of the concrete, injurious splitting, splintering and brooming of the wood or deformation of the steel. Manipulation of piles to force them into proper position considered to be excessive, will not be permitted. Any pile damaged by reason of internal defects, or by improper driving or driven out of its proper location or driven below the elevation fixed by the plans or by the engineer, shall be corrected at the contractor's expense by one of the following methods approved by the engineer for the pile in question:

1. The pile shall be withdrawn and replaced by a new and, if necessary, a longer pile.

2. A second pile shall be driven adjacent to the defective or low pile.

3. The pile shall be spliced or built up as otherwise provided herein or a sufficient portion of the footing extended to properly embed the pile. Timber piles shall not be spliced without specific permission of the engineer. All piles pushed up by the driving of adjacent piles or by any other cause shall be driven down again.

4. The dimensions of the cap or footing shall be adjusted to provide the cover shown on the plans.

No compensation will be allowed the contractor for increased quantities in a bent or footing because of driving an additional pile or piles to correct a defective pile or piles.

804.07 DETERMINING OF BEARING VALUES.

(a) When required, the contractor shall make load tests for the purpose of determining the order lengths of piling. Unless otherwise provided, anchor piles shall be at least 5 feet from the test piles.

In general, these tests shall consist of the applica-

tion of a test load placed upon a suitable platform supported by the pile, with suitable apparatus for accurately measuring the test load and the settlement of the pile under each increment of load. In lieu thereof, hydraulic jacks with suitable yokes and pressure gauges may be used.

The test load shall be applied in the various increments specified in such manner as not to cause vibration of the test pile. If hydraulic jacks are used to apply the load, they will be calibrated by the Department's laboratory provided the transporting of the jacks to and from the laboratory is furnished by the contractor and further that the laboratory has the necessary equipment to conduct the tests; otherwise the contractor shall have the jacks calibrated by a reputable commercial laboratory in which case certified laboratory reports of the calibration tests shall be furnished to the Department's laboratory.

(b) Loading Test. The test piles after being driven to the required penetration shall be allowed to stand undisturbed for such period of time as may be provided on the plans or in the special provisions before beginning loading operations.

The first increment of load to be placed on the test pile shall be the pile design load. The load on the pile shall then be increased to twice the design load by adding additional load in 3 equal increments. A period of 6 hours shall intervene between each increment of load, except that in the event that the pile is still settling at the end of the 6 hour period, the interval may be extended at the discretion of the engineer.

Upon attaining twice the design load on the pile or upon finding a gross settlement of 1/2 inch in the pile, if this should occur before the loading is complete up to twice the design load, the loading shall be halted and the pile allowed to stand under this load for a period of 48 hours. At the end of the 48 hour period, providing there has been no settlement during the last 24 hours, the load shall be removed and the pile allowed to stand for 6 hours without any load. However, should settlement con-

tinue into the second 24 hour period, the load shall remain in place a sufficient length of time beyond the expiration of the 48 hours to show that the test load does not cause further settlement under the final 24 hour period. The load shall then be removed and the pile allowed to stand for 6 hours without any load. Readings shall then be taken to determine the amount of rebound and the net settlement.

The safe allowable load of any pile so tested shall be considered equal to 1/2 that load which does not cause a greater permanent settlement than 1/4 inch, measured at the top of the pile, after a minimum of 48 hours load application, the last 24 hours of which shall be without any increase in settlement.

After completion of the 48 hour test, twice the pile design load shall be replaced on the pile as the first increment and loading continued by increments as described above, or as specified in the special provision, until a total settlement of one inch has been exceeded or a total of 3 times the design load has been applied.

(c) Pile Formulas. If the safe bearing capacity of piles is to be determined by formulas, the following shall be used:

$P = \frac{2WH}{S+1.0}$ for gravity hammers,

$P = \frac{2WH}{S+0.1}$ for single-acting steam or air hammers,

$P = \frac{2H\ (W+Ap)}{S+0.1}$ for double-acting steam or air hammers,

Where

P = safe bearing power in pounds,
W = weight, in pounds, of striking parts of hammer,
H = height of fall in feet,
A = area of piston in square inches,
p = steam pressure in pounds per square inch at the hammer,

S = the average penetration in inches per blow for the foot involved on test pile and/or the last foot on permanent piling.

The above formulas are applicable only when:

The hammer has a free fall.
The head of the pile is not broomed or crushed.
The penetration is reasonably quick and uniform.
There is no sensible bounce after the blow.
A follower is not used.

Twice the height of the bounce shall be deducted from "H" to determine its value in the formula.

Diesel hammers will be permitted. The formula applicable to the type hammer approved for use will be developed on construction.

804.08 TEST PILES.

(a) When required, the contractor shall drive test piles of the length, number, size and type specified, at the location and penetration shown on the plans, or as directed.

In case water jets are used in connection with the driving, the bearing power shall be determined by the formulas in Subsection 804.07 (c) from the results of driving after the jets have been withdrawn, or a load test may be applied.

Test piles shall be driven using the same type and size hammer and the same method or procedure as intended for permanent piles.

(b) When test piles are driven to determine the length of foundation piles required, it will be necessary to excavate a hole from the natural ground to the elevation of the bottom of footing, as shown on plans, and keep this hole open during the driving and loading of the test piles so that the driving and loading conditions will be representative of actual conditions of load on the permanent piles. In lieu of the above, the contractor will be permitted to drive the test pile within an approved casing. The casing shall extend to the bottom of the footing or to the elevation called for on the plans. The

contractor shall, at his own expense, provide any bracing of the test pile that may be required during the loading or driving operations.

(c) Cast-in-place concrete test piles shall be filled with concrete in accordance with Subsection 804.05 and the concrete allowed to set for at least 48 hours before the first increment of test load is applied.

804.09 UTILIZATION OF TEST PILES. The plans or special provisions will designate whether or not permanent piles are to serve as test piles. Should a permanent pile, so designated, fail under the test load, and should redriving or redriving and reloading be specified or authorized, the following procedure will be undertaken:

1. Precast concrete piles shall be extended, if necessary, as described in Subsection 804.11, and the pile redriven to such further depth as may be directed.

2. Steel bearing piles shall have an additional length spliced, if necessary, and the pile redriven to such further depth as may be directed.

3. Timber piles shall have an additional length spliced on, if necessary, in accordance with splice details furnished by the engineer, and the pile redriven to such further depth as may be directed.

4. Cast-in-place concrete piles shall not be redriven except by written permission. If ordered, the contractor will drive a new test pile to the designated depth and location.

If test piles are not to be utilized as permanent piles, they shall be removed to a minimum of one foot below natural ground or stream bed and disposed of as directed.

804.10 ORDER LISTS FOR PILING. The contractor shall furnish piles in accordance with an itemized list, which shall be furnished by the engineer, showing the number, size and length of all piles.

In determining lengths of piles for ordering and for

footage to be included in the contract, the lengths given in the order list shall be based on the lengths which are assumed to remain in the completed structure. The contractor shall, at his own expense, increase the lengths given to provide for fresh heading and for such additional length as may be necessary to suit the contractor's method of operation.

804.11 EXTENSION OF PRECAST CONCRETE PILES. The plans show the length of reinforcing steel to be exposed and the additional size and number of reinforcing bars to be spliced on, for the cases where extending and redriving are required, and where redriving is not required. The final cut of the concrete shall be perpendicular to the axis of the pile. The concrete shall be of the same quality as that used in the pile. Just prior to placing concrete, the top of the pile shall be thoroughly wetted and covered with a thin coating of neat cement or other suitable bonding material. All materials used shall conform to the applicable requirements of Sections 805 and 806.

804.12 CUT-OFFS.

(a) Precast Concrete Piles. Cut-offs for precast concrete piles shall be made perpendicular to the axis of the pile at the elevation shown on the plans or as directed. Generally the cut-off elevation will be set so as to permit the body of the pile to project at least 6 inches into the footing or cap. Care shall be exercised to avoid unnecessary spalling of the concrete. The reinforcement thus exposed, shall remain to engage the body of the footing or cap as the case may be.

(b) Steel Bearing Piles. Steel bearing piles shall be cut-off at right angles to the axis of the pile and to the elevation shown on the plans or as directed. The cuts shall be made in clean straight lines and any irregularity due to cutting or burning shall be corrected by deposits of weld metal prior to placing bearing caps should such be required.

(c) Timber Piles.

1. The tops of timber piling which support concrete footings or concrete caps shall be sawed

off at right angles to their axis at the elevation shown on the plans or as directed by the engineer.

2. Piles which support timber caps shall be sawed to a horizontal plane or to the slope specified in such manner as to closely fit the superimposed structure.

3. The treatment of pile heads shall conform to the applicable requirements of Section 812.

(d) Cast-in-place Concrete Piles. When pile shells are fully driven, inspected and approved, they shall be neatly cut off at right angles to the axis of the pile at the elevation specified.

804.13 METHOD OF MEASUREMENT.

(a) Piling. Piling driven in the locations designated on the plans will be measured by the linear foot of pile, complete in place, below cut-off elevation.

(b) Cut-offs. Cut-offs made as directed, will be measured by the linear foot. Measurement will not be made for the cut-off of any pile unless the length of such cut-off is in excess of one linear foot, nor will measurement of cut-offs be made where they have been necessitated by crushing, brooming, splitting or other injuries resulting from careless driving.

No measurement will be made for required cut-offs of steel bearing piling and cast-in-place concrete pile shells, such cut-offs will remain the property of the contractor.

(c) Extensions (including test piles). Measurement of extensions on precast concrete piles will be made by the linear foot, complete in place. Measurement will be made as follows: The length of cut-back on the ordered length of pile will be added to the net length of extension to obtain the gross length of extension; the gross length of extension will then be multiplied by 2 to determine the quantity for measurement, which measurement shall include any additional driving that may be required. No deduction will be made from the ordered length of pile driven due to cut-back for extending.

Measurement of extensions on all other types of piles will be made by the linear foot complete in place, for that portion of the pile added to the original length of pile driven, which measurement shall include any additional driving that may be required.

No measurement will be made for extensions necessitated by damage to the pile during driving.

(d) Redriving Test Piles. The purpose of this item is to provide compensation for moving back and setting up to redrive a test pile which had been previously driven, if ordered to do so by the engineer. Redriving of test piles shall be measured for each test pile for which redriving is required. In addition to the payment per pile redriven as provided for in this item, payment will be made for extensions as provided in paragraph (c) above.

(e) Splices.

1. Concrete Piles: Splices for precast concrete piles will not be measured as a splice.

2. Timber Piles: Measurement of splices on timber piles shall be by the linear foot. The total number of linear feet of piling driven shall be determined by adding 10 feet to the net length of piling for each splice in place in the finished structure. No measurement will be made for splices except those made at the direction and under the supervision of the engineer.

3. Steel Bearing Piles: Measurement of splices on steel bearing piles will be made by the linear foot. The total number of linear feet of piling driven shall be determined by adding 2 feet to the net length of piling for each splice in place in the finished structure. No measurement will be made for splices except those made at the direction and under the supervision of the engineer.

4. Cast-in-Place Concrete Piles: Splices for cast-in-place concrete piles will not be measured as a splice.

(f) Jetting. The number of jetted piles to be paid for shall be the number of individual piles of any type jetted into place as directed.

(g) Unloaded Test Piles: The number of test piles to be paid for shall be the number of individual piles of each type furnished and driven as directed. Cut-offs of test piles shall not be included in any pay footage. Test piles pulled and re-used as permanent piles shall be measured as provided above under paragraph (a).

(h) Loading Test Piles. The number of load tests to be paid for shall be the number of load tests made, completed and accepted.

(i) Reloading Test Piles. The number of reload tests to be paid for shall be the number of reload tests made.

(j) Pilot Holes. The number of pilot holes to be paid for shall be the number of holes completed and accepted.

(k) Pilot Holes in Embankments. The number of pilot holes in embankments to be paid for shall be the number of holes completed and accepted.

804.14 BASIS OF PAYMENT

(a) Piling. The number of linear feet of completed and accepted piling, measured as provided above, shall be paid for at the contract unit price per linear foot for "Precast Concrete Piles", "Steel Bearing Piles", "Untreated Timber Piles", "Treated Timber Piles", or "Cast-in-Place Concrete Piles", as the case may be. This price shall include all materials, labor and incidentals required for bolting, wrapping or fastening timber fender piles, and shall include the cost of driving batter piles specified on the plans and shall include the Class A concrete and reinforcing steel in cast-in-place concrete piles.

(b) Cut-Offs. Payment for cut-offs, measured as provided above, shall be made at the rate of 1/2 the contract unit price per linear foot for the particular type of pile which has been cut off.

(c) Extensions (including test piles). Payment for extensions shall be made at the contract unit price per linear foot for the type and size of pile being extended, measured as provided above.

(d) Splices. Payment for splices, measured as provided above, shall be made at the contract unit price per linear foot for the particular type of pile spliced.

(e) Jetting. Payment for jetting piles, measured as provided above, shall be made at the contract unit price per pile jetted.

(f) Unloaded Test Piles. Unloaded test piles, completed and accepted, will be paid for at the contract unit price per each.

(g) Loading Test Piles. Loading test piles, completed and accepted, will be paid for at the contract unit price per each.

(h) Reloading Test Piles. Reloading test piles, completed and accepted, will be paid for at the contract unit price per each.

(i) Pilot Holes. Payment for pilot holes shall be made at the contract unit price for each hole completed and accepted.

(j) Pilot Holes in Embankments. Payment for pilot holes in embankments will be made at the contract unit price for each hole completed and accepted.

(k) Redriving Test Piles. The number of test piles, redriven and accepted, will be paid for at the contract unit price per each.

Payment will be made under:

Item No.	Pay Item	Pay Unit
804(1)	Precast Concrete Piles (Size)	Linear Foot
804(2)	Untreated Timber Piles	Linear Foot
804(3)	Treated Timber Piles	Linear Foot
804(4)	Steel Bearing Piles (Size)	Linear Foot
804(5)	Cast-in-Place Concrete Piles (Size)	Linear Foot
804(6)	Jetting Piles	Each
804(7)	Unloaded Concrete Test Piles	Each

Item No.	Pay Item	Pay Unit
804(8)	Unloaded Timber Test Piles	Each
804(9)	Unloaded Steel Bearing Test Piles	Each
804(10)	Unloaded Cast-in-Place Concrete Test Piles	Each
804(11)	Loading Test Piles	Each
804(12)	Reloading Test Piles	Each
804(13)	Pilot Holes	Each
804(14)	Pilot Holes in Embankment	Each
804(15)	Redriving Test Piles	Each

Section 805

Concrete Masonry

805.01 DESCRIPTION. This work shall consist of furnishing and placing Portland cement concrete masonry for culverts, bridges and incidental construction in accordance with these specifications and in reasonably close conformity with the lines, grades and dimensions as shown on the plans or established by the engineer.

805.02 MATERIALS. Materials shall meet the requirements specified in the following subsections of Part IX Materials.

Adhesives	911.04
Portland Cement Type I	901.01
Portland Cement Type II	901.01
Portland Cement Type III	901.01
Masonry Cement Type I	901.01
Water	915.01
Air-entraining Admixtures	911.03
Water Reducing Admixtures	911.03
Fine Aggregate	903.02
Coarse Aggregate	903.03
Reinforcing for prestressed concrete	909.05, 909.06 909.07, 909.08
Expansion Joint Sealers	905.01(c)
Preformed Fillers	905.02
Curing Materials	911.01

CONSTRUCTION REQUIREMENTS

805.03 CARE AND STORAGE OF CONCRETE AGGREGATES. The handling and storage of concrete aggregates shall be such as to prevent segregation or the admixture of foreign materials; the engineer may require that aggregates be stored on separate platforms at satisfactory locations.

When specified, the coarse aggregate shall be separated into 2 or more sizes in order to secure greater uniformity of the concrete mixture. Different

sizes of aggregate shall be stored in separate stock piles sufficiently removed from each other to prevent the material at the edges of the piles from becoming intermixed.

805.04 STORAGE OF CEMENT. All cement shall be stored in suitable weatherproof buildings which will protect the cement from dampness. These buildings shall be placed in approved locations. Whenever possible the cement shall be sampled at the plant and approved. In the event the sampling is not done at the plant, storage buildings shall be provided with a capacity for the storage of a sufficient quantity of cement to allow sampling at least 12 days before the cement is to be used. Stored cement shall meet the test requirements at any time after storage when a retest is ordered.

On small jobs, storage in the open may be permitted when approved in writing, in which case a raised platform and ample waterproof covering shall be provided.

When required by the terms of the contract, the contractor shall keep accurate records of the deliveries of cement and of its use in the work. Copies of these records shall be supplied to the engineer in such form as may be required.

805.05 CLASSES OF CONCRETE. Each class of concrete shall be used in that part of the structure where called for on the plans or when designated. The classes are as follows:

Class A
Class A (A)
Class D
Class P
Class R
Class S
Class W
Class X
Class Y

The following requirements shall govern unless

otherwise shown on the plans: Class A concrete shall be used except where Class A (A), Class P, Class D, Class R, Class S, Class W, Class X or Class Y is stipulated.

Class A (A) concrete shall be used for all concrete in the superstructure except as otherwise provided.

Class D concrete shall be used for pier footings and for unreinforced sections, as required by the plans.

Class P concrete shall be used for precast-prestressed bridge members.

Class R concrete shall be used for revetments and for other unreinforced sections, as required by the plans.

Class S concrete shall be used for all sections deposited under water, when so stipulated on the plans.

Class W concrete shall be used for precast-prestressed piles, in lieu of Class P concrete when such an option is allowed on the plans or in the special provisions.

Class X concrete shall be used for non-prestressed precast bridge members.

Class Y concrete, which shall require the addition of an air-entraining admixture and a water reducing admixture, shall be used for all parts of superstructures as required by the plans or special provisions.

805.06 COMPOSITION OF CONCRETE.

(a) Cement and Aggregates: Type I or Type II cement shall be used at the option of the contractor in general concrete construction. Type III cement shall be used when specified in the special provisions or on the plans. The contractor shall vary, without charge, the ratio of fine to coarse aggregate as approved by the engineer, but in no case shall it be varied so as to materially affect the unit volume of cement per unit volume of concrete as determined by the original proportions designed to obtain a cement factor of not less than the following:

	Bags of Cement of 94 lbs. each to one Cu. Yd. of Concrete
Class A Concrete	6.0
Class A (A) Concrete	6.0
Class D Concrete	5.0
Class P Concrete	6.5
Class R Concrete	4.0
Class S Concrete	7.0
Class W Concrete	7.0
Class X Concrete	6.5
Class Y Concrete	6.5

The contractor's attention is directed to the fact that the specified cement contents indicated in the above table are the minimum permitted but are not assured by the Department, since the cement content required for any type of mix is dependent upon the gradation of aggregates within the limits of the specifications for that type gradation. The cement content is based upon the most ideal combination and gradation of both fine and coarse aggregates.

(b) Admixtures: When Class A (A) concrete is used, an approved water reducing admixture conforming to Subsection 911.03 shall be used. The use of admixtures in other classes of concrete will be optional with the contractor. If the contractor desires to use an air-entraining admixture and/or a water-reducing admixture, normal set or set-retarding, it will be at his own expense without reducing the cement content, and permission must be obtained from the engineer in writing. When the atmospheric temperature in the shade and away from artificial heat is above 70° F, the water reducing admixture shall be of the set retarding type and when the atmospheric temperature as described above is 70° F or below the water reducing admixture shall be of the normal set type. The set retarding admixture shall be used in the amount sufficient to produce the degree of retardation that is necessary for the particular pour being made. However, in no case shall the amount used be less than would be necessary to conform to all

requirements of Subsection 911.03. Admixtures shall always be dispensed in a liquid state and the method of dispensing shall be approved.

When Class Y concrete is required, an approved air-entraining admixture and an approved water reducing admixture (normal set or set-retarding) shall be used. The admixtures shall be used in such quantity as is necessary to produce an air content of 6 to 9 per cent when tested in accordance with LDH Designation: TR 203. The requirements on water reducing admixtures will be the same as described for Class A (A) concrete.

(c) Water: The maximum amount of water per sack of cement permitted, including the free water but not the absorbed water in the aggregates, for the different classes of concrete, shall not exceed the quantity shown in the following table. Free water shall be deemed to include all water entering the mix with the aggregate, except the water absorbed by the particles of aggregate.

	Maximum Water per Sack of Cement
Class A Concrete	6.0 gallons
Class A (A) Concrete	5.5 gallons
Class D Concrete	6.6 gallons
Class P Concrete	5.0 gallons
Class R Concrete	8.0 gallons
Class S Concrete	6.0 gallons
Classes W, X and Y*	

*Because of the absorptive nature of this aggregate and the inability to obtain a saturated surface dry condition for determining free moisture, a maximum amount of water cannot be specified. The consistency requirement will be the governing factor in determining the maximum allowable water.

(d) Coarse Aggregate. Coarse aggregate for the various classes of concrete shall be of the grade shown in the following table and described in detail under Subsection 903.03:

Class A Concrete	Grade A
Class A (A) Concrete	Grade A
Class D Concrete	Grade A, Grade B or Grade D
Class P Concrete	Grade A

Class R Concrete	Grade A, Grade B or Grade D
Class S Concrete	Grade A
Class W Concrete	Grade Y
Class X Concrete	Grade Y
Class Y Concrete	Grade Y

Aggregates of different Grades shall not be stockpiled together. Aggregates of the same Grade, regardless of source, whose specific gravities vary by not more than 0.02, may be stockpiled together.

(e) Consistency: The composition of the combined mixture shall be such as to produce concrete of suitable workability, with the specified cement content, and not more than the volume of water specified in the table hereinbefore.

The quantity of water used shall not be changed without the consent of the engineer.

The consistency of the various classes of concrete shall be such as to have slumps within the following ranges when tested in accordance with LDH Designation: TR 207.

Class A Concrete (Vibrated)	2-4 Inches
Class A Concrete (Nonvibrated)	2-5 Inches
Class A (A) Concrete	2-4 Inches
Class D Concrete	1-3 Inches
Class P Concrete	1-3 Inches
Class R Concrete	1-3 Inches
Class S Concrete	4-8 Inches
Class W Concrete	1-3 Inches
Class X Concrete	1-3 Inches
Class Y Concrete	2-4 Inches

The above ranges represent the desirable limits of slump; however, the engineer may authorize an increase in the maximum limits when necessary for the construction of walls 8 inches thick and thinner, as long as the cement water ratio is not exceeded.

(f) Compressive Strength: The concrete mix will be designed with the intent of producing concrete which, when molded and cured in accordance with LDH Designations: S 301 and S 302, and tested

as prescribed in AASHO Designation: T 22 of the Testing Procedures Manual shall show a minimum compressive strength in pounds per square inch as follows:

	5 Days	7 Days	28 Days
Class A Concrete	.....	2,000	3,000
Class A (A) Concrete	.....	2,000	3,000
Class D Concrete	.....	1,900	2,500
Class P Concrete	*4,000	4,000	5,000
Class R Concrete	.....	1,200	1,800
Class S Concrete	.....	2,000	3,000
Class W Concrete	*4,000	4,000	5,000
Class X Concrete	.....	2,500	3,750
Class Y Concrete	.....	2,000	3,000

*Steam Cured.

Cylinders by which the strength of Class P and Class W concrete is to be determined shall be cured by methods similar to those used in curing the pre-cast-prestressed concrete bridge members.

If the strength required for the class of concrete being produced is not secured with the minimum cement content specified, additional cement shall be used or other aggregate provided at the contractor's expense.

The engineer may require such additional samples from the concrete being placed for compression tests as necessary to determine that the mix proportions being used to produce the required strength.

805.07 SAMPLING AND TESTING. All sampling and testing will be done in accordance with the Department's Sampling and Testing Procedure Manuals.

805.08 MEASUREMENT OF MATERIALS. Materials shall be measured by weighing except for structures of less than 25 cubic yards, or where other methods are specifically authorized by the engineer. The apparatus provided for weighing the aggregates and cement shall be suitably designed and constructed for this purpose. Each size of aggregate and the cement shall be weighed separately. The allowable error in accuracy of weighing equipment shall be not more

than 1/2 of one per cent for all loads. The minimum graduation on the scales shall not exceed one tenth of one per cent of the rated capacity of the scales. Accuracy of batching shall be plus or minus one per cent of required weight. Cement in standard packages (sacks) need not be weighed, but bulk cement shall be weighed. The mixing water shall be measured by volume or by weight. The water measuring device shall be accurate to plus or minus one per cent of the required amount. All measuring devices shall be subject to approval.

When beam type scales are used, poises shall be designed to be locked in any position to prevent accidental change of position. A tell-tale indicator shall be provided.

Scales shall be inspected and sealed as often as the engineer may deem necessary to assure their continued accuracy. The Department shall have on hand ten 50-pound weights for testing scales.

Batching plants may be equipped to proportion aggregates and bulk cement by automatic weighing devices of an approved type.

Where volumetric measurements are authorized for projects where the amount of concrete is small, the weight proportions shall be converted to equivalent volumetric proportions. In such cases, suitable allowance shall be made for variations in the moisture condition of the aggregates, including the bulking effect in the fine aggregate.

When sack cement is used the quantities of aggregates for each batch shall be exactly sufficient for one or more full sacks of cement and no batch requiring fractional sacks of cement will be permitted.

805.09 MIXING CONCRETE.

(a) Mixing at Site. Concrete shall be thoroughly mixed in a batch mixer of an approved size and type which will insure a uniform distribution of the materials throughout the mass.

The mixer shall be equipped with adequate water storage and a device for accurately measuring and

automatically controlling the amount of water used in each batch. The mixer shall be equipped with an approved timing device which will automatically lock the discharge lever when the drum has been charged and release it at the end of the mixing period.

The entire contents of the mixer shall be removed from the drum before materials for a succeeding batch are placed therein. The materials composing a batch shall be deposited simultaneously in the mixer except that a portion of the mixing water shall enter in advance of the cement and aggregates. No mixer having a rated capacity of less than a 1-bag batch shall be used nor shall a mixer be charged in excess of its rated capacity.

All concrete shall be mixed for a period of not less than 1-1/2 minutes after all materials, including water, are in the mixer. During the period of mixing, the mixer shall operate at the speed for which it has been designed, but this speed shall be not less than 14 nor more than 20 revolutions per minute.

The first batch of concrete materials placed in the mixer shall contain a sufficient excess of cement, sand and water to coat the inside of the drum without reducing the required mortar content of the mix. Upon the cessation of mixing for a considerable period, the mixer shall be thoroughly cleaned.

(b) Truck Mixing. Truck mixers, unless otherwise authorized, shall be of the revolving drum type, watertight, and so constructed that the concrete can be mixed to insure a uniform distribution of materials throughout the mass. All solid materials for the concrete shall be accurately measured in accordance with Subsection 805.08 and charged into the drum at the proportioning plant. Except as subsequently provided, the truck mixer shall be equipped with a tank for carrying mixing water. Only the prescribed amount of water shall be placed in the tank unless the tank is equipped with a device by which the quantity of water added can be readily verified. The mixing water may be added directly to the batch, in which case a tank shall not be re-

quired. Truck mixers shall be equipped with electrically or mechanically actuated revolution counters by which the number of revolutions of the drum or blades may be verified. The counters shall be so located as to provide safe and convenient inspection. The delivery ticket will show the time of departure from the batching plant and the amount of water added.

Each truck mixer shall have attached thereto in a prominent place a metal plate or plates on which is plainly marked the various uses for which the equipment is designed, the manufacturer's guaranteed capacity of the drum in terms of the volume of concrete and the speed of rotation of the mixing drum or blades.

The maximum size of batch in truck mixers shall not exceed the maximum rated capacity of the mixer as stated by the manufacturer and stamped on a metal plate on the mixer. When a truck mixer is used for complete mixing each batch shall be mixed for not less than 70 nor more than 100 revolutions of the drum or blades at the rate of rotation designated by the manufacturer of the equipment on the metal plate on the mixer as mixing speed. Additional mixing, if any, shall be at the speed designated by the manufacturer of the equipment as agitating speed. All materials, including mixing water, shall be in the mixer drum before actuating the revolution counter for determination of the number of revolutions of mixing. When a truck mixer is used for the complete mixing of the concrete at the job site, the mixing operation shall begin within 30 minutes after the cement has been added to the aggregate. When cement is charged into a mixer drum containing surface-wet aggregate and when the ambient temperature is above 90° F, or when high early strength Portland cement is used, this limit shall be reduced to 15 minutes; the limitation on time between the introduction of the cement to the aggregates and the beginning of the mixing may be waived when, in the judgment of the engineer, the aggregates are sufficiently free from moisture so that there will be no harmful effects on the cement.

When the prescribed water is added at the batching plant and the slump requirements at the delivery site are not met, upon the authority of the engineer it will be permissible to add a minimum of 75 per cent of the mixing water at the time the cement and aggregates are added at the batch plant and the remaining mixing water at the job site, provided additional mixing is performed at the job site to insure thorough incorporation of the added water into the mix. The truck mixer shall be equipped with means of accurately measuring the amount of water used in each batch. The additional mixing shall be within the range of 20 to 30 revolutions at mixing speed.

(c) Partial Mixing at the Central Plant. When a truck mixer, or an agitator provided with adequate mixing blades, is used for transportation, the mixing time at the stationary machine mixer may be reduced to 30 seconds and the mixing completed in a truck mixer or agitator. The mixing time in the truck mixer or agitator equipped with adequate mixing blades shall be as specified for truck mixing.

(d) Plant Mix. Mixing at a central plant shall conform to the requirements for mixing at the site.

(e) Transit Mix. When a batching plant is provided for exclusive use on the project, and job conditions permit, on written request by the contractor, the engineer may approve mixing in transit.

(f) Time of Hauling and Placing Mixed Concrete. Concrete may be transported in a truck mixer, agitator, or other approved transportation device and shall be discharged at the job and placed in its final position in the forms within 60 minutes after the introduction of the mixing water to the cement and aggregate, or the cement to the aggregate, except that in hot weather or under other conditions contributing to quick stiffening of the concrete, the maximum allowable time may be reduced by the engineer. The maximum volume of mixed concrete transported in an agitator, and the speed of agitation, shall be in accordance with the manufacturer's specified rating.

(g) Hand Mixing. When hand mixing is authorized it shall be done on a watertight platform and in such a manner as to insure a uniform distribution of the materials throughout the mass. Mixing shall be continued until a homogeneous mixture of the required consistency is obtained.

(h) Delivery. The organization supplying concrete shall have sufficient plant capacity and transporting apparatus to insure continuous delivery at the rate required. The rate of delivery of concrete during concreting operations shall be such as to provide for the proper handling, placing and finishing of the concrete and to maintain a live workable surface. The methods of delivering and handling the concrete shall be such as will facilitate placing with the minimum of rehandling and without damage to the structure or the concrete.

(i) Retempering. The concrete shall be mixed only in such quantities as are required for immediate use and any which has developed initial set shall not be used.

805.10 HANDLING AND PLACING CONCRETE.

(a) General. In preparation for the placing of concrete all sawdust, chips, and other construction debris and extraneous matter shall be removed from the interior of forms. Struts, stays and braces, serving temporarily to hold the forms in correct shape and alignment, pending the placing of concrete at their locations, shall be removed when the concrete placing has reached an elevation rendering their service unnecessary. These temporary members shall be entirely removed from the forms and not buried in the concrete.

No concrete shall be used which does not reach its final position in the forms within the time stipulated under Subsection 805.09.

Concrete shall be placed so as to avoid segregation of the materials and the displacement of the reinforcement. The use of long troughs, chutes and pipes for conveying concrete from the mixer to the forms shall be permitted only on written authoriza-

tion of the engineer. In case an inferior quality of concrete is produced by the use of such conveyors, the engineer may order discontinuance of their use and the institution of a satisfactory method of placing.

Unless otherwise permitted, open troughs and chutes shall be of metal or metal lined. Where steep slopes are required, the chutes shall be equipped with baffles or be in short lengths that reverse the direction of movement.

All chutes, troughs and pipes shall be kept clean and free from coatings of hardened concrete by thoroughly flushing with water after each run; water used for flushing shall be discharged clear of the structure.

When placing operations would involve dropping the concrete more than 5 feet, it shall be deposited through sheet metal or other approved pipes except where deemed impractical by the engineer. After initial set of the concrete the forms shall not be jarred and no strain shall be placed on the ends of reinforcement bars which project.

Concrete, during and immediately after depositing, shall be thoroughly compacted. The compaction shall be done by mechanical vibration subject to the following provisions:

(1) The vibration shall be internal unless special authorization of other methods is given or as provided herein.

(2) Vibrators shall be of an approved type and design. They shall be capable of transmitting vibration to the concrete at frequencies of not less than 4500 impulses per minute.

(3) The contractor shall provide a sufficient number of vibrators to properly compact each batch immediately after it is placed in the forms.

(4) Vibrators shall be manipulated so as to thoroughly work the concrete around the reinforcement and imbedded fixtures and into the corners and angles of the forms.

Vibration shall be applied at the point of deposit and in the area of freshly deposited concrete. The vibrators shall be inserted and withdrawn out of the concrete slowly. The vibration shall be of sufficient duration and intensity to thoroughly compact the concrete, but shall not be continued so as to cause segregation. Vibration shall not be continued at any one point to the extent that localized areas of grout are formed.

Application of vibrators shall be at points uniformly spaced and not farther apart than twice the radius over which the vibration is visibly effective.

(5) Vibration shall not be applied directly or through the reinforcement to sections or layers of concrete which have hardened to the degree that the concrete ceases to be plastic under vibration. It shall not be used to make concrete flow in the forms over distances so great as to cause segregation, and vibrators shall not be used to transport concrete in the forms.

(6) Vibration shall be supplemented by such spading as is necessary to insure smooth surfaces and dense concrete, along form surfaces and in corners and locations impossible to reach with the vibrators.

(7) The provisions of this subsection shall apply to filler concrete for steel grid floor except that the vibrator shall be applied to the steel.

(8) The provisions of this subsection shall apply to precast piling, concrete cribbing and other precast members except that, if approved, the manufacturers' methods of vibration may be used.

Concrete shall be placed in horizontal layers. When less than a complete layer is placed in one operation, it shall be terminated in a vertical bulkhead. Each layer shall be placed and compacted before the preceding layer has taken initial set to prevent injury to the fresh concrete and avoid surfaces of separation between layers.

The concrete, between pours, shall be cleaned of

laitance and other objectionable material to a sufficient depth to expose sound concrete. To avoid irregular joints as far as possible upon exposed faces, the top surface of the concrete adjacent to the forms shall be finished to a grade strip. Where a "feather edge" might be produced at a construction joint, as in the sloped top surface of a wing wall, an inset form work shall be used to produce a blocked out portion in the preceding layer which shall produce an edge thickness of not less than 6 inches in the succeeding layer. Work shall not be discontinued within 18 inches of the top of any face, unless provision has been made for a coping less than 18 inches thick, in which case, if permitted, the construction joint may be made at the under side of the coping.

Immediately following the discontinuance of placing concrete all accumulations of mortar splashed upon the reinforcement steel and the surfaces of forms shall be removed. Dried mortar chips and dust shall not be puddled into the unset concrete. If the accumulations are not removed prior to the concrete becoming set, care shall be exercised not to injure or break the concrete-steel-bond at and near the surface of the concrete, while cleaning the reinforcement steel.

(b) Culverts. In general, the base slab or footings of a box culvert shall be placed and allowed to set before the remainder of the culvert is constructed. In this case suitable provision shall be made for bonding the sidewalls to the culvert base, preferably by means of raised longitudinal keys so constructed as to prevent, as far as possible, the percolation of water through the construction joint.

Before concrete is placed in the sidewalls, the culvert footings shall be thoroughly cleaned of all shavings, sticks, sawdust, or other extraneous material and the surface carefully chipped and roughened in accordance with the method of bonding construction joints as specified in Subsection 805.14 (b).

In the construction of box culverts 4 feet or less in

height, the sidewalls and top slab may be constructed as a monolith. When this method of construction is used, any necessary construction joints shall be vertical and at right angles to the axis of the culvert.

In the construction of box culverts more than 4 feet in height, the concrete in the walls shall be placed and allowed to set before the top slab is placed. In this case, appropriate keys shall be left in the sidewalls for anchoring the cover slab.

Each wing wall shall be constructed, if possible, as a monolith. Construction joints, where required, shall be horizontal and so located that no joint will be visible in the exposed face of the wing wall above the ground line.

(c) Girder, Slabs and Columns. Concrete, preferably, shall be deposited by beginning at the center of the span and working from the center toward the ends. Concrete in girders shall be deposited uniformly for the full length of the girder and brought up evenly in horizontal layers.

Concrete in girder haunches less than 3 feet in height shall be placed at the same time as that in the girder stem, and the column or abutment tops shall be cut back to form seats for the haunches. Whenever any haunch of fillet has a vertical height of 3 feet or more, the abutment or columns, the haunch and the girder shall be placed in 3 successive stages; first, up to the lower side of the haunch; second, to the lower side of the girder; and third, to completion.

Concrete in slab spans shall be placed in one continuous operation for each span unless otherwise provided.

The floors and girders of through girder superstructures shall be placed in one continuous operation unless otherwise specified, in which case, special shear anchorage shall be provided to insure monolithic action between girder and floor.

Concrete in T-beam or deck girder spans may be

placed in one continuous operation or may be placed in 2 separate operations, each of which shall be continuous; first, to the top of the girder stems, and second, to completion. In the latter case, the bond between stem and slab shall be positive and mechanical and shall be secured by means of suitable shear keys in the tip of the girder stem. The size and location of these keys shall be computed. In general, suitable keys may be formed by the use of timber blocks approximately 2 by 4 inches in cross-section and having a length 4 inches less than the width of the girder stem. These key blocks shall be spaced along the girder stems as required, but the spacing shall be not greater than one foot center to center. The blocks shall be beveled and oiled in such manner as to insure their ready removal, and they shall be removed as soon as the concrete has set sufficiently to retain its shape.

Concrete in columns shall be placed in one continuous operation, unless otherwise directed. The concrete shall be allowed to set at least 12 hours before the caps are placed.

Unless otherwise permitted, no concrete shall be placed in the superstructure until the column forms have been stripped sufficiently to determine the character of the concrete in the columns. The load of the superstructure shall not be allowed to come upon the bents until they have been in place at least 14 days, or until the concrete has the required strength.

(d) Arches. The concrete in arch rings shall be placed in such a manner as to load the centering uniformly.

Arch rings, preferably, shall be cast in transverse sections of such size that each section can be cast in a continuous operation. The arrangement of the sections and the sequence of placing shall be approved and shall be such as to avoid the creation of initial stress in the reinforcement. The sections shall be bonded together by suitable keys or dowels. When permitted, arch rings may be cast in a single continuous operation.

805.11 PNEUMATIC PLACING. Pneumatic placing of concrete will be permitted only if specified in the special provisions or if authorized. The equipment shall be so arranged that no vibrations result which might damage freshly placed concrete.

Where concrete is conveyed and placed by pneumatic means the equipment shall be suitable in kind and adequate in capacity for the work. The machine shall be located as close as practicable to the place of deposit. The position of the discharge end of the line shall not be more than 10 feet from the point of deposit. The discharge lines shall be horizontal or inclined upwards from the machine.

At the conclusion of placement the entire equipment shall be thoroughly cleaned.

805.12 PUMPING. Placement of concrete by pumping will be permitted only if specified in the special provisions or if authorized. The equipment shall be so arranged that no vibrations result which might damage freshly placed concrete.

Where concrete is conveyed and placed by mechanically applied pressure the equipment shall be suitable in kind and adequate in capacity for the work. The operation of the pump shall be such that a continuous stream of concrete without air pockets is produced. When pumping is completed, the concrete remaining in the pipeline, if it is to be used, shall be ejected in such a manner that there will be no contamination of the concrete or separation of the ingredients. After this operation, the entire equipment shall be thoroughly cleaned.

805.13 DEPOSITING CONCRETE UNDER WATER. Concrete shall not be deposited in water except with the approval of the engineer and under his immediate supervision; and in this case the method of placing shall be as hereinafter designated.

Concrete deposited in water shall be Class S. To prevent segregation, it shall be carefully placed in a compact mass, in its final position, by means of a tremie, or other approved method, and shall not be

disturbed after being deposited. Still water shall be maintained at the point of deposit and the forms under water shall be watertight.

For parts of structures under water, when possible, concrete seals shall be placed continuously from start to finish; the surface of the concrete shall be kept as nearly horizontal as practicable at all times. To insure thorough bonding, each succeeding layer of a seal shall be placed before the preceding layer has taken initial set.

A tremie shall consist of a tube having a diameter of not less than 10 inches, and if constructed in sections it shall have watertight couplings. The tremies shall be supported so as to permit free movement of the discharge end over the entire top surface of the work and so as to permit rapid lowering when necessary to retard or stop the flow of concrete. The discharge end shall be closed at the start of work so as to prevent water entering the tube; the tremie tube shall be kept as full as practicable while pouring the tremie seal. When a batch is dumped into the hopper, the flow of concrete shall be induced by slightly raising the discharge end, always keeping it in the deposited concrete. The flow shall be continuous until the work is completed.

Unwatering may proceed when the concrete seal is sufficiently hard and strong. All laitance or other unsatisfactory material shall be removed from the exposed surface by scraping, chipping or other means which will not injure the surface of the concrete.

805.14 CONSTRUCTION JOINTS.

(a) General. Construction joints shall be made only where located on the plans or shown in the pouring schedule, unless otherwise approved. The face edges of joints exposed to view shall be carefully finished true to line and elevation.

If not detailed on the plans, construction joints shall be placed as directed. Raised shear keys or reinforcing steel shall be used where necessary to transmit shear or bond the 2 sections together.

(b) Bonding.

(1) Construction Joints. Before depositing new concrete on or against concrete which has hardened, the forms shall be retightened. The surface of the hardened concrete shall be roughened as required and in a manner that will not leave loosened particles of aggregate or damaged concrete at the surface. It shall be thoroughly cleaned of foreign matter and laitance, and saturated with water. To insure an excess of mortar at the juncture of the hardened and the newly deposited concrete, the cleaned and saturated surfaces, including vertical and inclined surfaces, shall first be thoroughly covered with a coating of mortar or neat cement grout against which the new concrete shall be placed before the grout has attained its initial set.

(2) Epoxy Joints. Before depositing new concrete on or against concrete which has hardened, the forms shall be retightened. The vertical surfaces of the deck construction joints shall be coated prior to each succeeding pour with a liquid polysulfide/epoxy adhesive conforming to the requirements of Subsection 911.04.

The surface of the joint of old concrete to which new concrete is to be bonded shall be cleaned by sandblasting, with hammers, or wire brushes, so that all foreign material and loose and unsound concrete is removed and only sound concrete remains. If grease or oil are present, they shall be removed with a detergent wash such as trisodium phosphate and the entire area then washed with fresh water and brushed with a stiff brush. If a detergent is not required, washing will only be required as necessary to remove dust and small particles not removed by other cleaning methods.

When all free water has dried from the joint or area to be patched, LP/epoxy adhesive shall be applied by brush or spray to a 5-10 mil thickness. The adhesive will be allowed to set for 30 to 60 minutes to permit the solvent to escape. If the

concrete has absorbed the adhesive, another coat will be applied. When the solvent has escaped, but the adhesive is still tacky, the new concrete shall be placed.

805.15 CONCRETE EXPOSED TO SEA WATER. Unless otherwise specifically provided, concrete for structures exposed to sea water shall be Class A concrete. The concrete shall be mixed for a period of not less than 2 minutes and the water content of the mixture shall be carefully controlled and regulated so as to produce concrete of maximum impermeability. The concrete shall be thoroughly compacted and stone pockets shall be avoided. No construction joints shall be formed between levels of extreme low water and extreme high water as determined by the engineer. Between these levels sea water shall not come in direct contact with the concrete for a period of not less than 30 days. The original surface, as the concrete comes from the forms, shall be left undisturbed.

805.16 FALSEWORK AND CENTERING. Detailed plans for falsework and centering will be furnished in accordance with Section 801.

For designing falsework and centering, a weight of 150 pounds per cubic foot shall be assumed for green concrete. All falsework shall be designed and constructed to provide the necessary rigidity and to support the loads without appreciable settlement or deformation. The contractor shall be required to employ screw jacks, hardwood wedges or other approved methods to take up any settlement in the formwork either before or during the placing of concrete.

Falsework which cannot be founded on a satisfactory footing shall be supported on piling which shall be spaced, driven and removed in an approved manner.

Falsework shall be set to give the finished structure the camber specified or indicated on the plans.

Arch centering shall be constructed according to approved centering plans. Provision shall be made by means of suitable wedges, sand boxes or other devices for the gradual lowering of centers, and rendering the

arch self-supporting. When directed, centering shall be placed upon approved jacks in order to take up and correct any slight settlement which may occur after the placing of masonry has begun.

805.17 FORMS.

(a) Construction. Forms shall be designed and constructed so that they may be removed without injury to the concrete.

All forms shall be of wood or metal and shall be built mortartight and of sufficient rigidity to prevent distortion due to pressure of the concrete and other loads incident to the construction operations. Forms shall be constructed and maintained so as to prevent warping and the opening of joints due to shrinkage of the lumber.

The forms shall be substantial and unyielding and shall be so designed that the finished concrete will conform to the proper dimensions and contours. The design of the forms shall take into account the effect of vibration of concrete as it is placed.

(b) Form Surface. Forms for exposed surfaces shall be made of either metal or dressed lumber of uniform thickness with or without a form liner of an approved type, and mortartight. Forms for reentrant angles shall be chamfered and the forms shall be filleted at all sharp corners. The forms shall be given a bevel or draft in the case of all projections, such as girders and copings, to insure easy removal.

The forms shall be so designed that portions where finishing is required may be removed without disturbing portions of forms which are to be removed later and, as far as practicable, so that form marks will conform to the general lines of the structure. For narrow walls and columns, where the bottom of the form is inaccessible, the lower form boards shall be left loose so that they may be removed for cleaning out extraneous material immediately before placing the concrete.

When possible, forms shall be daylighted at intervals

not greater than 10 feet vertically, the openings being sufficient to permit free access for the purpose of inspecting, working and spading the concrete.

(c) Metal Ties. Metal ties or anchorages within the forms shall be constructed as to permit their removal to a depth of at least ½ inch from the face without injury to the concrete. In case ordinary wire ties are permitted, all wires, upon removal of the forms, shall be cut back at least ¼ inch from the face of the concrete with chisels or nippers; for green concrete, nippers are necessary. All fittings for metal ties shall be of such design that, upon their removal, the cavities which are left will be of the smallest possible size. The cavities shall be filled with cement mortar and the surface left sound, smooth, even and uniform in color.

(d) Setting and Maintaining. All forms shall be set and maintained reasonably true to the line designated until the concrete is sufficiently hardened. Forms shall remain in place for periods which shall be determined as specified. When forms appear to be unsatisfactory in any way, either before or during the placing of concrete, the work shall be stopped until the defects have been corrected.

(e) Re-use. The shape, strength, rigidity, mortar-tightness and surface smoothness of re-used forms shall be maintained at all times in a reasonably satisfactory condition. Any warped or bulged lumber must be re-sized before being re-used. Forms which are unsatisfactory in any respect shall not be re-used.

(f) Surface Treatment. All forms shall be treated with oil, approved form coating or saturated with water immediately before placing the concrete. For rail members or other members with exposed faces, the forms shall be treated with an approved oil or form coating to prevent the adherence of concrete. Any material which will adhere to or discolor the concrete shall not be used.

Prior to placing the concrete, the interior of all

forms shall be cleaned of all dirt, sawdust, shavings or other debris. Forms shall be inspected immediately prior to placing concrete.

Cleanout ports shall be provided at the top surface of concrete where a stoppage of placing occurs.

805.18 REMOVAL OF FALSEWORK, FORMS AND HOUSING. Except as herein provided, forms for surfaces required to be finished shall be removed when the concrete has aged not less than ½ nor more than 2 curing days after the concrete is placed. In order to facilitate slab finishing, forms for inside curb faces on roadway slabs may be removed in not less than 3 hours provided the concrete has set sufficiently and forms are constructed in a manner to permit their removal without damage to the curbs.

The following specifications for the removal of forms and falsework from portions of structures which do not require surface finish shall apply to the forms and falsework under the portions of slabs that cantilever more than one foot beyond the outside beams, to the forms and falsework under girders and to the forms and falsework under bent caps of framed bents regardless of whether or not those surfaces are required to be finished.

Forms and falsework for the portions of structures which do not require surface finishing shall be removed in accordance with either of the following methods, as the contractor elects.

Method 1: Forms and falsework may be removed as soon as the concrete has attained a flexural strength or compressive strength, as determined by either beam or cylinder tests, indicated in the following table:

Class of Concrete	Required Flexural Strength Lbs. per Sq. In.	Required Compressive Strength Lbs. per Sq. In.
A	500	3,000
A (A)	500	3,000
D	400	2,500
Y	500	3,000

Test specimens shall be made from the same con-

crete and cured under the same conditions as the portion of the structure involved. For the test beams, AASHO Designation: T 97 of the Testing Procedures Manual, shall be used, except the test beam will be made in the field and sampling of concrete for molding specimens and storing of the test beams shall be done in the same manner as provided for the test cylinders. For the test cylinders, AASHO Designation: T 22 of the Testing Procedures Manual, shall be used.

Method 2: If field operations are not controlled by beam or cylinder tests the following periods, exclusive of days when the temperature is below 40° F, for removal of forms and supports shall be used, except that colder days may be counted if satisfactory provision is made to maintain the air temperature adjacent to the concrete constantly above 50° F throughout the entire day.

Forms and falsework under slabs or beams or pile caps having span length of 10 feet and less.	7 days
Forms and falsework under slabs or beams or pile caps having span lengths over 10 feet and less than 17 ft.	7 days plus one day for each foot of span over 10 feet
Forms and falsework under slabs or beams or pile caps having spans over 17 ft. in length.	14 days
Forms and falsework under the portion of slabs that cantilever more than one foot beyond the outside beams.	7 days
Forms for walls, columns, side forms for beams, pile caps and slabs that cantilever one foot or less beyond the outside beam.	1 day
Forms for concrete caissons	2 days

In the determination of the time for the removal of forms and falsework, and the discontinuance of heating, consideration shall be given to the location and the character of the structure, the weather and other conditions influencing the setting of concrete, and the materials used in the mix.

The foregoing provisions relative to forms and falsework removal, under either method the contractor elects to use, shall apply only to forms or parts of forms which are so constructed as to permit removal without disturbing forms or falsework which are required to be left in place for a longer period on other portions of the structure.

Methods of form removal likely to cause overstressing of the concrete shall not be used. Forms and their supports shall not be removed without approval. Supports shall be removed in such a manner as to permit the concrete to uniformly and gradually take the stresses due to its own weight.

In general, arch centering shall be struck and the arch made self-supporting before the railing or coping is placed. This precaution is essential in order to avoid jamming of the expansion joints and variations in alignment. For filled spandrel arches, such portions of the spandrel walls shall be left for construction subsequent to the striking of centers, as may be necessary to avoid jamming of the expansion joints.

Centers shall be gradually and uniformly lowered in such a manner as to avoid injurious stresses in any part of the structure. In arch structures of 2 or more spans, the sequence of striking centers shall be specified or approved.

805.19 CONCRETING IN COLD WEATHER. No concrete shall be placed when the atmospheric temperature is below 35° F without written permission. In the event the temperature is expected to fall below 35° F, the contractor shall protect freshly placed concrete against freezing.

If permission is granted to conduct concreting operations when the atmospheric temperature is below 35° F, the contractor shall supply such heating appa-

ratus as stoves, salamanders or steam equipment and the necessary fuel. The contractor shall enclose the structure in such a way that the concrete surface and air within the enclosure is maintained between 50° F and 90° F. When dry heat is used, means of maintaining atmospheric moisture shall be provided. All aggregates and mixing water shall be heated to a temperature of at least 70° F but not more than 150° F; the aggregates may be heated by either steam or dry heat. If permitted, the torch method of heating mixed concrete may be used, provided the heating apparatus shall be such as to heat the mass uniformly and avoid hot spots which will burn the materials. The temperature of the concrete shall be not less than 50° F at the time of placing in the forms.

805.20 CURING CONCRETE. Concrete surfaces exposed to conditions causing premature drying shall be protected by covering as soon as possible with canvas, straw, burlap, sand or other satisfactory material and kept moist; or if the surfaces are not covered, they shall be kept moist by flushing or sprinkling. Curing shall continue for a period of not less than 7 days after placing the concrete. If high-early strength cement is used, this period may be reduced as directed. Other precautions to insure the development of strength shall be taken as the engineer may direct.

Unless otherwise directed, concrete bridge floors shall be closed to traffic for a period of at least 14 days after placing and for such additional time as may be considered advisable. When the concrete has cured for 2 days, buggies may be permitted to travel over the deck provided that approved runners are placed over sand cushions in the immediate area of the supporting girders or beams.

805.21 EXPANSION AND FIXED JOINTS AND BEARINGS. All joints shall be constructed according to details shown on the plans.

(a) Open Joints. Open joints shall be placed in the locations shown on the plans and shall be constructed by the insertion and subsequent removal of a wood strip, metal plate or other approved material. The insertion and removal of the template

shall be accomplished without chipping or breaking the corners of the concrete. Reinforcement shall not extend across an open joint unless so specified on the plans.

(b) Filled Joints. Expansion joints shall be constructed similar to open joints. When premolded types are specified, the filler shall be placed in correct position as the concrete on one side of the joint is placed. When the form is removed, the concrete on the other side shall be placed. Adequate water stops of metal, rubber or plastic shall be carefully placed as shown on the plans.

(c) Polysulfide Base Joint Sealing Compound (Cold Applied). This item shall consist of furnishing and installing expansion joints all in accordance with the plans and this specification.

The expansion joint filler shall consist of a 3-component system in accordance with subsection 905.01.

The faces of the joint shall be sand-blasted or wire-brushed clean to insure removal of all foreign matter from the surfaces of the joint. If grease or oil are present, they shall be removed with a detergent wash such as trisodium phosphate and the entire area then washed with fresh water and brushed with a stiff brush. If a detergent is not required, washing only will be required as necessary to remove residual dust and small particles.

When the joint has completely dried, the adhesive primer shall be applied by brush or spray to the vertical faces of the joint from the top surface to the depth as required by the joint dimensions. After waiting the required length of time for adhesive properties to appear in the primer, the premoulded polyurthane foam seat shall be compressed and wedged into the primed joint to a depth such that the top of the seat shall be at a minimum of ¾ inch from the top surface of the joint for joints up to one inch in width and not less than ½ the width for joints over one inch in width. Adhesive primer shall be applied to the ends of all foam seat strips before continuation strips are compressed

into the joint. The continuation strip shall be butted against the primed end and the process continued.

A second coat of adhesive primer shall be applied to the joint faces and the top of the foam seat to receive the polysulfide elastomer.

The elastomer shall be applied into the joint cavity using a trowel or caulking gun in such a manner that the cavity is completely filled. The joint surface shall be troweled with a spatula to work off excess material and eliminate air pockets.

Provisions shall be made to protect all exposed surfaces adjacent to the joint before the process is begun.

(d) Premolded Expansion Joint Filler. Non-extruding and resilient types shall conform to the requirements of Subsection 905.02 (a).

Bituminous fiber types shall conform to the requirements of Subsection 905.02 (a).

Bituminous type filler shall conform to the requirements of Subsection 905.02 (c).

Preformed compression joint seal shall conform to the requirements of Subsection 905.02 (d).

(e) Steel Joints. The plates, angles or other structural shapes shall be accurately shaped, at the shop, to conform to the section of the concrete floor. The fabrication and painting shall conform to the requirements of the specifications covering those items. When called for on the plans or in the special provisions the material shall be galvanized in lieu of painting. Care shall be taken to insure that the surface in the finished plane is true and free of warping. Positive methods shall be employed in placing the joints to keep them in correct position during the placing of the concrete. The opening at expansion joints shall be that designated on the plans at normal temperature and care shall be taken to avoid impairment of the clearance in any manner.

(f) Water Stops. Adequate water stops of metal, rub-

ber or plastic shall be placed as shown on the plans. Where movement at the joint is provided for, the water stops shall be of a type permitting such movement without injury. They shall be spliced, welded, or soldered, to form continuous watertight joints.

(g) Sheet Copper. Sheet copper shall conform to the requirements of Subsection 913.14.

(h) Bearing Devices. Bearing plates, rockers and other expansion devices shall be constructed according to details shown on the plans. The masonry surfaces on which bearings are to be set shall be finished to insure a true and uniform bearing at the grade and elevation shown on the plans. Bronze or copper-alloy plates shall conform to the requirements of Subsection 913.09. Structural steel and painting shall conform to the specifications for those items. When called for on the plans or in the special provisions, the material shall be galvanized in lieu of painting. The rockers or other expansion devices shall be set to conform to the temperature at the time of erection.

805.22 FINISHING CONCRETE. Surface finishes shall be classified as follows:

Class 1. Ordinary Surface Finish

Class 2. Rubbed Finish

Class 3. Tooled Finish

Class 4. Sand-blast Finish

Class 5. Wire Brush or Scrubbed Finish

Class 6. Bridge Deck Finish

Class 7. Sidewalk Finish

Class 8. Precast-Prestressed Concrete Finish

All concrete shall be given Class 1, Ordinary Surface Finish, and in addition, if further finishing is required, such other type of finish as is specified. If not otherwise specified, the following surfaces shall be given a Class 2, Rubbed Finish: The exposed faces of piers, abutments, wing walls, retaining walls, rail-

ings and parapets; the outside faces of girders, T-beams, slabs, columns, brackets, curbs, headwalls, arch rings, spandrel walls and parapets; but not on the tops and bottoms of floor slabs and sidewalks, bottoms of beams and girders, sides of interior beams and girders, backwalls above bridge seat or the underside of copings. The surface finish on piers and abutments shall include all exposed surfaces below bridge seat to low water elevation or one foot below finish ground line. Wing walls shall be finished from the top to one foot below the finish slope lines on the exposed face and shall be finished on top and for a depth of one foot below the top on the backfill sides.

Unless otherwise specified, roadway floors shall be given Class 6, Bridge Deck Finish.

(a) Class 1, Ordinary Surface Finish. Immediately following the removal of forms, all fins and irregular projections shall be removed from all surfaces except from those which are not to be exposed or are not to be waterproofed. On all surfaces, the cavities produced by form ties and all other holes, honeycomb spots, broken corners or edges and other defects shall be thoroughly cleaned, and after having been kept saturated with water for a period of not less than 3 hours shall be carefully pointed and trued with a mortar of cement and fine aggregate mixed in the proportions used in the grade of the concrete being finished. Mortar used in pointing shall be not more than one hour old. The mortar patches shall be cured as specified under curing. All construction and expansion joints in the completed work shall be left carefully tooled and free of all mortar and concrete. The joint filler shall be left exposed for its full length with clean and true edges.

The resulting surfaces shall be true and uniform. All surfaces which cannot be satisfactorily repaired shall be "rubbed" as specified for Class 2, Rubbed Finish.

(b) Class 2, Rubbed Finish. After removal of forms the rubbing of concrete shall be started as soon as its condition will permit. Immediately before starting

this work the concrete shall be kept thoroughly saturated with water for a minimum period of 3 hours. Sufficient time shall have elapsed before the wetting down to allow the mortar used in the pointing of rod holes and defects to thoroughly set. Surfaces to be finished shall be rubbed with a medium coarse carborundum stone, using a small amount of mortar on its face. The mortar shall be composed of cement and fine sand mixed in proportions used in the concrete being finished. Rubbing shall be continued until all form marks, projections and irregularities have been removed, all voids filled and a uniform surface has been obtained. The paste produced by this rubbing shall be left in place at this time.

After all concrete above the surface being treated has been cast, the final finish shall be obtained by rubbing with a fine carborundum stone and water. This rubbing shall be continued until the entire surface is of a smooth texture and uniform color.

After the final rubbing is completed, the surface shall be left free from all unsound patches, paste, powder and objectionable marks.

(c) Class 3, Tooled Finish. Finish of this character for panels and other like work may be secured by the use of a bushhammer, pick, crandall, or other approved tool. Air tools, preferably, shall be employed. No tooling shall be done until the concrete has set for at least 14 days and as much longer as may be necessary to prevent the aggregate particles from being "picked" out of the surface. The finished surface shall show a grouping of broken aggregate particles in a matrix of mortar, each aggregate particle being in slight relief.

(d) Class 4, Sand-Blasted Finish. The thoroughly cured concrete surface shall be sand-blasted with hard, sharp sand to produce an even fine-grained surface in which the mortar has been cut away, leaving the aggregate exposed.

(e) Class 5, Wire Brushed or Scrubbed Finish. This type of finish shall be produced by scrubbing the

surface of a green concrete with stiff wire or fiber brushes, using a solution of muriatic acid in the proportion of one part acid to 4 parts water. As soon as the forms are removed and while the concrete is yet comparatively green, the surface shall be thoroughly and evenly scrubbed as above described until the cement film or surface is completely removed and the aggregate particles are exposed, leaving an even pebbled texture presenting an appearance grading from that of fine granite to coarse conglomerate, depending upon the size and grading of aggregate used. As soon as the scrubbing has progressed sufficiently to produce the texture desired, the entire surface shall be thoroughly washed with water to which a small amount of ammonia has been added to remove all traces of the acid.

(f) Class 6, Bridge Deck Finish.

(1) Striking Off. After the concrete is placed as specified under Subsection 805.10, the surface shall be carefully struck off with an approved screed to conform to the cross section and grade shown on the plans. Proper allowance shall be made for camber, if required. The screed may be operated longitudinally or transversely and shall be moved forward with a combined longitudinal and transverse motion, the manipulation being such that neither end is raised from the support forms or guide rails during the process. In lieu of a manual screed, an approved mechanical vibratory screed may be used. A slight excess of concrete shall be kept in front of the cutting edge at all times.

When atmospheric conditions (temperature, humidity and wind) are such that rapid evaporation of mixing water from the concrete is likely to occur, the contractor shall furnish and apply water to the concrete in the form of a fine fog mist. The water shall be applied in sufficient quantity, as determined by the engineer, as may be necessary to curb the harmful effects which would result from rapid drying out of the concrete and to cool the concrete.

(2) Floating. After striking off and consolidating as specified above, the surface shall be made uniform by longitudinal or transverse floating, or both.

(3) Straightedging. After the floating has been completed, the slab surface shall be tested for trueness with a straightedge. For this purpose, the contractor shall furnish and use an accurate 10-foot straightedge. Any depressions found shall be immediately filled with freshly mixed concrete, struck off, consolidated and refinished. High areas shall be cut down and refinished. The straightedge testing and refloating shall continue until the entire surface is found to be free from observable departures from the straightedge and the slab has the required grade and contour, until there are no deviations of more than ⅛ inch under the 10-foot straightedge.

(4) Final Finishing. When the concrete has hardened sufficiently, the surface shall be given a final finish by either the transverse or longitudinal method as follows:

Transverse Method:

Drag finish. Unless otherwise permitted, the final finish shall be a drag finish. To obtain surface texture with a drag finish, a drag shall be used which shall consist of a seamless strip of damp burlap or cotton fabric, which shall produce a uniform surface of gritty texture after dragging it longitudinally along the full width of bridge roadway. For bridge roadways 16 feet or more in width, the drag shall be mounted on a bridge which travels on the forms. The dimensions of the drag shall be such that a strip of burlap or fabric at least 3 feet wide is in contact with the full width of bridge deck surface while the drag is used. The drag shall consist of not less than 2 layers of burlap with the bottom layer approximately 6 inches wider than the upper layer. The drag shall be maintained in such condition that the resultant surface is of uniform appearance and reasonably free from

grooves over 1/8 inch in depth. Drags that cannot be cleaned shall be discarded and new drags substituted.

Belt finish. When permitted or specified, the surface texture shall be a belt finish. When straightedging is complete and water sheen has practically disappeared and just before the concrete becomes nonplastic, the surface shall be belted with a 2-ply canvas belt not less than 8 inches wide and at least 3 feet longer than the bridge deck width. Hand belts shall have suitable handles to permit controlled, uniform manipulation. The belt shall be operated with short strokes transverse to the center line and with a rapid advance parallel to the center line.

Broom finish. When permitted or specified, the surface texture shall be a broom finish. It shall be applied when the water sheen has practically disappeared. The broom shall be drawn from the center to the edge of the bridge deck with adjacent strokes slightly overlapping. The brooming operation shall be so executed that the corrugations produced in the surface shall be uniform in appearance and not more than 1/8 inch in depth. Brooming shall be completed before the concrete is in such condition that the surface will be torn or unduly roughened by the operation. The surface thus finished shall be free from rough and porous areas, irregularities, and depressions, resulting from improper handling of the broom. Brooms shall be of such quality, size, and construction and be so operated as to produce a surface finish, meeting the approval of the engineer. Subject to satisfactory results being obtained, the contractor will be permitted to substitute mechanical brooming in lieu of manual brooming as herein described.

Longitudinal Method:

Belt finish. Unless otherwise permitted, the final finish shall be a belt finish. When straightedging is complete and water sheen has practically disappeared and just before the concrete

has become nonplastic, the surface shall be belted with a 2-ply canvas belt not less than 8 inches wide and at least 3 feet longer than the section of bridge slab being finished. The belt shall be operated with short longitudinal strokes parallel to the bridge centerline and shall be kept sufficiently taut to reduce bowing of belt at center to a dimension not greater than one per cent of the length of bridge section being finished. Belts shall be kept clean and pliable.

Drag finish. When permitted or specified, the final finish shall be a drag finish. To obtain acceptable surface texture, a drag shall be used which shall consist of a seamless strip of damp burlap or cotton fabric, which shall produce a uniform surface of gritty texture as the drag is pulled transversely across the bridge deck. The drag shall be mounted on a bridge which travels on the same support forms used for operation of the longitudinal strike-off screed. The dimensions of the drag shall be such that a strip of burlap or fabric at least 3 feet wide is in contact with the bridge deck surface for the full length of the bridge section being finished. The drag shall consist of not less than 2 layers of the material with the bottom layer at least 6 inches wider than the upper layer. The drag shall be maintained and operated in such a condition and way that the resultant surface is of uniform appearance and reasonably free from grooves over ⅛ inch in depth. Drags that cannot be cleaned and kept pliable shall be discarded.

Broom finish. When permitted or specified, the surface shall be given a broom finish. This finish shall be applied at the proper time following operations of the longitudinal screed and after the surface has been made uniform by such floating and straightedging as needed. The broom shall be of an approved type and shall be drawn transversely from the edge of bridge deck, or curb, perpendicular to the centerline and in the same direction as the strike-

off operation, with adjacent and adjoining strokes slightly overlapping. The brooming operations shall be so performed that the corrugations produced shall be uniform in appearance all across the bridge deck and not more than ⅛ inch in depth. Brooming shall be completed while the concrete is in such condition as to avoid undue tearing or roughening of the surface. The surface thus finished shall be free from rough and porous areas, irregularities and depressions, resulting from improper handling of the broom. Subject to satisfactory results being obtained, the contractor will be permitted to substitute mechanical brooming in lieu of manual brooming described herein.

(g) Class 7, Sidewalk Finish. After the concrete has been deposited in place, it shall be compacted and the surface shall be struck off by means of a strike board and floated with a wooden or cork float. An edging tool shall be used on all edges and at all expansion joints. The surface shall not vary more than ⅛ inch under a 10-foot straightedge. The surface shall have a granular or matte texture which will not be slick when wet.

(h) Class 8, Precast-Prestressed Concrete Finish. All concrete for precast-prestressed bridge members shall be given Class 1, Ordinary Surface Finish, at the plant as soon as possible after casting and before delivery. It is recognized that it is not feasible to eliminate entirely the formation of small cavities due to trapped air in the concrete surfaces next to steel forms, and the repair of a reasonable number of these cavities will not be required. However, the manufacturer of precast members will be required to adopt measures to reduce the number and size of trapped air cavities to a reasonable minimum, and an excessive number of these cavities will be cause for rejection of the precast member. In all other respects, the concrete finish for precast-prestressed bridge members shall be given Class 1, Ordinary Finish, by the manufacturer.

After completion of the structure, all construction damage shall be repaired so as to restore the Class

1 finish and the exposed surfaces of precast-prestressed concrete piles and the outside faces of exterior precast-prestressed concrete girders shall be cleaned to produce a uniform color. The cleaning shall not be done in a manner to destroy the somewhat glazed surface of the concrete resulting from the use of metal forms.

805.23 PRESTRESSED CONCRETE.

(a) Description. The construction of prestressed concrete members shall conform to the requirements of preceding subsections in this section except as those requirements are modified or supplemented by the provisions which follow.

(b) Supervision and Inspection. Unless otherwise specifically permitted, the contractor or fabricator shall provide a technician skilled in the use of the system of prestressing to be used who shall supervise the work and give the engineer such assistance as in his judgment may be necessary.

Free access to all parts of the contractor's or manufacturer's plant engaged in the fabrication of prestressed concrete bridge members shall be afforded the engineer or his authorized representative at all times while prestressed members are being cast.

Inspection of prestressed concrete bridge members shall be in accordance with the current Interim Manual for the inspection of prestressed concrete bridge members of the AASHO with latest amendments. Upon abandonment of the Interim Manual and adoption of a permanent Manual, inspection shall be in accordance with the current adopted Manual for Inspection of prestressed concrete bridge members of the AASHO with latest amendments.

(c) Equipment and Stressing Requirements—General. The contractor or fabricator shall provide all equipment necessary for the construction and the prestressing. Prestressing shall be done with approved jacking equipment. If hydraulic jacks are used, they shall be equipped with accurately reading pressure gages.

In all methods of tensioning, the stress induced in the reinforcing members shall be measured both by jacking gages and by elongations of the reinforcement, and the results shall check within close limits. Means shall be provided for measuring the elongation of reinforcement to the nearest 1/32 inch.

Prior to use in manufacture of prestressed members under these specifications, all jacks to be used, together with their gages, shall be calibrated by an approved laboratory. For jacks up to 200 tons capacity, and which can be placed within the available testing machine, the calibration will be performed without charge by the Department's Testing Laboratory, provided the jacks are delivered there by the contractor. For larger jacks, calibration by proving ring or other acceptable method, performed by an established testing company at the expense of the contractor, will be required. During progress of the work, if any jack or gage appears to be giving erratic results, or if gage pressure and elongations indicate materially differing stresses, recalibration will be required.

It is anticipated that there may be a possible difference in indicated stress between jack pressure and elongation of about 5 per cent. In such event, the error shall be so placed that the discrepancy shall be on the side of a slight overstress rather than understress. In the event of an apparent discrepancy between gage pressure and elongation of as much as 10 per cent, the entire operation shall be carefully checked and the source of error determined before proceeding further.

The amount of stress to be given each stressing element shall be as shown on the plans.

(d) Concrete. Concrete for all prestressed members shall be Class "P" or Class "W" whichever is specified.

The design of the concrete mix, within the limits of these specifications, shall be the sole responsibility of the contractor subject to approval by the engineer of the mix and materials, but such approval

shall not relieve the contractor of responsibility for the product furnished.

In all other respects the concrete shall be controlled, mixed and handled as specified in other subsections of this section.

Concrete shall not be deposited in the forms until the engineer has inspected the placing of the reinforcement, conduits, anchorages, and prestressing steel and has given his approval thereof.

The concrete shall be vibrated internally or externally, or both, as ordered by the engineer. The vibrating shall be done with care in such a manner as to avoid displacement of reinforcing, conduits, or wires.

Tops of prestressed beams shall be rough floated. At approximately the time of initial set, the entire top of beams shall be scrubbed transversely with a coarse wire brush to remove all laitance and to produce a roughened surface for bonding slab.

(e) Curing. To establish the adequacy of the curing methods used and to determine whether the concrete has attained the required minimum compressive strength for the various operations, 7 test cylinders will be made and cured under same conditions as the members. Two cylinders will be broken at the end of 28 days. The remaining 5 cylinders will be broken at any time requested by the contractor. However, in the event all 5 cylinders are broken at the request of the contractor, and the concrete has not yet attained the required strength, the members involved will be held at the plant until the 28-day cylinders are broken. If the concrete has not yet attained the required strength, all members involved will be rejected.

Steam Curing. Steam curing, when selected by the contractor, shall be done under a suitable enclosure to contain the live steam in order to minimize moisture and heat losses. The initial application of the steam shall be from 2 to 4 hours after the final placement of concrete to allow the initial set of the concrete to take place. If re-

tarders are used, the waiting period before application of the steam shall be increased to from 4 to 6 hours. The steam shall be at 100 per cent relative humidity to prevent loss of moisture and to provide excess moisture for proper hydration of the cement. Application of the steam shall not be directly on the concrete. During application of the steam the ambient air temperature shall increase at a rate not to exceed 40° F per hour until a maximum temperature of from 140° F to 160° F is reached. The maximum temperature shall be held until the concrete has reached the required strength. In discontinuing the steam, the ambient air temperature shall not decrease at a rate to exceed 40° F per hour until a temperature has been reached about 20° F above the temperature of the air to which the concrete will be exposed.

(f) Transportation and Storage. Precast girders should be transported in an upright position, and points of support and directions of the reactions with respect to the girder should be approximately the same during transportation and storage as when the girder is in its final position. In the event that the contractor deems it expedient to transport or store precast girders in other than this position, it shall be done at his own risk.

Care shall be taken during storage, hoisting, and handling of the precast units to prevent cracking or damage. Units damaged by improper storing or handling shall be replaced by the contractor at his expense.

All members may be handled immediately after completion of stressing. In the event that stressing is not done in a continuous operation, members shall not be handled before they are sufficiently stressed, as determined by the engineer, to sustain all forces and bending moments due to handling.

All prestressed members shall be held at the plant until the concrete has attained a compressive strength of 5000 psi.

Prestressed members may be installed at any time after completion of stressing and grouting, providing

the concrete has attained a strength of 5000 psi, except for the driving of prestressed piling.

Prestressed piling may be driven after the concrete has attained a compressive strength of 5000 psi, but in no event before the expiration of 10 days after casting if steam cured or 14 days after casting if conventionally cured.

(g) Pretensioning Method. The prestressing elements shall be accurately held in position and stressed by jacks. A record will be kept of the jacking force and the elongations produced thereby. Several units may be cast in one continuous line and stressed at one time. Sufficient space shall be left between ends of units to permit access for cutting after the concrete has attained the required strength. No bond stress shall be transferred to the concrete, nor shall end anchors be released, until the concrete has attained a compressive strength as shown by standard cylinders made and cured identically with members, of at least 4000 psi. The elements shall be cut or released in such an order that lateral eccentricity of prestress will be a minimum.

All cables to be prestressed in a group shall be brought to a uniform initial tension prior to being given their full pretensioning. This uniform initial tension of approximately 500 to 1,000 pounds shall be measured by a dynamometer or other approved means so that its amount can be used as a check against elongation computed and measured.

After this initial tensioning, the group shall be stressed until the required elongation and jacking pressure are attained and reconciled within the limits specified hereinbefore.

With the cables stressed in accordance with the plan requirements and the foregoing specifications and with all other reinforcing in place, the concrete shall be cast to the lengths desired.

(h) Posttensioning Method. The tensioning process shall be conducted so that the tension being applied and the elongation may be measured at all times. The friction loss shall be estimated as provided be-

low. A record shall be kept of gage pressures and elongations at all times and submitted to the engineer for his approval. Loads shall not be applied to the concrete until it has attained strength as specified in (g) for the pretensioning method.

Straight posttensioning tendons may be tensioned from one end. Curved tendons shall generally be stressed by simultaneous jacking from both ends of the stressing element unless otherwise provided on the plans or in the special provisions.

Friction losses. Friction losses in posttensioned members occur from angle change in draped cables and from wobble of the ducts. These losses can be estimated by the following formula:

$T_o = T_x e^{(kl+\mu\alpha)}$

In which

T_o = Steel stress at jacking end.

T_x = Steel stress at any point x.

e = Base of Naperian logarithms.

k = Friction wobble coefficient per foot of prestressing steel.

l = Length of prestressing steel element from jacking end to point x, in feet.

μ = Friction curvature coefficient.

α = Total angular change of prestressing steel element in radians from jack to point x.

using the following average values of k and μ

Type of Steel	Type of Duct	k	μ
Wire cables	Bright metal sheathing	0.0020	0.30
	Galvanized metal sheathing	0.0015	0.25
	Greased or asphalt coated and wrapped	0.0020	0.30
	Direct contact with concrete	0.0015	0.45

Type of Steel	Type of Duct	k	μ
High-strength bars	Bright metal sheathing	0.0003	0.20
	Galvanized metal sheathing	0.0002	0.15
	Direct contact with concrete	0.0005	0.40
Galvanized strand	Bright metal sheathing	0.0015	0.25
	Galvanized metal sheathing	0.0010	0.20
	Direct contact with concrete	0.0015	0.50

Friction losses occur prior to anchoring but should be checked during stressing operations.

(i) Grouting of Bonded Steel. Posttentioned prestressed bridge members preferably shall be of the bonded type in which the tensioned steel is installed in holes or flexible metal ducts cast in the concrete and bonded to the surrounding concrete by filling the tubes or ducts with grout. The grout shall consist of a mixture of one part Portland cement, 0.25 part fly ash containing not more than 6 per cent carbon, 0.75 part screened and washed sand (at least 95 per cent passing a No. 30 sieve), with 4 to 6 gallons of water per bag of cement. At his option, however, the contractor may substitute a grout mixture containing 1.75 parts Portland cement and 0.25 part fly ash, provided that the grout meets all of the other requirements of this specification.

All prestressing reinforcement to be bonded shall be free of dirt, loose rust, grease, or other deleterious substances. Before grouting, the ducts shall be free of water, dirt or any other foreign substances. The ducts shall be blown out with compressed air until no water comes through the duct. For long members with draped strands an open tap at the low point of the duct may be necessary.

The grout shall be fluid (consistency of thick paint) but proportioned so that free water will not separate out of the mix. Unpolished aluminum powder may be added in an amount of one to two teaspoons per sack of cement. Commercial plasticizers used in

accordance with the manufacturer's recommendation may be used provided they contain no ingredients that are corrosive to steel. Pressure used in grouting shall be that recommended for the system being used.

(j) Prestressing Reinforcement. Prestressing reinforcement shall be high-tensile-strength steel wire, high-tensile-strength seven-wire strand or high-tensile-strength alloy bars as called for in the plans or in the special provisions. Prestressing reinforcement shall conform to the applicable requirements of Section 909.

(k) Sampling and Testing Prestressing Reinforcement and Anchorages. Sampling and testing of prestressing reinforcement and anchorages shall be performed in accordance with the applicable requirements of Section 909.

Ends of pretensioned strands not to be encased in end diaphragms shall be cut off flush with ends of beam and shall be coated with a suitable bituminous material.

Should the contractor desire to substitute 270K high strength stress relieved 7-wire strand for ASTM Designation: A 416 grade strand, he shall submit complete details to the Bridge Design Engineer to show that the design he proposes to use is essentially the same as the design plans and as described in these specifications. The design submitted shall correspond in total prestressing force and location of prestressing force, in all essential requirements, to the design drawings. The Bridge Design Engineer shall be the sole judge as to the adequacy and propriety of the substitute design. The 270K strand shall conform to the requirements of Subsection 909.05 and such strands shall be clearly marked for position identification of strand type.

805.24 PLACING ANCHOR BOLTS. All necessary anchor bolts in piers, bents, abutments or pedestals shall be set carefully in Portland cement mortar at the location and in the manner described on the plans and in accordance with the requirements of Subsection 807.50, or as described herein.

The locations of anchor bolts to be built into the masonry shall be verified by the contractor prior to setting. In this case great care shall be exercised to insure the proper setting of the bolts, and any inaccuracies which will be detrimental to the structure shall be corrected by approved means.

When swedged anchor bolts are called for on the plans, the anchor bolts shall preferably be set in preformed holes having a minimum diameter of 3 inches to allow for adjustment and sufficient in depth to admit the swedged anchor bolt. The holes may be formed by the insertion in the fresh concrete of oiled wooden plugs or sheet metal sleeves or other approved devices which are subsequently withdrawn after the concrete has partially set. All such holes shall be adequately protected against the formation of ice while open. When erecting the members, the contractor shall first set the members and shoes in place; then the preformed holes shall be filled sufficiently with grout so that when the swedged anchor bolts are placed to the required depth, the grout will completely fill the holes.

Should the contractor elect to set swedged anchor bolts, either at initial casting or by drilling, he will be required to verify the center line to center line spacing between the anchor bolt holes of each fabricated member before setting the anchor bolts. If bolt holes are drilled, the diameter of the drilled holes shall not be less than ½ inch larger than the diameter of the bolts.

805.25 METHOD OF MEASUREMENT. The yardage to be measured shall be the number of cubic yards of concrete of the several classes, complete in place and accepted. In computing the concrete yardage for payment, the dimensions used shall be those shown on the plans or ordered in writing by the engineer. No measurement or other allowance will be made for forms, falsework, cofferdams, pumping or bracing. No measurement or allowance will be made for expansion joint materials and joint fillers or for structural excavation unless otherwise specifically provided in the plans.

No deductions in quantities of concrete shall be made for the enclosed reinforcing bars in counterweights and adjusting blocks, but the volume of structural steel so enclosed shall be deducted from the volume of concrete. Measurement will be based on the actual dimensions of the finished counterweights, including adjusting blocks.

No deductions will be made for the volume of reinforcing steel, water pipes and electrical conduits, steel angles forming armored joints in roadway slabs, weep holes or cast iron drains.

Deductions will be made for the volume of steel beams and beam and girder flanges embedded in concrete, for all expansion joints, and for all pile heads embedded in concrete. In computing the volume to be deducted for concrete pile heads embedded in concrete, nominal butt dimensions, that is, 12 inches x 12 inches, 14 inches x 14 inches, etc., shall be used. In computing the volume to be deducted for timber pile embedded in concrete, a butt diameter of 12 inches shall always be used, regardless of size and length of pile.

The quantity of concrete involved in fillets, scorings and chamfers 1½ square inches or less in cross sectional areas shall not be deducted from the quantities to be measured.

If a bid is asked on concrete handrailing, that portion of the railing above the top of the roadway curb or sidewalk curb, as the case may be, shall not be included in the yardage of concrete but shall be measured as handrailing.

The length of prestressed concrete members to be measured shall be the total length out to out in linear feet measured along the centerline of the various classes of precast-prestressed concrete girders, beams or other bridge members, except piling, complete in place and accepted. The dimensions used shall be those shown on the plans or ordered in writing by the engineer. Precast concrete piling shall be measured and paid for as provided in Section 804.

When payment for expansion joint filler is called

for on the plans, the length to be measured shall be the length of the joint, including the length on curbs and sidewalks, that is to be filled.

805.26 BASIS OF PAYMENT. The number of cubic yards of completed and accepted concrete of the several classes shall be paid for at the contract price per cubic yard for the various items of Class A, Class A (A), Class D, Class R, Class S, or Class Y, as the case may be, complete in place, but shall not constitute payment for reinforcing steel, nor for metal expansion joints.

The number of linear feet of completed and accepted prestressed concrete members of the various types shall be paid for at the contract unit price per linear foot of "Type I, Type II, Type III, or Type IV Precast-Prestressed Concrete Girders" or other members as provided on the plans and in the special provisions, as the case may be. Payment shall include concrete, prestressed and non-prestressed reinforcement, tie rods, nuts, washers, masonry, anchor plates, metal or other bearing plates and assemblies, or other appurtenances indicated or necessary in the fabrication, handling and erection of prestressed bridge members.

The number of linear feet of completed and accepted expansion joint filler shall be paid for at the contract unit price per linear foot, complete in place.

No payment will be made for steel punchings used in counterweights and adjusting blocks, cost of same to be included in price bid on concrete.

Metal expansion joints shall be paid for as pounds of structural steel complete in place and accepted.

Reinforcing steel shall be paid for under the pay item of that name.

Payment will be made under:

Item No.	Pay Item	Pay Unit
805(1)	Class A Concrete	Cubic Yard
805(2)	Class A (A) Concrete	Cubic Yard
805(3)	Class A Concrete in Pipe Headwalls	Cubic Yard

Item No.	Pay Item	Pay Unit
805(4)	Class A Concrete in Box Culverts	Cubic Yard
805(5)	Class A Concrete in Box Girders	Cubic Yard
805(6)	Class A Concrete in Bents	Cubic Yard
805(7)	Class A Concrete in Footings	Cubic Yard
805(8)	Class A Concrete in Piers above Footings	Cubic Yard
805(9)	Class A Concrete in Retaining Walls	Cubic Yard
805(10)	Class A Concrete in Counterweights	Cubic Yard
805(11)	Class D Concrete	Cubic Yard
805(12)	Class R Concrete	Cubic Yard
805(13)	Class S Concrete	Cubic Yard
805(14)	Class Y Concrete	Cubic Yard
805(15)	Type I Precast-Prestressed Concrete Girders	Linear Foot
805(16)	Type II Precast-Prestressed Concrete Girders	Linear Foot
805(17)	Type III Precast-Prestressed Concrete Girders	Linear Foot
805(18)	Type IV Precast-Prestressed Concrete Girders	Linear Foot
805(19)	Expansion Joint Filler	Linear Foot

Section 806
Reinforcement

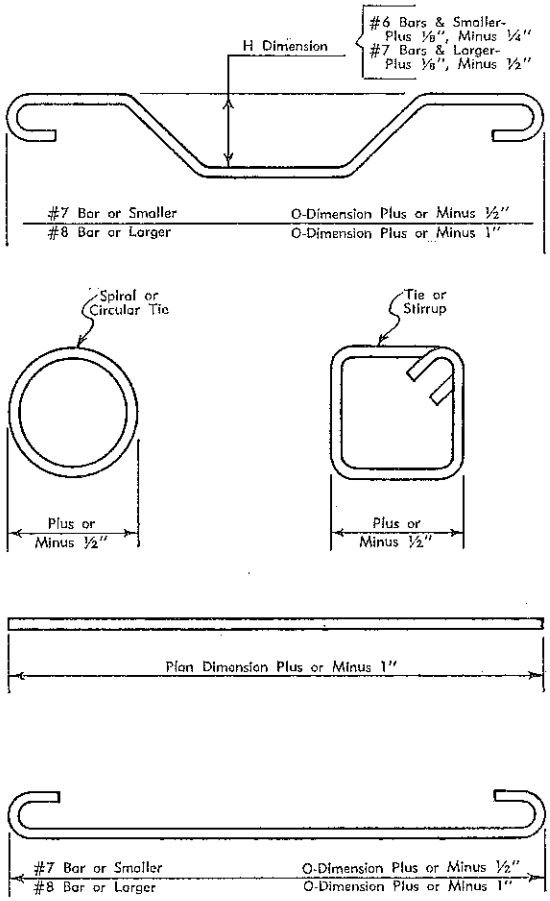
806.01 DESCRIPTION. This work shall consist of furnishing and placing reinforcing steel in accordance with the specifications and in conformity with the plans.

806.02 MATERIALS. All materials shall conform to the applicable subsections of Section 909.

806.03 STEEL LISTS. Before placing reinforcing steel, 2 copies of a list of all reinforcing steel showing the location, mark number, size, and type bend, shall be furnished to the engineer at the site for his use in administering the contract. Furnishing such lists to the engineer shall not be construed to mean that the lists will be reviewed for accuracy. The contractor shall be wholly and completely responsible for the accuracy of the lists and for furnishing and placing all bar reinforcing steel in accordance with the details shown on the plans and as specified.

The contractor shall also furnish the engineer 2 copies of a placing plan for all structures where reinforcing steel is involved unless the plans contain sufficient detail for proper placement of reinforcing steel. Placing plans shall show the location, type and spacing of supports.

806.04 TOLERANCES. Fabricating tolerances for bars shall not be greater than that shown in figures below:



806.05 PROTECTION OF MATERIAL. From its delivery to the job until used, reinforcing steel shall be stored above the surface of the ground upon platforms, skids or other supports. It shall be protected at all times from damage.

The various sizes and lengths shall be plainly marked and tagged by the contractor to facilitate inspection and checking.

806.06 FABRICATION. Bent bar reinforcement shall be cold bent to the shapes shown on the plans, and unless otherwise provided on the plans or by authorization, bends shall be made in accordance with the following requirements.

Stirrups and tie bars shall be bent around a pin having a diameter not less than 2 times the minimum thickness of the bar. Bends for other bars shall be made around a pin having a diameter not less than 6 times the minimum thickness except for bars larger than one inch, in which case the bends shall be made around a pin of 8 bar diameters.

Bar reinforcement shall be shipped in standard bundles, tagged and marked in accordance with the Code of Standard Practice of the Concrete Reinforcement Steel Institute.

806.07 PLACING AND FASTENING. All steel reinforcement shall be placed as near as practicable in the position shown on the plans and firmly held during the placing and setting of the concrete. When placed in the work it shall be free from dirt, loose rust, loose scale, paint, oil, grease or other foreign material. Thin powdery rust and tight rust is not considered detrimental and need not be removed. Bars shall be tied at all intersections with No. 14 or No. 16 gage wire except where spacing is less than one foot in each direction when alternate intersections shall be tied.

Distance from the forms shall be maintained by means of metal chains, precast mortar or concrete blocks, ties, hangers, or other approved supports. Blocks in the form of a frustrum of a cone or pyramid are preferred. The blocks shall be cast with the sides beveled in such manner that the size of the block increases away from the area to be placed against the forms. Except in unusual cases, and when specifically otherwise authorized by the engineer, the size of the surface to be placed adjacent to the forms shall not exceed 2½ inches square or the equivalent thereof in cases where circular or rectangular areas are provided. Metal chairs which are in contact with the exterior surface of the concrete shall be hot-dipped galvanized or plastic coated. Layers of bars shall be separated by precast mortar blocks or by other approved devices. The use of pebbles, pieces of broken stone or brick, metal pipe and wooden blocks will not be permitted. All supports and spacers shall be approved types. Precast mortar blocks shall be furnished with suitable tie wire in each block for

anchoring the block to avoid displacement when placing concrete. Vertical stirrups shall always pass around main tension members and shall be securely attached thereto. The minimum spacing center to center of parallel bars shall be 2½ times the diameter of round or 3 times the side dimensions of square bars, but in no case shall the clear distance between the bars be less than 1½ times the maximum size of the coarse aggregate. The minimum covering, measured from the surface of the concrete to the face of any reinforcement bars, shall not be less than 2 inches except as follows: Top of slab—1½ inches; bottom of slab—1 inch; stirrups and ties in T-Beams —1½ inches. Additional coverage as shown on the plans shall be provided for reinforcement in the bottom of footings, or where exposed to salt water or unusual corrosive or abrasive conditions. Reinforcement in any member shall be placed and then inspected and approved before placing of concrete begins. Concrete placed in violation of this provision may be rejected and removal required.

806.08 SPLICING. All reinforcement shall be furnished in the full lengths indicated on the plans. Splicing of bars, except where shown on the plans, will not be permitted without written approval. Splices shall be staggered as far as possible. Unless shown on the plans, bars shall be lapped 35 diameters. Construction joints shall not be made within the limits of the lapped bars. In lapped splices the bars shall be placed in contact and wired together in such a manner as to maintain a clearance of not less than the minimum clear distance to other bars and the minimum distance to the surface of the concrete as specified in Subsection 806.07. Welding of reinforcement steel shall be done only if detailed on the plans or if authorized by the engineer in writing. Welding shall conform to the latest Specifications for Welded Highway and Railway Bridges of the American Welding Society. Welding qualifications shall conform to the requirements of Section 916.

806.09 SUBSTITUTIONS. Substitution of different size bars will be permitted only with specific authorization by the engineer. If steel is substituted, it shall

have cross-sectional and surface areas equivalent to the design areas, or larger.

806.10 METHOD OF MEASUREMENT. Steel reinforcement incorporated in the concrete masonry will be measured by the pound. The measurement will be based on the total computed weight for the sizes and length of bars as shown on the plans.

The weight of plain or deformed bars will be computed from the theoretical weight of plain round or square bars of the same nominal size and area as shown in the following table:

Bar Size Number	Nominal Area Sq. In.	Weight Per Linear Foot
2	0.05	0.167
3	0.11	0.376
4	0.20	0.668
5	0.31	1.043
6	0.44	1.502
7	0.60	2.044
8	0.79	2.670
9	1.00	3.400
10	1.27	4.303
11	1.56	5.313
14S	2.25	7.65
18S	4.00	13.60

When wire is ordered by gage numbers, the following relation between number and diameter, in inches, shall apply unless otherwise specified:

Gage Number	Equivalent Diameter Inches	Equivalent Diameter Inches	Gage Number
0	.3065	.1620	8
1	.2830	.1483	9
2	.2625	.1350	10
3	.2437	.1205	11
4	.2253	.1055	12
5	.2070	.0915	13
6	.1920	.0800	14
7	.1770		

The weight of reinforcement used in railings, when they are paid for a linear foot basis, shall not be mea-

sured. The weight of reinforcement in precast piles, and in other items where the reinforcement is included in the contract price for the items, shall not be measured.

No allowances will be made for spaces in column spirals, clips, wire separators, chairs, and other material used in fastening the reinforcing in place. If bars are substituted upon the contractor's request and as a result more steel is used than specified, only the amount specified shall be included.

When laps are made for splices, other than those shown on the plans, for the convenience of the contractor, the extra steel shall not be included.

Reinforcing steel furnished for testing purposes shall not be included.

Structural shapes used as reinforcement shall be measured as provided for in Subsection 807.58 and paid for as structural steel.

806.11 BASIS OF PAYMENT. The accepted quantities of reinforcing steel will be paid for at the contract price per pound complete in place.

Item No.	Pay Item	Pay Unit
806(1)	Deformed Reinforcing Steel	Pound

Section 807

Structural Steel

807.01 DESCRIPTION. This work shall consist of furnishing and placing structural steel for structures or portions thereof in accordance with the details shown on the plans and these specifications.

807.02 MATERIALS. All materials shall conform to the applicable part of Section 913.

807.03 DRAWINGS. Shop drawings and working drawings shall be furnished in accordance with Subsection 801.03.

FABRICATION

807.04 INSPECTION. The Department will inspect all structural steel.

The engineer will examine the material before it is worked in the shop and will have authority to reject all materials or workmanship not in conformity with the plans and specifications. The contractor or fabricator shall give the Bridge Construction Engineer at least 10 days notice before commencing the fabricating of any structural steel. The engineer shall be furnished with 6 complete copies of all mill orders, including material orders. Heat number markings will be shown steel die stamped on all main material. Round rods and certain bar shapes that are shipped, bundled and tagged with the heat number from the mill shall have this heat number transferred steel die stamped to each piece as it arrives at the fabrication plant in the presence of our inspector. Material used from stock shall show steel die stamped heat numbers along with test reports.

In the fabricating shop the transferring of heat numbers shall be steel die stamped for all main members. Neatly painted numbers may be used on sub-members such as gusset plates and stiffeners. In case of doubt as to the grade of steel being used, samples will be taken by the inspector for submittal to the Depart-

ment of Highways Testing Laboratory in Baton Rouge for tests to establish the grade of steel in question. A color code system shall be required for all steel to be used in structures for the Department. There should be a distinct color for each grade of steel. This color should be placed on material on entering shop and carried on all pieces to final fabrication.

The contractor shall furnish means and assistance for the testing of all materials and workmanship. The engineer shall have free access at all times to any portion of the shops where work is being done under these specifications.

The acceptance of any material or finished member shall not preclude their subsequent rejection if found defective. Rejected material shall be promptly replaced.

The contractor or fabricator shall furnish the engineer adequate office space so that he may be able to perform his paper work in a convenient manner. This office space shall contain desk, chair, telephone and file cabinet with lock. The office shall be located where there is not excessive noise and preferably private. Toilet facilities and a place to change clothes should be convenient.

807.05 TYPE OF FABRICATION. Riveted, bolted and welded construction shall be so noted on the plans. High tensile bolts may be substituted for rivets in either shop or field, unless otherwise specified on the plans.

807.06 QUALITY OF WORKMANSHIP. Workmanship and finish shall be equal to the best general practice in modern bridge shops, as interpreted by the engineer.

807.07 HANDLING AND STORING MATERIALS. Structural material, either plain or fabricated, shall be stored above the ground upon platforms, skids, or other supports. It shall be kept free from dirt, grease and other foreign matter and shall be protected as far as practicable from corrosion. It shall be properly drained.

Girders and beams shall be placed upright and stored. Long members, such as columns and chords, shall be supported on skids placed near enough together to prevent injury from deflection.

807.08 STRAIGHTENING MATERIAL. Rolled material, before being laid off or worked, must be straight within mill tolerances allowed by ASTM Designation: A 6. If straightening is necessary, it shall be done by methods that will not injure the metal. The use of water or any other fluid for quenching is prohibited. Sharp kinks and bends shall be cause for rejection of the material.

807.09 FINISH. Portions of the work exposed to view shall be finished neatly. Shearing, flame cutting and chipping shall be done carefully and accurately and shall be ground to a neat finish.

807.10 RIVET HOLES. All holes for rivets shall be either punched or drilled. Material forming parts of a member composed of not more than 5 thicknesses of metal may be punched 1/16 inch larger than the nominal diameter of the rivets whenever the thickness of the metal is not greater than ¾ inch for structural carbon steel or 5/8 inch for alloy steel.

When there are more than 5 thicknesses or when any of the main material is thicker than ¾ inch in structural carbon steel, or 5/8 inch in alloy steel, or when required under Subsection 807.13, all the holes shall be subpunched or subdrilled 3/16 inch smaller and, after assembling, reamed 1/16 inch larger, or drilled from the solid to 1/16 inch larger, than the nominal diameter of the rivets.

807.11 PUNCHED HOLES. The diameter of the die shall not exceed the diameter of the punch by more than 1/16 inch. If any holes must be enlarged to admit the rivets, they shall be reamed. Holes must be clean cut, without torn or ragged edges. Poor matching of holes will be cause for rejection; any repair shall be witnessed by the engineer.

807.12 REAMED OR DRILLED HOLES. Reamed holes shall be cylindrical, perpendicular to the member and not more than 1/16 inch larger than the nominal di-

ameter of the rivets. Where practicable, reamers and drills shall be directed by mechanical means. Drilled holes shall be 1/16 inch larger than the nominal diameter of the rivet. All burrs shall be removed. Poor matching of holes will be cause for rejection. Reaming and drilling shall be done with twist reamers or twist drills. If required, assembled parts shall be taken apart for removal of burrs caused by drilling. Connecting parts requiring reamed or drilled holes shall be assembled and securely held while being reamed or drilled and shall be match-marked before disassembling.

807.13 SUBPUNCHING, REAMING AND SHOP ASSEMBLY. Unless otherwise specified, holes in all field connections and field splices of main truss of arch members, continuous beams, towers (each face), bents, plate girders and rigid frames shall be subpunched or subdrilled if subdrilling is required according to Subsection 807.10 and reamed while assembled in the shop. The assembly, including camber, alignment, accuracy of holes and milled joints, shall be approved before reaming is commenced.

Unless otherwise authorized, each individual (full length) truss, arch, continuous beam, tower (each face) bent or girder shall be assembled in the shop before reaming is commenced.

All holes for floor beam and stringer field end connections shall be subpunched and reamed to a steel template or reamed while assembled.

If additional subpunching and reaming is required, it shall be specified in the special provisions or on the plans.

807.14 ACCURACY OF PUNCHED AND DRILLED HOLES. All holes punched full size, subpunched, or subdrilled shall be so accurately punched that after assembling (before any reaming is done) a cylindrical pin ⅛ inch smaller in diameter than the nominal size of the punch hole may be entered perpendicular to the face of the member, without drifting, in at least 75 per cent of the contiguous holes in the same plane. If the requirement is not fulfilled, the badly punched

pieces will be rejected. If any hole will not pass a pin 3/16 inch smaller in diameter than the nominal size of the punched holes, this will be cause for rejection.

807.15 ACCURACY OF REAMED AND DRILLED HOLES. When holes are reamed or drilled, 85 per cent of the holes in any contiguous group shall, after reaming or drilling, show no offset greater than 1/32 inch between adjacent thicknesses of metal.

All steel templates shall have hardened steel bushings in holes accurately dimensioned from the centerlines of the connection as inscribed on the template. The centerlines shall be used in locating accurately the template from the milled or scribed ends of the members.

807.16 SHOP ASSEMBLING.

(a) General. Shop assembly of trusses, arches, continuous beam spans, bents, towers (each face), and plate girders shall be according to Subsection 807.13, except partial assembly as described herein will be allowed when specified on the plans or in the special provisions. Complete shop assembly of an entire structure, including floor system, which may be necessary in the case of complicated designs shall be done when shown on the plans or when stipulated in the special provisions. The requirements of Subsection 807.13 shall be modified as follows when "partial assembly" is permitted by the special provisions or by notes on the plans. The panels of trusses and open-spandrel arches and the columns of bents and towers shall be reamed or drilled with at least 3 abutting panels, and in no case less than 150 feet of length assembled and with milled ends of compression members in full bearing. Connections of web members shall be reamed or drilled steel templates.

(b) Reaming And Drilling Through Templates.

(1) Reaming or drilling full size of field connections through templates shall be done after the templates have been located with the utmost care as to position and angle and firmly bolted.

Templates used for the reaming of matching members, or of the opposite faces of one member, shall be exact duplicates. Templates for connections which duplicate shall be so accurately located that like members are duplicates and require no match-marking.

(2) When templates are used to ream field connections of web members of a truss, arch, bent or tower, at least one end of each web member shall be milled or scribed normal to the long axis of the member and the templates shall be accurately set at both ends from this milled or scribed end. Templates for reaming gussets of a truss shall be accurately set and located before reaming or drilling to their true geometric dimensions, as shown on the shop plans.

(c) The fabricator shall have the option of making complete assembly. A camber diagram shall be furnished by the fabricator based on calculated values.

Surfaces of metal in contact shall be cleaned with high cycle wire brush sander or disc grinder before assembling. The parts of a member shall be assembled, well pinned, and firmly drawn together with bolts before reaming or riveting is commenced. Assembled pieces shall be taken apart, for the removal of burrs and shavings produced by the reaming operation at the discretion of the engineer. The member shall be free from twists, bends, and other deformation.

Preparatory to the shop riveting of full-sized punched material, the rivet holes, if necessary, shall be spear-reamed for the admission of the rivets. The reamed holes shall not be more than 1/16 inch larger than the nominal diameter of the rivets.

807.17 CAMBER DIAGRAM. A camber diagram shall be furnished the engineer, showing the camber at each panel point for each truss girder or beam taken from actual measurements at assembly.

807.18 DRIFTING OF HOLES. The drifting done during assembling shall be only such as to bring the

parts into position, and not sufficient to enlarge the holes or distort the metal. If any holes must be enlarged to admit the rivets, they shall be reamed.

807.19 MATCH-MARKING. Connecting parts assembled in the shop for the purpose of reaming holes in field connections shall be match-marked with steel stencils, and a diagram showing such marks shall be furnished to the engineer.

807.20 RIVETS. The size of rivets called for on the plans shall be the size before heating. Rivet heads shall be of standard shape, unless otherwise specified, and of uniform size for the same diameter of rivet. They shall be in full contact with the surface of the member.

807.21 BOLTS AND BOLTED CONNECTIONS. The specifications of this subsection do not pertain to the use of high-tensile-strength bolts. Bolted connections fabricated with high-tensile-strength bolts shall conform to Subsection 807.22.

(a) General. Bolts shall be unfinished, turned, or an approved form of ribbed bolt. Bolted connections shall be used only as indicated by the plans or special provisions. Bolts shall have single self-locking nuts or double nuts. Beveled washers shall be used where bearing faces have a slope of more than 1:20 with respect to a plane normal to the bolt axis.

Except as otherwise provided in this subsection, construction shall conform to applicable specifications for riveted structures.

(b) Unfinished Bolts. Unfinished bolts shall be standard bolts (ordinary rough or machine bolts) as described in the applicable part of Section 913.

(c) Turned Bolts. Holes for turned bolts shall be carefully reamed and the bolts turned to a light driving fit with the threads entirely outside of the holes and a washer shall be used. Turned bolts shall be finished by a finishing cut. Heads and nuts shall be hexagonal.

(d) Ribbed Bolts. Ribbed bolts shall make a driving fit with the holes. If, for any reason, the bolt twists

before drawing tight, the hole shall be carefully reamed and an oversize bolt used as a replacement. Nuts shall be hexagonal.

807.22 CONNECTIONS USING HIGH-TENSILE-STRENGTH BOLTS.

(a) General. This specification covers the assembly of structural joints using ASTM Designation: A 325 high strength steel bolts tightened to a high tension. The bolts are used in holes 1/16 inch larger than the nominal bolt size.

Construction shall conform to the applicable specifications for riveted or welded structures of wrought iron, carbon structural steel and high strength steel, except as otherwise provided herein.

(b) Bolts, Nuts and Washers. Bolts, nuts and washers shall conform to AASHO Designation: M 164 (ASTM Designation: A 325), except as hereinafter provided.

Bolt dimensions shall conform to the current requirements for regular semi-finished hexagon bolts of the American Standards Association (ASA Standard B 18.2), except as hereinafter provided. Alternatively, bolts may be furnished meeting one of the following descriptions:

(1) Hexagon head having same height as regular semi-finished hexagon bolt but having width across flats equal to corresponding heavy semi-finished hexagon bolt.

(2) Interference-body bolts with heads conforming to the dimensions for driven button heads of the American Standards Association (ASA Standard B 18.4) for large rivets of the same nominal diameter, except that the head may be flattened to the same height as the head of the regular semi-finished hexagon bolts. Interference-body bolts are not to be used in other than A 36 steels.

(3) Nut dimensions shall conform to current requirements for heavy semi-finished hexagon nuts

of the American Standards Association (ASA Standard B 18.2). Alternatively, finished hexagon nuts, conforming to ASA Standard B 18.2 and meeting the requirements of ASTM Designation: A 194, Grade 2 H, may be used instead of heavy semi-finished hexagon nuts.

Circular washers shall be flat and smooth and their nominal dimensions shall be not less than those given in Table 1 of this specification with ASA Standard B 27.2, Type A washer tolerances applied to these nominal dimensions. Beveled washers shall be square or rectangular, taper in thickness, and conform to the dimensions given in Table 1. Where necessary, washers may be clipped on one side to a point not closer than 7/8 of the bolt diameter from the center of the washer.

TABLE 1—WASHER DIMENSIONS[1]

	Circular Washers				Square or Rectangular Beveled Washers for American Standard Beams and Channels		
Bolt Size D	Nominal Outside Diameter[2]	Nominal Diameter of Hole	Thickness Min.	Thickness Max.	Minimum side dimension	Mean thickness	Slope or taper in Thickness
1/2	1-1/16	17/32	.097	.177	1-3/4	5/16	1:6
5/8	1-5/16	21/32	.122	.177	1-3/4	5/16	1:6
3/4	1-15/32	13/16	.122	.177	1-3/4	5/16	1:6
7/8	1-3/4	15/16	.136	.177	1-3/4	5/16	1:6
1	2	1-1/16	.136	.177	1-3/4	5/16	1:6
1-1/8	2-1/4	1-1/4	.136	.177	2-1/4	5/16	1:6
1-1/4	2-1/2	1-3/8	.136	.177	2-1/4	5/16	1:6
1-3/8	2-3/4	1-1/2	.136	.177	2-1/4	5/16	1:6
1-1/2	3	1-5/8	.136	.177	2-1/4	5/16	1:6
1-3/4	3-3/8	1-7/8	.178[3]	.28[3]	.....	.....	.....
2	3-3/4	2-1/8	.178	.28	.....	.....	.....
Over 2 to 4 incl.	2D-1/2	D+1/8	.24[4]	.34[4]	.....	.....	.....

[1]Dimensions in inches
[2]May be exceeded by 1/4 in.
[3]3/16 in. nominal
[4]1/4 in. nominal

(c) Bolted Parts. Surfaces of bolted parts in contact with the bolt head and nut shall not have a slope of more than 1:20 with respect to a plane normal to the bolt axis. Bolted parts shall fit solidly together when assembled and shall not be separated by gaskets or any other interposed compressible material. Holes may be punched, subpunched and reamed, or drilled, as required by the applicable specification and shall be of a nominal diameter not more than 1/16 inch in excess of the nominal bolt diameter.

When assembled, all joint surfaces, including those adjacent to the washers, shall be cleaned with high cycle wire brush sander or disc grinder and be free of scale, burrs, and other defects that would prevent solid seating of the parts.

Contact surfaces within friction-type joints shall be free of oil, paint, lacquer, or galvanizing.

(d) Installation. Bolts shall be installed with a hardened washer under the nut or bolt head, whichever is the element turned in tightening. A hardened washer shall also be used under the head of regular semi-finished hexagon bolts and under finished hexagon nuts, even when these are not the elements turned in tightening. The washer may be omitted under the head of heavy semi-finished hexagon bolts and interference-body bolts, and under heavy semi-finished hexagon nuts, when these are not the elements turned. A flat washer may be used when the abutment surface adjacent to the bolt head or nut does not have a slope of more than 1:20 with respect to a plane normal to the bolt axis. Where an outer face of the bolted parts has a slope of more than 1:20 with respect to a plane normal to the bolt axis, a smooth beveled washer shall be used to compensate for lack of parallelism.

All fasteners shall be tightened to give at least the required minimum bolt tension values shown in Table 2 on completion of the joint. Tightening shall be done with properly calibrated wrenches or by the "turn-of-nut" method.

TABLE 2—BOLT TENSION

Bolt Size (in.)	Required Minimum Bolt Tension (lbs.*)
1/2	12,050
5/8	19,200
3/4	28,400
7/8	36,050
1	47,250
1 1/8	56,450
1 1/4	71,700
1 3/8	85,450
1 1/2	103,950

*Equal to the proof load of bolt given in ASTM Designation: A 325.

(e) Calibrated Wrenches. When calibrated wrenches are used to provide the bolt tension specified in Table 2, their setting shall be such as to induce a bolt tension slightly in excess of this value. These wrenches shall be calibrated by tightening, in a device capable of indicating actual bolt tension, not less than 3 typical bolts from the lot to be installed. Power wrenches shall be adjusted to stall or cut-off at the selected tension. If manual torque wrenches are used, the torque indication corresponding to the calibrating tension shall be noted and used in the installation of all bolts of the tested lot. Nuts shall be in tightening motion when torque is measured. When using calibrated wrenches to install several bolts in a single joint, the wrench shall be returned to "touch up" bolts previously tightened, which may have been loosened by the tightening of subsequent bolts, until all are tightened to the prescribed amount.

Turn-of-nut: Before final tightening of the bolts by this method, the several parts of the joint shall be properly compacted by bringing a sufficient number of bolts to a snug tight condition such as can be produced by a few blows of an impact wrench, or by an ordinary spud wrench. All bolts shall be tightened in accordance with the provisions given in Table 3, progressing from the most rigid part of the joint to-

wards the free edges, after being brought to a snug tight fit.

TABLE 3

Bolt Diameter in inches	From snug tight rotate nuts*	
	1/2 turn for grips	3/4 turn for grips
3/4	5 in. and under	above 5 in.
7/8	5 in. and under	above 5 in.
1	8 in. and under	above 8 in.
1 1/8	8 in. and under	above 8 in.
1 1/4	8 in. and under	above 8 in.
1 3/8	8 in. and under	above 8 in.
1 1/2	8 in. and under	above 8 in.

*Permissible tolerance: 1/4 turn over, nothing under.

Impact wrenches shall be of adequate capacity and sufficiently supplied with air to perform the required tightening in approximately 10 seconds.

If required because of bolt entering and wrench operation clearances, tightening by either procedure may be done by turning the bolt while the nut is prevented from rotating, provided both bolt head and nut bear against surfaces having slopes not greater than 1:20.

(f) Inspection. The engineer shall satisfy himself that all requirements of this specification are met.

The engineer shall approve the procedure for calibration of wrenches and installation of bolts and shall further observe the field installation to determine that these procedures are followed.

Spot checks should be made with a manual torque wrench that has been calibrated as previously specified herein.

807.23 RIVETING. Rivets shall be heated uniformly to a light cherry red color and shall be driven while hot. Any rivet whose point is heated more than the remainder shall not be driven. When a rivet is ready for driving, it shall be free from slag, scale and other adhering matter. Any rivet which is scaled excessively will be rejected.

All rivets that are loose, burned, badly formed or otherwise defective shall be removed and replaced with satisfactory rivets. Any rivet whose head is defective in size or whose head is driven off center will be considered defective and shall be removed. Stitch rivets that are loosened by driving of adjacent rivets shall be removed and replaced with satisfactory rivets. Caulking, recupping or double gunning of rivet heads will not be permitted.

Shop rivets shall be driven by direct-acting rivet machines when practicable. Approved beveled rivet sets shall be used for forming rivet heads on sloping surfaces. When the use of a direct-acting rivet machine is not practicable, pneumatic hammers of approved size shall be used. Pneumatic bucking tools will be required when the size and length of the rivets warrant their use.

Rivets may be driven cold provided their diameter is not over 3/8 inch.

807.24 EDGE PLANING. Sheared edges of plates more than 5/8 inch in thickness and carrying calculated stress shall be planed to a depth of 1/4 inch. Re-entrant cuts shall be filleted before cutting.

807.25 SHOP WELDING. Shop welding of steel structures, when authorized, or shown on the plans, shall conform to the latest Specifications for Welded Highway and Railway Bridges of the American Welding Society. Welding qualifications shall conform to the requirements of Section 916.

807.26 FLAME CUTTING. Steel or wrought iron may be flame cut, provided a smooth surface is secured by the use of a mechanical guide. Flame cutting by hand shall be done only where approved and the surface shall be made smooth by planing, chipping or grinding. The cutting flame shall be so adjusted and manipulated as to avoid cutting beyond the prescribed lines. Re-entrant cuts shall be filleted to a radius of not less than 3/4 inch.

In the case of manganese steel (A 440), flame cut edges shall be removed to a depth of at least 1/4 inch, by milling, chipping or grinding, except that machine

flame cut edges may be used without such removal if the edges are softened after cutting; (a) by heating the cut edge uniformly and progressively to a red heat, visible in ordinary shop light (1150° to 1250° F) to a depth of at least 1/16 inch; or (b) by means of a post-heating torch attached to and following the cutting torch; the tips, gas pressure, speed of travel and the distance of post-heating torch from kerf regulated to the thickness of the steel.

807.27 FACING OF BEARING SURFACES. The surface of bearing and base plates and other bearing surfaces that are to come in contact with each other or with concrete shall meet the American Standards Association surface roughness requirements as defined in ASA Standard B 46.1-55, Surface Roughness, Waviness and Lay, Part I:

Steel slabs	ASA	2,000
Heavy plates in contact in shoes to be welded	ASA	1,000
Milled ends of compression members, stiffeners, and fillers	ASA	500
Bridge rollers and rockers	ASA	250
Pins and pin holes	ASA	125
Sliding bearings	ASA	125

807.28 ABUTTING JOINTS. Abutting joints in compression members and girder flanges, and in tension members where so specified on the drawings, shall be faced and brought to an even bearing. Where joints are not faced, the opening shall not exceed 1/4 inch.

807.29 END CONNECTION ANGLES. Floor beams, stringers and girders having end connection angles shall be built to exact length back to back of connection angles. If end connections are faced, the finished thickness of the angles shall not be less than that shown on the detail drawings.

807.30 LACING BARS. The ends of lacing bars shall be neatly rounded unless another form is required.

807.31 FINISHED MEMBERS. Finished members shall be true to line and free from twists, bends and open joints.

807.32 WEB PLATES. In girders having no cover plates and not to be encased in concrete, the top edge of the web plate shall not extend above the backs of the flange angles and shall not be more than 1/8 inch below at any point. Any portion of the plate projecting beyond the angles shall be chipped flush with the backs of the angles. Web plates of girders having cover plates may be 1/2 inch less in width than the distance back to back of flange angles.

Splices in webs of girders without cover plates shall be sealed on the top by welding.

At web splices, the clearance between the ends of the web plates shall not exceed 3/8 inch. The clearance at the top and bottom ends of the web splice plates shall not exceed 1/4 inch.

807.33 BENT PLATES. Cold-bent load-carrying rolled-steel plates shall conform to the following:

(a) They shall be so taken from the stock plates that the bend-line will be at right angles to the direction of rolling.

(b) The radius of bends, measured to the concave face of the metal, shall not be less and preferably shall be greater than shown in the following table, in which "T" is the thickness of the plate:

Angle Through Which Plate is Bent	Minimum Radius
61° to 90°	1.0T
91° to 120°	1.5T
121° to 150°	2.0T

If a shorter radius is essential, the plates shall be bent hot. Hot-bent plates shall conform to requirement (a) above.

(c) Before bending, the corners of the plate shall be rounded to a radius of 1/16 inch throughout that portion of the plate at which the bending is to occur.

807.34 FIT OF STIFFENERS. End stiffeners of girders and stiffeners intended as supports for concentrated loads shall be milled or ground to secure an even bear-

ing against the flange. Intermediate stiffeners shall fit sufficiently tight to exclude water after being painted. As an alternate the stiffeners may be cut short, jammed to the tension flange and seal welded to the compression flange. Fillers under stiffeners shall fit within 1/4 inch at each end.

Welding will be permitted in lieu of milling or grinding if noted on the plans or specified in the special provisions. Welding transversely across the tension flanges of beams or girders, which have a flange stress of more than 75 per cent of their designed capacity, will not be permitted.

807.35 EYEBARS. The fabrication of eyebars shall conform to the latest specifications of AASHO unless otherwise provided.

807.36 ANNEALING AND STRESS RELIEVING. Structural members which are indicated in the contract to be annealed or normalized shall have finished machining, boring and straightening done subsequent to heat treatment. Normalizing and annealing (full annealing) shall be as specified in ASTM Designation: E 44. The temperatures shall be maintained uniformly throughout the furnace during heating and cooling so that the temperature at no 2 points on the member will differ by more than 100° F at any one time.

A record of each furnace charge shall identify the pieces in the charge and show the temperatures and schedule actually used. Proper instruments including recording pyrometers, shall be provided for determining at any time the temperatures of members in the furnace. The records of the treatment operation shall be available to and meet the approval of the engineer.

Members, such as bridge shoes, pedestals, or other parts which are built up by welding sections of plate together shall be stress relieved in accordance with the procedure of the American Welding Society when required by the plans, specifications or special provisions governing the contract.

807.37 PINS AND ROLLERS. Pins and rollers shall be accurately turned to the dimensions shown on the

drawings and shall be straight, smooth, and free from flaws.

Pins and rollers more than 7 inches in diameter shall be forged and annealed. Pins and rollers 7 inches or less in diameter may be either forged and annealed or cold-finished carbon-steel shafting.

In pins larger than 9 inches in diameter, a hole not less than 2 inches in diameter shall be bored full length along the axis after the forging has been allowed to cool to a temperature below the critical range under suitable conditions to prevent injury by too rapid cooling, and before being annealed.

807.38 BORING PIN HOLES. Pin holes shall be bored true to the specified diameter, smooth and straight, at right angles with the axis of the member and paralled with each other unless otherwise required. The final surface shall be produced by a finishing cut.

The distance outside to outside of holes in tension members and inside to inside of holes in compression members shall not vary from that specified more than 1/32 inch. Boring of holes in built-up members shall be done after the riveting is completed.

807.39 PIN CLEARANCES. The diameter of the pin hole shall not exceed that of the pin by more than 0.020 inch for pins 5 inches or less in diameter, or 0.03125 inch for larger pins.

807.40 SCREW THREADS. Threads for all bolts and pins for structural steel construction shall conform to the American National Coarse Thread Series Class 2, free fit, except that the pin ends having a diameter of 1 3/8 inches or more shall be threaded 6 threads to the inch.

807.41 PILOT AND DRIVING NUTS. Two pilot nuts and two driving nuts for each size of pin shall be furnished, unless otherwise specified.

807.42 CAMBER FOR ROLLED BEAMS IN SIMPLE SPAN. When required on the plans, beams shall be cambered to conform to the vertical curve or level grade as may be required after full dead load is applied. Camber shall approximate a simple regular

curve from end to end of beam. The camber ordinate at mid-length of the beam, unless shown otherwise on the plans, shall be equal to the dead load deflection of the beam plus the mid-ordinate of the vertical curve, if the span is on a vertical curve. The camber ordinate may vary from the above by 1/4 inch over or 1/4 inch under.

Beams may be cambered cold or may be heated. If heat is used, the tension flange shall be heated uniformly and progressively to not more than a red heat visible in ordinary shop light (1150° to 1250° F) while the beam is loaded to produce compression in the bottom flange. The heating and loading shall be done in such a manner that the permanent camber remaining shall be within the limits specified above or shown on the plans. After the cambering operation has been concluded, the beam shall be left to air cool and no quenching process of any kind shall be permitted.

807.43 STRAIGHTENING OF OTHER MEMBERS. No quenching process of any kind shall be permitted without permission of the engineer.

807.44 ROADWAY JOINT ASSEMBLY. Roadway joint assembly should be paired and fitted prior to painting before shipping.

807.45 SHEAR CONNECTORS.

(a) Description. This item shall consist of furnishing and placing devices known as "shear connectors" and welding them to the top flanges of the welded composite steel girders, all in accordance with these specifications and in conformity with the dimensions, shapes and designs shown on the plans.

Shear connectors furnished under this item may be either 3/4" studs, 7/8" studs, or channel type, at the contractor's option.

Channel shear connectors shall be of structural welding steel and may be welded in the field or shop.

Channel shear connectors shall conform to the details shown on the plans and shall be welded to

the girders with the size of weld shown and in the position and at the spacing shown on the plans.

Stud shear connectors shall conform to the following:

(b) Construction Requirements.

1. Stud shear connectors shall be end welded to steel beams or girders with automatically timed stud welding equipment connected to a suitable power source.

2. If 2 or more stud welding guns are to be operated from the same power source, they shall be interlocked so that only one gun can operate at a time and so that the power source has fully recovered from making one weld before another weld is started.

3. At the time of welding, the studs shall be free from any rust, rust pits, scale, oil or other deleterious matter which would adversely effect the welding operation.

4. Welding shall not be done when the base metal temperature is below 0° F or when the surface is wet or exposed to rain or snow.

5. While in operation, the welding gun shall be held in position without movement until the weld metal has solidified.

6. When necessary to obtain satisfactory welds, the areas on the beam or girder to which the studs are to be welded shall be wire-brushed, peened, prick-punched, or ground free of scale or rust.

7. Longitudinal and lateral spacings of studs with respect to each other and to edges of beam or girder flanges shall not vary more than 1/2 inch from the dimensions shown on the plans except that a variation of one inch will be permitted where required to avoid obstruction with other attachments on the beam or where a new stud is being welded to replace a defective one. The minimum distance from the edge of a stud to the

edge of a beam shall be one inch, but preferably not less than 1-1/2 inches.

8. The first 2 studs welded on each beam or girder, after being allowed to cool, shall be bent 45° by striking each stud with a hammer. If failure occurs in the weld of either stud, the procedure shall be corrected and 2 successive studs successfully welded and tested before any more studs are welded to the beam or girder. The engineer shall be promptly informed of any changes in the welding procedure at any time during construction.

9. When the temperature of the base metal is below 32° F one stud in each 100 studs welded shall be bent 45° in addition to the first 2 bent as specified in 8 above.

10. Studs on which a full 360° weld is not obtained may, at the option of the contractor, be repaired by adding a 3/16 inch fillet weld in place of the lack of weld, using the shielded metal-arc process with low-hydrogen welding electrodes.

11. If the reduction in the height of studs as they are welded becomes less than normal, welding shall be stopped immediately and not resumed until the cause has been corrected.

12. Before welding a new stud where a defective one has been removed, the area shall be ground smooth and flush, or in the case of a pullout of metal, the pocket shall be filled with weld metal using the shielded metal-arc process with low-hydrogen welding electrodes and then ground flush. In compression areas of flanges, a new stud may be welded adjacent to the defective area in lieu of repair and replacement on existing weld area. (See Paragraph 7 above).

(c) Inspection Requirements.

1. If visual inspection reveals any stud which does not show a full 360° weld, any stud which has been repaired by welding, or any stud in which the reduction in height due to welding is less than

normal, such stud shall be struck with a hammer and bent 15° off the vertical. For studs showing less than 360° weld, the direction of bending shall be opposite to the lack of weld. Studs that crack either in the weld or the shank shall be replaced.

2. The engineer, at his option, may select additional studs to be subjected to the bend test specified above.

3. The studs tested that show no sign of failure may be left in the bent position.

4. If during the progress of the work, inspection and testing indicates that the shear connectors being obtained are not satisfactory, the contractor will be required at his expense to make such changes in welding procedure, welding equipment and type of shear connector as necessary to secure satisfactory results.

5. At the option and the expense of the purchaser, the manufacturer of the studs may be required at any time to submit sample studs for requalification in accordance with the established procedure.

807.46 MARKING AND SHIPPING. Each member shall be painted or marked with an erection mark for identification and an erection diagram shall be furnished with erection marks shown thereon.

Members weighing more than 3 tons shall have the weights marked thereon. Structural members shall be loaded on trucks or cars in such a manner that they may be transported and unloaded at their destination without being excessively stressed, deformed or otherwise damaged.

Bolts and rivets of one length and diameter and loose nuts or washers of each size shall be packed separately. Pins, small parts and packages of bolts, rivets, washers and nuts shall be shipped in boxes, crates, kegs or barrels, but the gross weight of any package shall not exceed 300 pounds. A list and

description of the contained material shall be plainly marked on the outside of each shipping container.

807.47 PAINTING. Shop and field paints and their application shall comply with the applicable requirements of Section 811.

ERECTION

807.48 HANDLING AND STORING MATERIALS. Structural material, either plain or fabricated, shall be stored above the ground upon platforms, skids, or other supports. It shall be kept free from dirt, grease and other foreign matter and shall be protected as far as practicable from corrosion. It shall be properly drained.

Girders and beams shall be placed upright and shored. Long members, such as columns and chords, shall be supported on skids placed near enough together to prevent injury from deflection.

807.49 FALSEWORK. The falsework shall be designed properly, constructed substantially and maintained for the loads which will come upon it.

807.50 BEARING AND ANCHORAGE. Masonry bearing plates shall not be placed upon bridge seat bearing areas which are improperly finished, deformed or irregular. Bearing plates shall be set level in exact position and shall have a full and even bearing upon the masonry. Unless otherwise directed, they shall be placed on a layer of canvas and red lead applied as follows:

Thoroughly swab the bridge seat bearing area with red lead paint and place upon it 3 layers of 12 to 14 ounce duck, each layer being thoroughly swabbed on its top surface with red lead paint. Place the superstructure shoes or pedestals in position while the paint is plastic. As an alternate to canvas and red lead, sheet lead in single sheets of the specified thickness or prefabricated masonry pads as specified in Subsection 915.06 may be used if called for on the plans or authorized.

The contractor shall set anchor bolts in conformance with Subsection 805.24. The location of the anchor

bolts in relation to the slotted holes in the expansion shoes shall correspond with the temperature at the time of erection. The nuts on anchor bolts at the expansion ends of spans shall be adjusted to permit the free movement of the span.

807.51 STRAIGHTENING BENT MATERIAL. The straightening of plates and angles or other shapes shall be done by methods not likely to produce fracture or other injury. The metal shall not be heated unless permitted, in which case the heating shall not be to a higher temperature than that producing a dark "cherry red" color. After heating, the metal shall be cooled as slowly as possible.

Following the straightening of a bend or buckle, the surface of the metal shall be carefully inspected for evidence of fracture.

807.52 ASSEMBLING STEEL. The parts shall be accurately assembled as shown on the plans and any match-marks shall be followed. The material shall be carefully handled so that no parts will be bent, broken, or otherwise damaged. Hammering which will injure or distort the members shall not be done. Bearing surfaces and surfaces to be in permanent contact shall be cleaned before the members are assembled. Unless erected by the cantilever method, truss spans shall be erected on blocking so placed as to give the trusses proper camber. The blocking shall be left in place until the tension chord splices are fully riveted and all other truss connections pinned and bolted. Rivets in splices of butt joints of compression members and rivets in railings shall not be driven until the span has been swung. Splices and field connections shall have 1/2 of the holes filled with bolts and cylindrical erection pins (half bolts and half pins) before riveting. Splices and connections carrying traffic during erection shall have 3/4 of the holes so filled.

Fitting-up bolts shall be of the same nominal diameter as the rivets, and cylindrical erection pins shall be 1/32 inch larger.

807.53 RIVETING. Pneumatic hammers shall be used for field riveting, except when the use of hand tools

are permitted. Rivets larger than 7/8 inch in diameter shall not be driven by hand. Cup-faced dollies, fitting the head closely to insure good bearing, shall be used. Connections shall be accurately and securely fitted up before the rivets are driven. Drifting shall be only such as to draw the parts into position and not sufficient to enlarge the holes or distort the metal. Unfair holes shall be reamed or drilled. In other respects, riveting shall conform to Subsection 807.23. Field rivets shall not be smaller than the heads of the shop rivets. In removing rivets, the surrounding metal shall not be injured; if necessary, they shall be drilled out.

807.54 PIN CONNECTIONS. Pilot and driving nuts shall be used in driving pins. They shall be furnished by the contractor without charge. Pins shall be so driven that the members will take full bearing on them. Pin nuts shall be screwed up tight and the threads burred at the face of the nut with a pointed tool.

807.55 FIELD WELDING. Field welding of steel structures, when authorized or as shown on plans, shall conform to the latest specifications for Welded Highway and Railway Bridges of the American Welding Society. Welding qualifications shall conform to the requirements of Section 916.

807.56 MISFITS. The correction of minor misfits involving harmless amounts of reaming, cutting and chipping will be considered a legitimate part of the erection. However, any error in the shop fabrication or deformation resulting from handling and transportation which prevents the proper assembling and fitting up of parts by the moderate use of drift pins or by a moderate amount of reaming and slight chipping or cutting, shall be reported immediately to the inspector and his approval of the method of correction obtained. The correction shall be made in his presence. If the contract provides for complete fabrication and erection, the contractor shall be responsible for all misfits, errors and injuries and shall make the necessary corrections and replacements. If the contract is for erection only, the inspector with the cooperation of the contractor shall keep a correct record of labor and

materials used and the contractor shall render within 30 days an itemized bill for the approval of the engineer.

807.57 SETTING BENCH MARK PLATES. A bench mark plate furnished and delivered by the engineer shall be set by the contractor without extra compensation on each bridge. It shall be located on the downstream side and at the end of the bridge on the right descending bank. If the bridge carries a concrete floor the bench mark plate shall be set at the end of the curb. No permanent plates or markers other than those furnished or specified will be permitted on any structure.

807.58 METHOD OF MEASUREMENT.

General: All structural steel will be measured by the weight of metal in pounds remaining in the completed and accepted structures, and the weight shall be computed on the basis of theoretical net weight from the approved shop detail drawings. No allowance will be made for rivets, bolts, nuts, washers or welds, and no deductions will be made for rivet holes, bolt holes, beam copings, cut flanges or edge preparation for welding. Deduction will be made for pin holes. All plates shall be estimated from the sizes billed and deductions made for cut corners.

Such miscellaneous parts as ladders, stairways, platforms, structural supports and brackets for machinery and power equipment, including pit pumps; steel framework for counterweights; floor plates; keeper plates and their tap bolts; sheet metal covers for gears, drum switches and other parts where required; shim plates; bearing plates for approach spans of whatever material is required; curb angles; anchor bolts, including those for roadway gates; and bronze and cast iron for expansion plates will be classified and measured as Structural Carbon Steel (A 36).

No measurement of structural steel of any class will be allowed for temporary work of any kind or for additional weight in members provided for erection purposes.

No allowance will be made in the pay quantity for

any items not remaining in the finished structure, except as hereinafter provided.

No allowance will be made for shop or field paints.

No allowance will be made for over-run on plates or rolled sections.

When full-sized tests of built-up structural members and eyebars are required by the contract, any full-size members tested to destruction will be measured, if the test proves satisfactory. However, if the test proves the member to be unsatisfactory, the members represented by it will be rejected, and no measurement or allowance will be made for such members.

Structural Carbon Steel (A 36): Carbon steel shall include all steel classified as such on the contract drawings, and unless otherwise noted on the plans, such minor items as anchor materials including pins, rollers, metal railings, steel plates and shapes for expansion joints, ladders, wrought iron sheets, checkered floor plates, bronze castings and plates, steel castings, and iron castings, (except cast iron drains in floors), and all other items described under "General", necessary to complete this portion of the structure.

Manganese Vanadium Steel (A 441): Manganese vanadium steel shall include all steel classified as such on the contract drawings.

Manganese Steel (A 440): Manganese steel shall include all steel classified as such on the contract drawing.

Metal weights shall be computed on the following basis:

Aluminum, cast or wrought	173.0	pounds/cu. ft.
Bronze, cast	536.0	pounds/cu. ft.
Copper-alloy	536.0	pounds/cu. ft.
Copper, sheet	558.0	pounds/cu. ft.
Iron, cast	445.0	pounds/cu. ft.
Iron, malleable	470.0	pounds/cu. ft.
Iron, wrought	487.0	pounds/cu. ft.

Lead, sheet	707.0 pounds/cu. ft.
Steel, rolled, cast, copper bearing, silicon, nickel, and stainless	490.0 pounds/cu. ft.
Zinc	450.0 pounds/cu. ft.

Shear connectors will be measured by the lump.

807.59 BASIS OF PAYMENT. The number of pounds of completed and accepted steel and other metals of the various categories, measured as provided above, shall be paid for at the contract unit price per pound for "Structural Carbon Steel (A 36)", "Manganese Vanadium Steel (A 441)", or "Manganese Steel (A 440)," as the case may be.

Asphaltic concrete filling for recesses in structural steel members, if required, shall be included in the unit prices for the various items of structural steel.

The expense of conducting "full-size tests," if required, shall be borne by the contractor.

Shear connectors installed and accepted shall be paid for at the contract lump sum price.

When the contract price of Structural Carbon Steel (A 36), Manganese Vanadium Steel (A 441), or Manganese Steel (A 440), or of the combination of these items exceeds $10,000.00, the number of pounds of the various items to be allowed on the monthly estimates shall be as follows:

Ninety per cent of the invoice price for the number of pounds of the various items of structural steel delivered and properly stored at the project site or other designated locations in the vicinity of the construction as provided in Subsection 109.07.

Seventy-five per cent of the contract price for the number of pounds of the various items of structural steel erected in place and bolted.

Ninety per cent of the contract price for the number of pounds of the various items of structural steel erected in place and riveted field connections completed.

One hundred per cent of the contract price for the number of pounds of the various items of structural steel erected complete in place and painted.

Payment will be made under:

Item No.	Pay Item	Pay Unit
807(1)	Structural Carbon Steel (A 36)	Pound
807(2)	Manganese Vanadium Steel (A 441)	Pound
807(3)	Manganese Steel (A 440)	Pound
807(4)	Shear Connectors	Lump

Section 808
Steel Grid Flooring

808.01 DESCRIPTION. This work shall consist of furnishing and installing steel grid flooring of the open type or the concrete filled type as specified, in accordance with these specifications and in reasonably close conformity with the details shown on the plans.

The floor shall meet the requirements for the design of steel grid floors as contained in the current AASHO Standard Specifications for Highway Bridges. Before fabrication or construction is undertaken, the contractor shall submit complete shop and assembly details to the Bridge Design Engineer for approval. Shop details shall conform to the requirements of Subsection 801.03.

808.02 MATERIALS. The steel grid flooring shall conform to the requirements of Subsection 913.21.

Concrete. All concrete in filled steel grid floors shall be Class A conforming to the applicable requirements of Section 805.

Skid Resistance. The upper edges of all members forming the wearing surface of an open type grid flooring should be fabricated or treated to give the maximum skid resistance.

808.03 FABRICATION. The steel grid floor shall conform to all requirements of these specifications, even though the manufacturer's specifications are different. Deviations from these specifications to conform to manufacturer's specifications, where different, will not be permitted without approval of the Bridge Design Engineer.

808.04 NOTICE OF BEGINNING OF WORK. The contractor shall give the Bridge Construction Engineer at least 10 days notice of the beginning of work at the mill or in the shop, so that inspection may be provided. The term "mill" means any rolling mill or found-

ry where material for the work is to be manufactured. No material shall be manufactured or work done in the shop before shop drawings have been approved and before the Bridge Construction Engineer has been notified.

808.05 FACILITIES FOR INSPECTION. The contractor shall furnish facilities for the inspection of material and workmanship in the mill and shop, and the inspector shall be allowed free access to the necessary parts of the works.

808.06 STORAGE OF MATERIALS. Steel grid flooring shall be stored at the bridge site, above ground, upon platforms, skids, or other supports. It shall be kept free from dirt, grease, and other foreign matter, and shall be protected as far as possible from corrosion. It shall be properly drained.

808.07 STRAIGHTENING MATERIAL. Steel grid flooring sections, before being installed, shall be straight, except for camber if specified. If straightening is necessary, it shall be done by methods that will not injure the metal.

808.08 ARRANGEMENT OF SECTIONS. Where the main elements are normal to centerline of roadway, the units generally shall be of such length as to extend over the full width of the roadway for roadways up to 40 feet, but in every case the units shall extend over at least 3 panels. Where joints are required, the ends of the main floor members shall be welded at the joints over their full cross-sectional area or otherwise connected to provide full continuity.

Where the main elements are parallel to centerline of roadway, the sections shall extend over not less than 3 panels, and the ends of abutting units shall be welded over their full cross-sectional area or otherwise connected to provide full continuity in accordance with the design.

808.09 PROVISION FOR CAMBER. Unless otherwise provided on the plans, provision for camber shall be made as follows:

Steel units so rigid that they will not readily follow

the camber required shall be cambered in the shop. To provide a bearing surface parallel to the crown of the roadway, the stringers shall be canted or provided with shopwelded beveled bearing bars. If beveled bars are used, they shall be placed along the centerline of the stringer flange, in which case the design span length shall be governed by the width of the bearing bar instead of by the width of the stringer flange.

Longitudinal stringers shall be mill cambered or provided with bearing strips so that the completed floor after dead-load deflection shall conform to the longitudinal camber shown on the plans.

808.10 FIELD ASSEMBLY. Areas of considerable size shall be assembled before the floor is welded to its supports. The main elements shall be made continuous and sections shall be connected together along their edges by welding of bars or by riveting them. The connections shall meet with the approval of the engineer. The rivets may be cold driven.

808.11 CONNECTION TO SUPPORTS. The floor shall be connected to its steel supports by welding. Before any welding is done, the floor shall either be loaded to make a tight joint with full bearing or it shall be clamped down. The location, length and size of the welds shall be subject to the approval of the Bridge Design Engineer, but in no case shall they be less than the manufacturer's standards.

The ends of all the main steel members of the slab shall be securely fastened together at the sides of the roadway for the full length of the span by means of steel plates or angles welded to the ends of the main members, as shown on the plans.

808.12 WELDING. All shop and field welding shall conform to the latest Specifications for Welded Highway and Railway Bridges of the American Welding Society. Welding qualifications shall conform to the requirements of Section 916.

Surfaces to be welded shall be free from paint, grease, loose scale, rust and other material that will prevent a proper weld. A thin coating of linseed oil, without pigment, need not be removed; however, any

clinkers or slag caused by flame cutting or other causes shall be removed before welding.

Field welding shall conform to the approved method and location as shown on the shop drawings.

808.13 PAINTING. The open steel grid floor shall receive one shop coat and 3 field coats of paint in accordance with the requirements of Section 811. Painting of concrete filled grid floor shall be in accordance with the last paragraph of this subsection.

The shop coat of paint may be applied by dipping, spraying or brushing. Paint, for the shop coat, of composition different from that stipulated in these specifications will be considered and the engineer will advise before bids are received, if requested, whether any particular manufacturer's paint is satisfactory for the shop coat. Particular attention is directed to the cleaning of surfaces to be painted. Slag shall be cleaned from all welds, and spatter, rust, loose mill scale, dirt, oil or grease, and all other foreign substances shall be removed from all surfaces to be painted before the shop coat of paint is applied.

Field coats may be applied by brushing or spraying. If paint is sprayed, it may be applied with either a single nozzle gun or a gang sprayer appropriately rigged up. Spraying of paint shall be done when the wind is comparatively calm and care shall be taken that movable parts of machinery and concrete surfaces are properly protected during the application of the paint. The flooring shall be sprayed before applying the final field coat to surfaces below the open grid floor.

For the filled type of grid flooring, the underside of the bottom plate and the other faces of headers, trim bars and end bars shall receive one coat of shop paint, and 3 coats of field paint.

808.14 USE OF ALTERNATE SECTIONS. If the contractor prefers to use a type of steel grid flooring other than that shown on the special plans for a particular bridge, he will be permitted to substitute another section selected from the various types shown on the standard plan titled "Open Grid Bridge Floor-

ing", included in the project plans. However, in each case, the plans will specify which of the alternate sections will be considered equal to the section shown on the special plans, and therefore acceptable to the Bridge Design Engineer. If the use of an alternate section requires supporting members in addition to those shown on the special plans, the maximum spacing of such members shall be shown on the standard plan for the section being used. The size of such members shall be determined on the basis of the specified design load, as shown on the plans, and in accordance with the current AASHO Standard Specifications for Highway Bridges for design methods. In the event an alternate section is used, all structural changes in the design of the floor system necessitated by the substitution shall be incorporated in the shop details covering the grid flooring so that it will be possible to check the entire floor system from the information shown in the shop details.

808.15 CONCRETE FILLER. Where indicated, on the plans, concrete filler shall be placed in the open grid.

Floor types, with bottom flanges not in contact, shall be provided with bottom forms of metal or wood to retain the concrete filler without excessive leakage.

If metal forms are used, they shall fit tightly on the bottom flanges of the floor members and be placed in short lengths so as to extend only about one inch onto the edge of each support, but in all cases the forms shall be such as will result in adequate bearing of the slab on the support.

The concrete shall be thoroughly consolidated by vibrating the steel grid floor. The vibrating device and the manner of operating it shall be subject to approval.

808.16 METHOD OF MEASUREMENT. The steel grid flooring shall include all steel which enters into the fabrication, assembling and erecting of the flooring, and all welding or riveting required. Structural shapes such as curb plates and angles, risers, etc., if called for on the plans, will not be measured as steel grid flooring, but as fabricated carbon steel as provided in Section 807. However, base plates for curbs will not

be measured separately, but will be included in the area for measurement of the steel grid flooring. If an alternate section is used, no supporting members in addition to those shown on the special plans will be measured, as they will be considered an integral part of the alternate flooring.

Measurement will be made by the square foot for the area of steel grid flooring remaining in the completed and accepted structure. Measurements will be made to the outside line of the grid flooring, including the headers, trim, or end bars surrounding the grid, after the flooring is in place. Openings for manholes, notches for leaf guide casting, etc., will not be deducted.

Concrete used for filling steel grid flooring will be measured by the cubic yard. Deduction in the quantity of concrete will be made for the volume of steel grid flooring enclosed by the concrete. In order to compute the net volume of concrete, the weight per square foot of the open floor (weight taken from standard plan) shall be converted in volume per square foot of flooring, at the rate of 490 pounds per cubic foot.

808.17 BASIS OF PAYMENT. The accepted quantity of steel grid flooring will be paid for at the contract price per square foot complete in place.

Concrete will be paid for under Item 805(1).

Structural steel, when called for on the plans, will be paid for under Item 807(1).

Payment will be made under:

Item No.	Pay Item	Pay Unit
808(1)	Steel Grid Flooring	Square Foot

Section 809
Movable Bridges

809.01 DESCRIPTION. This work shall consist of the furnishing, fabrication, and erection of movable span bridges, and of all appurtenances required for their operation such as machinery, traffic barriers, power plant, operating house, and machinery houses.

The requirements for fixed span bridges, as given in these specifications, shall apply to movable bridges except as herein provided.

809.02 SILENCE OF SPECIFICATIONS. The apparent silence of the specifications as to any detail, or the omission from them of a detailed description of any point, shall be regarded as meaning that only the best general practice is to prevail and that only material and workmanship of first quality are to be used in such cases.

809.03 OBJECTION TO SPECIFICATIONS. If the contractor has any objections to any features of the machinery, traffic barriers or power equipment, as required by these specifications, he must state his objections immediately in writing to the engineer before any parts are manufactured; otherwise his objections will be ignored, if offered as an excuse for defective or broken parts.

809.04 GUARANTEE OF MACHINERY, TRAFFIC BARRIERS AND POWER EQUIPMENT. All machinery, traffic barriers and power plant equipment shall be satisfactory, and the contractor shall furnish and install, without charge, any and all parts which may fail or otherwise prove defective, within one year of the date on which the bridge is finally accepted, if it should be found that the parts failed due to defective material or faulty workmanship, and, if such parts should, within the said one year, cause any breakdown or accident, the contractor will not only be required to furnish and install the defective part, but will also be held pecuniarily responsible to the Department for all expense to the latter due to such failure.

809.05 BOND. As a guarantee for the replacement of defective or broken parts as stated above, the contractor will be required to furnish satisfactory bond in full amount of the price bid for machinery, traffic barriers and power equipment. This bond shall remain in effect for a period of one year from date of final acceptance of the bridge and shall be filed in the offices of the Louisiana Department of Highways prior to the payment of the final estimate.

809.06 DRAWINGS. Shop drawings and working drawings shall be furnished in accordance with Subsection 801.03.

809.07 MAINTENANCE AND OPERATION INSTRUCTION BOOKLETS. Maintenance and operation instruction booklets shall be furnished in accordance with Subsection 801.03.

809.08 INSTRUCTOR AND INSTRUCTION TO OPERATORS. The contractor shall notify the engineer when the span, including the power plant, traffic barriers and machinery, is sufficiently complete so that the span is operable, in order that the permanent bridge operators may be assigned for instruction. At this time, the contractor shall furnish a competent man, experienced in the operation of equipment of this character, for a period of 5 working days of 8 hours each to instruct the bridge operators in the complete and correct operation of the bridge. This 5 day period of instruction shall be just prior to final inspection. This provision shall also apply for manually operated movable bridges.

809.09 TOOLS AND MAINTENANCE EQUIPMENT TO BE FURNISHED BY THE CONTRACTOR. The contractor shall furnish a set of tools, tool chest with lock, and equipment as may be required for ordinary servicing and maintenance of the bridge. In the absence of further specific requirements, this shall include a set of wrenches to fit the heads and nuts of all machinery bolts and grease guns and oiling equipment to fit all lubrication fittings.

809.10 METALS. Structural metals and metals to be used in the manufacture of parts for movable bridges shall be as listed in Part IX, Materials, and Part XI,

Design of Movable Bridges, of these specifications and as shown on the plans.

809.11 WIRE ROPE AND ATTACHMENTS. Wire rope and attachments shall be as listed in Part IX, Materials, and as shown on the plans.

CONSTRUCTION REQUIREMENTS

809.12 GENERAL FABRICATION AND ERECTION REQUIREMENTS. Except as otherwise provided herein, the fabrication and erection of structural parts shall conform to the requirements for fixed-span bridges.

809.13 MANUFACTURE AND FABRICATION OF MACHINERY AND TRAFFIC BARRIERS.

(a) Shop Practice: The manufacture of machinery and traffic barrier parts shall be in accordance with the best practice of modern foundries and machine shops. The general manufacture of machined parts shall be in accordance with applicable standards of the American Standards Association for the various items required.

(b) Inspection: The contractor shall give the engineer ample notice before beginning the manufacture of any item, so that inspection may be provided. The contractor shall furnish facilities for the inspection of material and workmanship and the inspectors shall be allowed free access to the necessary parts of the work. This inspection shall be at the option of the Department and shall in no way relieve the contractor of any responsibility placed upon him by his contract.

(c) Tolerances (Plus and Minus) for Accurate Work: The allowances which should be made for different kinds of fits are tabulated hereinafter. They are based on the use of the hole as the nominal size and give the amounts by which the shaft should be less than (minus) or greater than (plus) the nominal hole size. If the shaft is selected as the base, the allowances for the hole will be of the same magnitude but of opposite sign. The permissible tolerance is the difference between the minimum and maximum allowances.

(d) Classification of Fits and Surface Finishes:

	ASA Surface Finish
Loose Fit (Class 1), Large Allowance. This fit provides for considerable freedom and embraces certain fits where accuracy is not essential. Suitable for ordinary bearings on shafts which are subject to light journal pressures (600 psi or less).	Bearings—16 Journals— 8
Free fit (Class 2), Liberal Allowance. For running fits with speeds of 600 rpm or over and journal pressure of 600 psi or over. Also use this fit for heavily loaded journals on shafts and trunnions.	Bearings—16 Journals— 8
Medium Fit (Class 3), Medium Allowance. For running fits under 600 rpm and with journal pressures less than 600 psi; also for sliding fits.	Bearings—16 Journals— 8
Snug Fit (Class 4), Zero Allowance. This is the closest fit which can be assembled by hand and necessitates work of considerable precision.	125
Wringing Fit (Class 5), Zero to Negative Allowance. This is also known as a tunking fit and is practically metal to metal.	125
Tight Fit (Class 6), Slight Negative Allowance. Light pressure is required to assemble these fits.	125
Medium Force Fit (Class 7), Negative Allowance. Considerable pressure is required to assemble these fits, and the parts are considered permanently assembled.	125
Heavy Force and Shrink Fit (Class 8), Considerable Negative Allowance. These fits are used for steel holes	

(d) Classification of Fits and Surface Finishes:

	ASA Surface Finish
where the metal can be highly stressed without exceeding its elastic limit.	125
Shafts Outside Bearings:	250

Allowances for the various classifications of fits shall be in accordance with the following tables.

ALLOWANCES FOR VARIOUS TYPES OF FIT

(Allowances, Tolerances and Interference are given in ten-thousandths of an inch)

Size, Inches	Loose Fit (Class 1)		Free Fit (Class 2)		Medium Fit (Class 3)		Snug Fit (Class 4)		Wringing Fit (Class 5)		Tight Fit (Class 6)	Med. Force Fit (Class 7)	Heavy Force & Shrink. (Class 8)
	Tightest fit	Loosest fit	Tightest fits	Loosest fit	Tightest fit	Loosest fit	Tighest fit	Loosest fit	Tighest fit	Loosest fit	Selected fit	Selected fit	Selected fit
	Allowance	Allowance plus Tolerances	Allowance	Allowance plus Tolerances	Allowance	Allowance plus Tolerances	Allowance	Allowance plus Tolerances	Allowance	Allowance plus Tolerances	Average Interference	Average Interference	Average Interference
	(+)	(+)	(+)	(+)	(+)	(+)		(+)	(+)	(+)	(−)	(−)	(−)
1-1/16—1-3/16	30	90	15	43	10	26	0	10	4	6	3	6	11
1-3/16—1-3/8	30	90	16	44	10	28	0	10	4	6	3	6	13
1-3/8 —1-5/8	30	90	18	48	12	30	0	12	5	7	4	8	15
1-5/8 —1-7/8	40	100	20	52	13	33	0	12	5	7	4	9	18
1-7/8 —2-1/8	40	100	22	54	14	34	0	13	5	8	5	10	20
2-1/8 —2-3/8	40	100	24	58	15	35	0	13	5	8	6	11	23
2-3/8 —2-3/4	50	110	26	62	17	39	0	13	5	8	6	13	25
2-3/4 —3-1/4	50	130	29	67	19	43	0	15	6	9	8	15	30
3-1/4 —3-3/4	60	140	32	72	21	45	0	15	6	9	9	18	35
3-3/4 —4-1/4	60	140	35	77	23	49	0	16	6	10	10	20	40
4-1/4 —4-3/4	70	150	38	80	25	51	0	17	7	10	11	23	45
4-3/4 —5-1/2	70	150	41	85	26	54	0	17	7	10	13	25	50
5-1/2 —6-1/2	80	180	46	94	30	60	0	18	7	11	15	30	60
6-1/2 —7-1/2	90	190	51	101	33	63	0	19	8	11	18	35	70
7-1/2 —8-1/2	100	200	56	108	36	68	0	20	8	12	20	40	80

(+) denotes clearance or amount of looseness
(−) denotes interference of metal or negative allowance.

For larger than 8½" diameter use following:

FORMULAS FOR RECOMMENDED ALLOWANCES AND TOLERANCES

Class of Fit	Method of Assembly	Allowance	Selected Average Interference of Metal	Hole Tolerance	Shaft Tolerance
(1) Loose	Strictly interchangeable	$0.0025\sqrt[3]{d^2}$		$0.0025\sqrt[3]{d}$	$0.0025\sqrt[3]{d}$
(2) Free	Strictly interchangeable	$0.0014\sqrt[3]{d^2}$		$0.0013\sqrt[3]{d}$	$0.0013\sqrt[3]{d}$
(3) Medium	Strictly interchangeable	$0.0009\sqrt[3]{d^2}$		$0.0008\sqrt[3]{d}$	$0.0008\sqrt[3]{d}$
(4) Snug	Strictly interchangeable	0.0000		$0.0006\sqrt[3]{d}$	$0.0004\sqrt[3]{d}$
(5) Wringing	Selective assembly		0.0000	$0.0006\sqrt[3]{d}$	$0.0004\sqrt[3]{d}$
(6) Tight	Selective assembly		0.00025d	$0.0006\sqrt[3]{d}$	$0.0006\sqrt[3]{d}$
(7) Medium force	Selective assembly		0.0005d	$0.0006\sqrt[3]{d}$	$0.0006\sqrt[3]{d}$
(8) Heavy force or shink	Selective assembly		0.001d	$0.0006\sqrt[3]{d}$	$0.0006\sqrt[3]{d}$

d = diameter of fit in inches.
The formulas for allowance values give the ideal condition of fit for Classes 1 to 4.
The formulas for selected average interference of metal give the ideal condition of fit for Classes 5 to 8.

809.14 SHAFTS, TRUNNIONS AND JOURNALS. Shafts and trunnions shall be made with fillets where abrupt changes in section occur.

The journals of shafts and trunnions shall be polished to ASA No. 8 surface finish after being machined. In shafts and trunnions more than 8 inches in diameter, there shall be a hole bored lengthwise through the center. The diameter of the hole shall be about 1/5 of the diameter of the shaft or trunnion.

809.15 COUPLINGS. The faces of flange couplings

shall be planed to ASA No. 125 surface finish, and holes bored in pairs.

809.16 HUBS. Hubs of wheels, pulleys, gears, and couplings shall be bored true to center for Class 7 fit upon their shafts or axes. The ends of hubs shall be finished, as required.

809.17 BUSHINGS. Bushings shall be bored to fit the shaft or journal to the tolerances specified, and the shaft turned to fit.

The bearing shall be bored to fit the outside of the bushing.

The edges of oil grooves and bushings shall be rounded.

Babbitt metal shall be poured in the bearing in such a way that the thickness of the bushing after boring will be uniform.

809.18 BEARINGS. The rubbing and bearing surfaces shall have an ASA No. 16 surface finish and the joints between cap and base of bearings shall have an ASA No. 125 surface finish. The holes in cap and base shall be drilled. The holes in bearings for bolts fastening them to their supports shall be drilled or reamed to size and bolts turned as called for in Subsection 809.24. The holes in the supports shall be reamed to fit after the bearings have been adjusted. Bearings shall be finished on both ends. Trunnion bearings shall be bored parallel with the base.

809.19 GEAR TEETH. The teeth of gears transmitting power for the operation of the bridge shall be machine cut. The periphery and ends of teeth of gears shall be turned. The pitch circle shall be scribed on the teeth. The teeth of the rack may be cast or cut and finished, as specified.

809.20 BEVEL GEARS. The teeth of bevel gears shall be cut by a planer having a rectilinear motion in lines through the apex of the cone. Rotating milling cutters shall not be used for making bevel gears.

809.21 WORMS AND WORM WHEELS. Threads on worms shall be machine cut and the teeth of worm

wheels shall fit the worm accurately with surface or line contact.

809.22 KEY AND KEYWAYS. Keys shall be planed and keyways machine cut. The finish of the keys and keyways shall be such as to give the key a Class 7 fit on all the sides. Tapered keys shall bear on the top, bottom and sides; parallel faced keys on the sides only.

809.23 CASTINGS. Castings shall be cleaned and all fins and other irregularities removed so that they will have clean, smooth surfaces, suitable for this class of work. Castings which are to be attached to structural steel or other castings shall have their contact surfaces finished to ASA No. 250 surface finish. Unfinished edges of bases, ribs and similar parts, shall be neatly cast with rounded corners. Inside angles shall have proper fillets. Bosses shall be finished to the correct plane. Surfaces of castings in contact with masonry shall have ASA No. 2000 finish.

809.24 BOLT HOLES AND TURNED BOLTS. Holes for unfinished bolts shall be drilled or reamed not more than 1/16 inch larger in diameter than the bolt. The diameter of the shank of turned bolts shall be of such size as to make a Class 1 fit for the holed parts.

809.25 AIR BUFFERS. The workmanship on air buffers shall be so accurate that the weight of the cylinder and its attachments will be sustained by the confined air for 6 minutes, with the cylinder lubricated with a light oil and with a piston travel not more than that which occurs during the closure of the bridge. The valves must be closed and the buffers balanced so that the whole weight is carried by the piston rod.

809.26 BRAKES AND BRAKE LININGS. Brake shoes or bands shall be made so as to bear uniformly on the brake wheel. Brake linings shall preferably be attached to the shoes by means of copper rivets or approved bonding and in such manner as to be easily accessible for replacement.

809.27 RACK AND TRACK. In swing bridges, track segments shall be finished on the top and at the ends to ASA No. 250 surface finish. The center line shall be scribed on the surface.

The toothed segments forming the rack shall be fitted accurately. Particular care shall be taken to have the pitch of the teeth at the joints accurate. The tip of rack teeth shall be machine finished to a true circle. The pitch line shall be scribed on the teeth.

The backs of racks which bear on metal surfaces and the surfaces in contact with them shall be finished to ASA No. 1000 surface finish. Surfaces which bear on masonry shall have ASA No. 2000 surface finish.

809.28 PIVOT PEDESTALS. The disc seats shall be so finished as to insure a horizontal position of the span.

809.29 DISCS. Discs for pivot bearings shall be fitted accurately, finished to gage, and shall be ground accurately to the final finish. The sliding surfaces of steel and phosphor-bronze discs shall be polished to ASA No. 8 surface finish. Disc centers shall be assembled, fitted accurately and match-marked.

809.30 BALANCE WHEELS. The periphery and faces of balance wheels shall be turned to ASA No. 250 surface finish, the corners shall be rounded, and the center line of the balance wheels shall be scribed on the periphery. The hubs shall be bored accurately and faced on both ends.

809.31 PLANING GIRDERS. In built track girders and segmental girders of rolling bascule bridges, the edges of the webs, side plates, and angles shall be so planed to ASA No. 250 surface finish that full bearing on the track plate will be secured.

809.32 TREAD PLATES AND TRACK SEGMENTS. The contact surfaces of tread plates and track segments shall be planed to ASA No. 250 surface finish so that full bearing on the tread plates will be secured.

809.33 OIL OR GREASE GROOVES IN TRUNNIONS. The oil or grease grooves in the surfaces of trunnions and similar large bearings shall be machine cut. Small inequalities may be removed by chipping and filing. The grooves shall be smooth, especially the rounded corners.

809.34 BORING AND ASSEMBLY OF TRUNNION BEARINGS. When trunnion bearings are to be mounted on flexible supports, they shall be so bored that when the trunnion girder or support deflects under full dead load, the axes of the trunnions will be coincident.

Trunnions shall be fitted to their bearings in the shop. If they are to be disassembled for shipment, they shall be match-marked for field erection.

809.35 SHEAVES. The grooves in sheaves shall be turned. The shape of the grooves shall conform as closely as feasible to the rope section so that while the ropes shall run freely in the grooves, the sides of the grooves shall prevent the wire ropes from flattening under static loads, as when supporting counterweights. Segmental sheaves shall be completely assembled and, if of welded construction, shall be stress relieved before the grooves are turned. The variation from the required diameter shall not exceed plus or minus 0.01 inch.

Sheaves shall have a Class 8 fit on shaft or axle.

Both ends of hub shall be finished as specified.

809.36 HOLES FOR SHEAVES FOR VERTICAL LIFT BRIDGES. In vertical lift bridges, the holes in the girders and columns for the bolts connecting the main sheave bearings to their supporting girders, shall be drilled from the solid through cast iron or steel templates on which the bearings were set and accurately aligned when the holes in the bearings were bored. The bolt holes and the bolts shall be the same diameter and the bolts driven to place without injury to themselves, the bearings, the girders, or the columns.

809.37 SHOP ASSEMBLY OF MACHINERY. When specified, machinery parts shall be assembled in the shop on their structural supports. They shall be aligned, adjusted and fitted in their correct relative positions and holes in the structural supports shall be drilled to correctly match the holes in the machinery parts. The parts shall be match-marked before disassembling and they shall be erected in the field in the same relative positions.

When specified, the complete center of swing spans, including rack, track segments shall be assembled in the shop and aligned, fitted, drilled and the parts match-marked. When specified, the complete gear train shall be assembled in the shop and subjected to a specified time run.

When assembling in the shop is not required, the holes in the structural supports shall be left blank to be drilled in the field after the machinery parts have been set to correct alignment and adjustment, or subpunched or drilled 1/4 inch smaller and reamed to size in the field after erection.

809.38 HYDRAULIC PIPING. The inside of the pipe shall be bright clean and free from grease, drawing compounds, oxide, scale, carbon deposits and any pipe which has been pickled to remove scale shall be treated to eliminate pickle brittleness. The inside of the pipe shall then be coated with clean oil and the ends of the pipe sealed for protection against corrosion during shipment to and storage at the job site. The corrosion preventive oil used shall be such that after extended storage periods it can readily be removed with an alkaline cleaning solution or with benzine. Welding of hydraulic piping shall conform to Section 807.

809.39 PROTECTION OF MACHINERY AND TRAFFIC BARRIER PARTS DURING SHIPMENT. All finished rubbing and bearing surfaces of machinery and traffic barrier parts shall be given a protective coating before shipment. The bearing surfaces of trunnions and of heavy axles and shafts, in addition to the protective coating, shall be protected by wooden lagging securely attached.

The bearing surfaces of other shafts, axles and similar parts shall be covered with burlap or other satisfactory protecting material. Small machinery and traffic barrier parts shall be boxed or crated.

All electrical apparatus shall be thoroughly protected by boxes or crates. Electric motors not designed to be operated fully exposed to the weather shall be protected by waterproof coverings.

809.40 ERECTION.

(a) Position of Span During Erection: Movable bridges may be erected in either the open or closed position, as may be approved by the navigation authorities and the engineer.

(b) Protection of Machinery and Traffic Barrier Parts During Erection: Parts which are protected from the weather in the completed structure or during shipment from the shop shall be likewise protected during unloading, field storage and erection. Special care shall be exercised in protecting electrical parts. Wire ropes shall be stored not less than 16 inches above the ground and free from conditions likely to produce corrosion of the wires or decay of the hemp cores. While being unwound or otherwise handled during the operations incident to their installation upon counterweights, sheaves and drums, they shall not be kinked or bent to short radius curves nor shall they be dragged over stones, rough metal surfaces or other material likely to produce abrasions upon the exposed surfaces of the wires.

(c) General Requirements for Machinery and Traffic Barrier Erection: The alignment and adjustment of machinery and traffic barriers shall be done by skilled mechanics. Trunnion bearings and all important shaft bearings shall be set using piano wire or optical methods providing similar accuracy, to determine their correct adjustment.

Shims shall preferably be sheet copper or brass. The contractor shall have a supply of shims varying in size and thickness with a minimum thickness of 3/1000 of an inch. Where necessary, shims shall be used for aligning and adjusting machinery to its proper place preparatory to securing it rigidly in position by bolts or other fastenings. To prevent localization of stresses in the machinery and traffic barrier parts, the shims shall not be less in dimensions than the bearing area shimmed.

All minor pockets and depressions formed as a result of erection and which may collect moisture or oil shall be drained in the field even when drainage

is not called for on the plans, provided that none of the parts drained are unduly weakened by the drainage openings.

(d) Lubrication: All rotating and sliding parts shall be thoroughly cleaned and well lubricated during erection. All parts shall be lubricated before the operating machinery is tested. Counterweight and operating ropes shall be given one coat of approved lubricant.

(e) Camber, General Requirements: When movable bridges are in process of erection, care shall be taken to set the camber blocking to the necessary heights, so that the span will be assembled to the proper camber curves when the structural parts are in the unstressed condition. When the camber blocking is struck and the spans swung, the rivets in all the main truss connections shall have been driven or the joints 100 per cent pinned and bolted, so that no slip will occur in the connections.

(f) Camber for Swing Spans: When swing spans are erected upon camber blocking, the blocking shall be set to such elevation as to fulfill the following requirements:

1. When the blocking is removed and the span allowed to swing free under full dead load at normal temperature, the elevations at the span ends shall be at a distance below grade equal to the specified end lift.

2. When the wedges are fully driven and the structure is acting under full dead load including the deck, the elevation at all panel points shall conform to the specified grade line.

It will be observed that the above method involves the superimposition of 2 cambers. The first is equal to the deflection of the structure as a cantilever under full dead load and the second is equal to the deflection when acting as a continuous or partially continuous span under full dead load and the dead load end reactions.

(g) Alignment of Bascule Leaves: The trusses or

girders of a bascule span erected in an open position shall be held to correct alignment and position by means of struts, braces and guys. When required, the punching of laterals shall be left blank until the bridge is lowered so as to permit adjustment of alignment to insure correct closing and locking.

(h) Alignment of Trunnion Bearings: Special care shall be taken in alignment of trunnion bearings by means of beveled shims or other means provided so that when full deflection of the trunnion girder or bearing support occurs under dead load, the axes of the trunnions will be coincident.

(i) Alignment of Vertical Lift Spans: Special care shall be taken to assure the proper spacing and aligning of the towers so that the towers and guides will be truly vertical when the dead load of the span and counterweight has been applied.

(j) Service Test of Machinery: A service test of the power operation of the span shall be made by moving it through a number of complete cycles to be determined by the engineer. These cycles of movement shall be executed in succession without intervals of rest between them so that any tendency of operating parts to become heated may be discovered. All defects found in the operation of the span shall be corrected.

809.41 COUNTERWEIGHTS. The counterweights shall be sufficient to balance the moving span and its attachments in any position, except that in vertical lift bridges the counterweight ropes shall not be balanced unless otherwise specified.

Counterweights shall preferably be of concrete supported in a steel box or by a steel frame. They shall be made adjustable so that variations in the weight of the movable span may be easily provided for. This shall be done by adding or taking of concrete or cast iron blocks in properly located pockets. Concrete blocks weighing not over 100 pounds each shall be used unless otherwise provided and they shall be provided with eye or ring bolts to facilitate handling. Space for 5 per cent under and 5 per cent above the calculated weight shall be provided. Movable blocks to

the amount of 10 per cent shall be provided. The pockets shall be provided with drain holes not less than 6 inches in diameter. If the counterweights of bascule and vertical lift bridges are located above the floor of the approaches, the vertical clearance between the counterweights and the floor, curbs, sidewalks or handrails shall not be less than 2 feet and 6 inches when the bridge is in the fully open position. In calculating this clearance, the counterweight ropes shall be assumed to stretch 2 per cent of their calculated length.

Concrete for counterweight and adjusting blocks shall be Class A, weighing about 148 pounds per cubic foot, unless otherwise specified. Steel punchings or scrap metal may be used when necessary to increase the weight. If clean steel punchings are used, and placed in layers and grouted with a mortar composed of one part of Portland cement and 2 parts of sand, the maximum available total weight shall not be taken as more than 315 pounds per cubic foot. Such a mixture shall not be used as a counterweight which revolves about a horizontal axis, unless retained in place by a surrounding steel box or by walls of reinforced concrete.

The fabricator of the structural steel shall determine the weight and, where necessary, the location of the center of gravity of the moving span, including all parts attached thereto, and of the counterweights, including their frames. These determinations shall be based on weights carefully computed from approved shop plans, and these weights shall include the structural steel, machinery, flooring and everything attached to the movable parts of the bridge. The adjustment pocket of the counterweights are to be assumed 1/2 full when determining the size of counterweights.

The determination of the proper mixture for the counterweights in order to give the proper unit weight is especially important and a series of tests shall be made well in advance of the time that placing of the concrete is to begin to determine the unit weight of the concrete which can be obtained from the materials at hand. Test blocks containing not less than one cubic foot shall be made and a record kept showing the

weight of the blocks when cast, and when 1, 2, 3 and 7 days old. This record of test blocks must be submitted to the engineer for approval before concreting is commenced and these tests shall be made by the contractor in time to have this information available for the fabricator by the time the latter is ready to detail the counterweights.

The unit weight of materials entering into the construction of the floor deck is an important factor in the determination of the volume of the counterweights, and the contractor shall furnish the engineer and fabricator with the unit weight of the materials used in the floor. The determination of the unit weights shall be made by actually weighing samples of these materials. If the floor is of concrete, test blocks shall be made as outlined above to determine the unit weight of the floor slab as constructed.

The contractor shall assume full responsibility for the correctness of the center of gravity calculations, where necessary, the detail drawings of the counterweights, and the construction of the counterweights of correct unit weight so that the bridge when completed will be in proper balance. The contractor shall be fully responsible for the balancing of the bridge and shall make, free of charge, all necessary adjustments and alterations which may be required to obtain a proper balance.

If the contractor sublets the fabrication, such subletting will not relieve him from the full responsibility for the correctness of the counterweight calculations and all other work, whether performed by him or his subcontractors. This, however, shall not relieve the subcontractor of any responsibility which he may have under his contract with the contractor.

809.42 POWER PLANT.

(a) General: This item shall be as provided in Part XI, Design of Movable Bridges, of these specifications and as shown on the plans except as provided herein.

(b) Power Supply: On electrically operated bridges, the contractor shall make all necessary arrangements with the power company and shall furnish

and install the service pole and shall bring the electrical power service to the switchboard in the operating house. Unless otherwise shown, the electrical service shall be 220/110 volts, 4 wire delta, 3 phase, 60 cycles A.C., and shall be brought into the operating house underground in rigid metal conduit.

No direct payment or additional allowance will be made for the power used in the operation of the movable span while testing and adjusting, or for power used while instructing the permanent bridge operators, or for power used for any other reason while the bridge is being completed prior to final inspection. The cost of power consumed before the final inspection and acceptance by the Department shall be included in the lump sum bid under Item 809(3).

(c) Inspection of Switchboard and Control Desk: Before shipment, the control desk and switchboard shall be tested for operation sequence of devices, grounds and ability to stand operating voltages and currents in accordance with N.E.M.A. standards. The contractor shall give the engineer ample notice before making final tests so that the engineer may arrange to have an observer present to witness these tests. Witnessing of the tests, or not, shall be at the option of the Department, and shall in no way relieve the contractor of any responsibility placed upon him by his contract.

(d) Grounding and Bonding: The entire system shall be grounded and bonded in accordance with the National Electric Code. All conduit runs shall be bonded at the control desk and switchboard as well as throughout the system.

(e) Wiring: Unless otherwise provided, all conductors shall be copper, and have 600 volt moisture and heat resistant insulation, National Electric Code Designation Type RHW, with neoprene jacket, and shall conform to the requirements of Subsection 915.13.

All conductors, except spares, shall be terminated on high pressure connector, barrier type terminal blocks. All conductors shall be tagged with adhesive

type wire markers, with the proper identification stamped thereon.

Conductors smaller than AWG No. 12 shall not be used. All conductors shall be stranded, per IPCEA specifications.

(f) Conduit: The entire conduit system shall be rigid metal conduit, except that a short length of flexible conduit shall be provided at the connections to motors, brakes, limit switches, and other equipment as shown on the plans. All conduit shall be hot dip galvanized, metallized, or sherardized. All conduit fittings, condulets, etc., shall be cast or malleable iron, with cast or malleable iron covers, and solid neoprene gaskets, and shall be hot dip galvanized or cadmium plated. All conduit clamps, clamp backs, and nest backs, shall be heavy duty malleable iron, hot-dip galvanized or cadmium plated. Insulated throat metal bushings shall be used at the ends of all conduits to prevent injury to the conductors. One-eighth inch drain holes shall be drilled at the low point of all conduit runs. Threads shall be painted with white or red lead before assembly. Material used in the manufacture of conduit shall be in accordance with Subsection 915.12.

(g) Junction Boxes: Junction boxes shall be made of welded aluminum plate, with a minimum wall thickness of ¼ inch. All corners and edges shall be well rounded, and all welds shall be ground smooth. Junction boxes shall have drain and breather fittings, located top and bottom.

Junction boxes shall have sufficient terminal blocks to terminate all conductors except spares. Mounting terminal blocks on the sides, top or bottom of the boxes will not be permitted. A clear distance of at least 6 inches shall be provided between rows of terminal blocks, and not less than 6 inches between terminal blocks and the sides of the box. The minimum depth of the junction box shall be twice the diameter of the largest conduit entering the box plus 2 inches, but in no case less than 6 inches. Junction boxes shall have hinged covers, equipped with neoprene gaskets to form watertight seals, and

held closed with stainless steel hinged bolts with winged nuts.

All hardware used to attach hubs or terminal blocks to the box, and all other hardware shall be stainless steel.

Materials used in the fabrication of these boxes shall be in accordance with Subsection 915.14.

(h) Terminal Blocks: Terminal blocks shall be provided for the termination of all conductors, except spares, which do not terminate at devices equipped with terminals. Terminal blocks shall be of the barrier type equipped with high pressure connectors. Black over white plastic marking strips shall be provided and each connector shall be identified by engraving the marking strip with the same identification as the elementary wiring diagram.

(i) Internal Combustion Engines: Internal combustion engines shall be as shown on the plans.

(j) Fuel Tank: Fuel tanks shall be of 100 gallon capacity and constructed of galvanized sheet metal not less than ⅛ inch thick. The tank shall be located outside the engine room, below the level of the intake, preferably suspended under the floor of the engine room. The tank shall be equipped with drain, and vent and filler pipes located outside the engine room. The filler pipe shall be so constructed as to permit gauging of the tank with a calibrated stick gauge.

809.43 OPERATING HOUSE. The operating house shall be constructed in accordance with the plans. All obviously necessary parts or fittings, not specifically shown or called for, shall be furnished by the contractor, as if shown or called for, without extra charge.

809.44 MACHINERY HOUSES. Machinery houses shall be constructed in accordance with the plans. All obviously necessary parts or fittings, not specifically shown or called for, shall be furnished by the contractor, as if shown or called for, without extra charge.

809.45 METHOD OF MEASUREMENT.

(a) Movable Bridge Machinery: Movable bridge machinery will be measured by the lump and the mea-

surement shall include all gears, including gears for operating limit switches, shafts, couplings, bearings, castings, wedges, wedge bases, latches, speed reducers, lubricating system, center pivots, racks and tracks for swing spans, bearing discs, balance wheels, trunnions and trunnion bearings, pins, sleeves, sheaves, wire ropes and their sockets and socket pins, bolts, screws, bolts and nuts connecting machinery parts to structural steel, castings which form an integral part of the machinery, winding drums, tread plates and castings for segmental girders and track girders for rolling lift spans and their connecting bolts, pistons and cylinders, eccentrics, pinions, ring gears, racks, clutches, brakes other than electrical brakes, rollers, valves, locks, toggles, crank arms, cranks, axles, hooks, bearing liners, wrenches, springs, manually operated roadway traffic gates, oil burning navigation lights, mechanically operated position indicators, and all other similar parts and fittings necessary for the satisfactory operation of the bridge which require machine shop work and which are not included in any other class, and all items which are classified as "Movable Bridge Machinery" on the plans.

(b) Traffic Barriers: Traffic barriers will be measured by the lump. This item shall consist of furnishing all materials and erecting the traffic barriers in accordance with the details shown on the plans and with these specifications.

(c) Power Plant: Power plant will be measured by the lump and the measurement shall include all electrical motors, internal combustion engines with all incidental parts, electrical generator sets, electrically operated brakes, switchboard and control desk with their attachments and electrical parts, controllers, resistances, limit switches, transformers, circuit breakers, electric navigation lights, navigation sound signals, storage batteries, battery chargers, electrically operated position indicators, service lighting, traffic warning signals, electrically operated roadway traffic gates, flood lights, wiring, conduits and their fittings, junction boxes, submarine cables, flexible cables, collector rings, contactors,

switches, instructors, pit pumps, name plates for each operating element, and all other items and equipment required for the installation of a complete power plant and all items which are classified as "Power Plant" on the plans.

(d) Operating House: The operating house will be measured by the lump and the measurements shall include all obviously necessary parts of the house, including furniture and cabinets. If the house is supported on piling, the piling will be measured as provided under "Bearing Piles", Section 804.

(e) Machinery Houses: Machinery houses will be measured by the lump and the measurement shall include all obviously necessary parts of the houses.

(f) Class A concrete in counterweights will be measured by the cubic yard and the yardage to be paid for shall be determined as provided in Section 805. No deduction in the volume of concrete will be made for steel punchings or scrap metal which may be used when necessary to increase the weight.

Deformed reinforcing steel or structural steel used in counterweights, as the case may be, will be measured as provided in Sections 806 and 807.

809.46 BASIS OF PAYMENT. Machinery, traffic barriers, power plant, operating house and machinery houses shall be paid for at the lump sum contract prices for "Movable Bridge Machinery", "Traffic Barriers", "Power Plant", "Operating House", and "Machinery Houses", as the case may be, complete in place.

Concrete and reinforcing steel or structural steel used in counterweights, as the case may be, will be paid for as provided in Sections 805, 806 and 807.

Payment will be made under:

Item No.	Pay Item	Pay Unit
809(1)	Movable Bridge Machinery	Lump
809(2)	Traffic Barriers	Lump
809(3)	Power Plant	Lump
809(4)	Operating House	Lump
809(5)	Machinery Houses	Lump

Section 810
Railing

810.01 DESCRIPTION. This work shall consist of furnishing all materials and constructing railing of the type specified. All work shall be in accordance with these specifications and in reasonably close conformity to the lines, grades and dimensions shown on the plans or established by the engineer.

Pipe in pipe railing or pipe and concrete railing may be either aluminum or galvanized steel at the option of the contractor unless otherwise designated.

810.02 MATERIALS. All materials used in the construction of railings, railing posts, end flares, entrance posts, pylons, etc. shall conform to the applicable subsections of Section 912.

CONSTRUCTION REQUIREMENTS

810.03 CONSTRUCTION, FABRICATION, ERECTION AND PAINTING. All construction, fabrication, erection and painting shall conform to the applicable requirements of Section 805—Concrete Masonry, Section 806—Reinforcement, Section 807—Structural Steel, Section 811—Painting and as further described hereunder.

810.04 LINE AND GRADE. The line and grade of the railing shall be true to that shown on the plans, and shall not follow any unevenness in the superstructure. Unless otherwise specified or shown on the plans, the railing and curbs on bridges, whether superelevated or not, shall be vertical and the railing posts shall be constructed normal to grade.

810.05 EXPANSION JOINTS. Expansion joints shall be so constructed as to permit freedom of movement. After all work is completed, all loose or thin shells or mortar likely to spall under movement shall be removed.

810.06 PLACING RAILING. In no case shall concrete railing be placed until centering or falsework for the

span has been released, rendering the span self-supporting.

810.07 METAL RAILING. Metal railing shall be carefully adjusted prior to fixing in place to insure proper matching at abutting joints and correct alignment and camber throughout their length. Holes for field connections shall be drilled with the railing in place on the structure at proper grade and alignment.

810.08 METHOD OF MEASUREMENT. Railing will be measured by the linear foot. The length for measurement shall be the actual length of completed railing measured along the face of the railing and end flares, entrance posts or pylons, from end to end of each line of railing exclusive of any openings in each line of railing between railing posts and between posts and end flares, entrance posts or pylons. This measurement shall include all work constructed above the top of the roadway curb, side walk surface or side walk curb. Entrance post, flares, pylons, and other items integral with the railing shall be included unless otherwise specified.

The reinforcing steel used in construction of this item will not be measured.

810.09 BASIS OF PAYMENT. The accepted quantities of railing will be paid for at the contract unit price per linear foot for the type specified complete in place.

Payment will be made under:

Item No.	Pay Item	Pay Unit
810(1)	Concrete Railing	Linear Foot
810(2)	Steel Railing	Linear Foot
810(3)	Steel Channel Railing	Linear Foot
810(4)	Pipe Railing	Linear Foot
810(5)	Steel and Concrete Railing	Linear Foot
810(6)	Pipe and Concrete Railing	Linear Foot

Section 811

Painting

811.01 DESCRIPTION. This work shall consist of the painting of all items specified and shall include the preparation of surfaces, the application, protection and drying of the paint coatings in accordance with these specifications or as directed by the engineer.

The terms used in these specifications shall be the standard definitions adopted by the ASTM or the AASHO. The gallon used is the United States gallon containing 231 cubic inches.

811.02 MATERIALS. Materials shall meet the requirements of the following subsections of Part IX Materials.

(a) Metal Surfaces:	
Shop Coat (Prime Coat)	908.02
First Field Coat	908.02
Second Field Coat	908.02
Third Field Coat	908.04
(b) Timber Structures:	
First Coat	908.03
Second Coat	908.03
Third Coat	908.03

811.03 NUMBER OF COATS, COLOR AND FILM THICKNESS.

(a) Metal Surfaces in Steel and Concrete Structures: It is the intent of these specifications that all metal surfaces, whether classified as structural steel, machinery, traffic barriers, power plant, or otherwise, shall be painted, unless otherwise stipulated or unless painting would interfere with the proper operation of the part, with 4 coats of paint as follows:

1. Shop Coat—Red Lead Paint. 1.5 mils minimum
2. First Field Coat—Red Lead Paint tinted with one ounce

of lampblack, paste form, to one gallon of finished paint; lampblack to be incorporated by manufacturer.	1.5 mils minimum
3. Second Field Coat—Red Lead Paint	1.5 mils minimum
4. Third Field Coat—Aluminum Paint	1.0 mils minimum

The total minimum dry film thickness of all 4 coats shall be 5.5 mils.

Metal surfaces of stock items, such as gear reducers, electric motors, gasoline engines, and the like, which are ordinarily painted by the manufacturer, shall receive only the 3 field coats of paint specified above.

Control desks and switchboards shall be painted as described elsewhere. Equipment mounted on the control desks and switchboards is not to be painted unless required elsewhere.

Galvanized, sherardized or metalized surfaces of sheet metal, electrical conduit, water and gas pipes shall be painted with 2 field coats of aluminum paint. All other galvanized surfaces shall not be painted unless otherwise specified.

Painting of aluminum metal surfaces shall not be required.

(b) Timber Structures: When specified on the contract drawings, timber railings of bridges and other timber structures, shall be painted with 3 coats of paint as follows:

First Coat	White Ready-Mix Paint
Second Coat	White Ready-Mix Paint
Third Coat	White Ready-Mix Paint

CONSTRUCTION REQUIREMENTS

811.04 WEATHER LIMITATIONS. Paint shall not be applied when the air temperature is below 40° F or when the air is misty, or when conditions are otherwise unsatisfactory for the work. It shall not be ap-

plied upon damp or frosted surfaces. Painting shall be discontinued whenever the temperature is expected to drop below 35° F before the paint film has dried.

Material painted under cover in damp or cold weather shall remain under cover until dry or until weather conditions permit its exposure in the open. Painting shall not be done when the metal is hot enough to cause the paint to blister and produce a porous paint film.

811.05 PROTECTION OF PUBLIC AND WORK. In conducting painting operations on bridges and other structures, the contractor shall protect pedestrian, vehicular and other traffic upon or underneath the structure and also portions of bridge superstructure and substructure against damage or disfigurement by splatters, splashes and smirches of paint or paint materials.

811.06 MIXING OF PAINT. Paint shall be factory mixed except aluminum paint which shall be mixed, just prior to painting. All paint shall be mixed thoroughly before applying and during application shall be stirred frequently so that the pigments are kept in suspension and the proper consistency maintained.

811.07 APPLICATION. Painting shall be done in a neat and workmanlike manner. Paint for shop and field coats may be applied with hand brushes, rollers or sprayers or by a combination of these 3 methods of application. However, by any method, the coating of paint applied shall be smoothly and uniformly spread so that no excess paint will collect at any point. The right is reserved to require the use of hand brushing should the results of spraying be unsatisfactory.

When brushes are used, the paint shall be so manipulated under the brush as to produce a smooth, uniform and even coating in close contact with the metal or with previously applied paint, and shall be well worked into all corners and crevices.

Power spraying equipment shall apply the paint in a fine even spray without the addition of any thinner. In cool weather, the paint may be warmed to reduce the viscosity. Such warming shall be accomplished by

heating the paint containers in water or by placing them on steam radiators. Paint when applied with spray equipment shall immediately be followed by hand brushing when necessary to secure uniform coverage and to eliminate air-holes, blistering, splotches or wrinkling.

On all surfaces which are inaccessible for paint brushes or rollers, the paint shall be applied by sprayers or with sheepskin daubers to insure thorough covering.

The prime and intermediate coats of paint shall be not less than 1.5 mils thick when dry, and the finish coat of paint shall be not less than 1 mil thick when dry. No portion of the paint films shall be less than these specified film thicknesses. The film thickness shall not be so great that either the appearance or service life of the paint will be detrimentally affected.

Not less than 72 hours shall elapse between applications of coats of paint under normal weather conditions.

The contractor shall take all necessary precaution to prevent discoloration of concrete or other surfaces by the painting operation.

811.08 THINNING PAINT. Paint as delivered in containers, when thoroughly mixed, is ready for use. If it is necessary in cool weather to thin the paint in order that it shall spread more freely, this shall be done only by heating in hot water or on steam radiators, and liquid shall not be added nor removed unless permitted.

811.09 PAINTING GALVANIZED SURFACES. For the purpose of conditioning galvanized surfaces for painting, the painting shall be deferred as long as possible in order that the surface may weather.

Galvanized surfaces which are required to be painted shall be treated as follows or by some other approved method.

In one gallon of soft water, dissolve 2 ounces each of copper chloride, copper nitrate, and sal ammoniac, then add 2 ounces of commercial muriatic acid. This

should be done in an earthen or glass vessel, never in tin or other metal receptacle. Apply the solution with a wide flat brush to the galvanized surface. When dry, the surface shall be washed with clear water.

811.10 CLEANING OF SURFACES.

(a) All metal surfaces not to be painted shall be thoroughly cleaned by an approved method which will remove all dirt, rust, oil, grease, rust-scale, loose mill scale, weld slag and other foreign matter which will adversely affect concrete bonding ability or surface friction where required.

(b) All metal surfaces, except galvanized, to be painted shall be commercial blast cleaned as specified by the Steel Structures Painting Council Standard SSPCSP6, Number 6, Commercial Blast Cleaning.

811.11 SHOP PAINTING.

(a) Surfaces to be Painted: When fabrication and cleaning are completed, surfaces not previously painted during assembly shall be painted one complete coat of approved paint before any damage to the cleaned surface occurs from weather or other exposure. Shop contact surfaces shall not be painted unless otherwise specified. Surfaces to be in contact after field erection shall not be painted unless a coat of lacquer or other protective coating is specified on the plans or fabrication details. Surfaces not to be in contact but which will be inaccessible after either fabrication or field erection shall receive the specified shop and field coats of paint. Surfaces to be in contact with concrete shall not be painted. Where paint would be detrimental to field welding operations, or field bolted splice areas, the surface shall not be painted within a suitable distance from the edges to be welded or spliced.

(b) Erection Marks: Erection marks shall be painted on painted surfaces.

(c) Loading: Material shall not be loaded for shipment until the paint is dry.

(d) Contact and Inaccessible Surfaces: Surfaces to

be riveted or bolted in contact either in the shop or field shall not be painted. Surfaces not in contact but which will be inaccessible after assembly or erection shall be painted 3 coats.

(e) Machine Finished Surfaces: With the exception of abutting chord and column splices, rocker shoes and bases, and column and truss shoe bases, machine-finished surfaces shall be coated as soon as practicable after being accepted and before removal from the shop. Surfaces of iron and steel castings, machine-finished for the sole purpose of removing scales, fins, blisters or other surface deformations, shall be given the shop coat of paint.

(f) Pins and Pin Holes: All pins and pin holes shall be painted with one shop coat.

811.12 FIELD PAINTING. As soon as the field cleaning has been done to the satisfaction of the engineer, the heads of field rivets and bolts, and any surfaces from which the shop coat of paint has been worn off or has become otherwise defective, shall be covered with one coat of the same paint as was used in the shop. When the paint applied for touching up rivet heads and abraded surfaces has become dry, the first field coat may be applied. In no case shall a coat be applied until the previous coat has dried throughout the full thickness of the paint film.

Small cracks and cavities which have not been sealed in a watertight manner by the first field coat shall be filled.

The 2nd and 3rd coats of field paint shall not be applied to the steel work below the highway floor level until the concrete roadway slab has been completed and the metal work carefully cleaned, nor shall the 2nd and 3rd field coats be applied to outside steel until the concrete has been rubbed.

In the application of aluminum paint by brushing, the finish strokes shall generally be in the same direction.

Where timber decks are provided, the top flanges of all stringers and floor beams shall be protected by

a covering composed of a heavy layer of bituminous material (tar, asphalt or pitch) applied hot and one thickness of 2-ply tar paper wide enough to project 3 inches beyond the edges of the members. These edges shall be bent down at an angle of 45°.

If traffic causes an objectionable amount of dust, the contractor shall at his own expense, allay the dust for the necessary distance on each side of the bridge and take any other precautions necessary to prevent dust and dirt from coming in contact with freshly painted surfaces or with surfaces before the paint is applied.

811.13 METHOD OF MEASUREMENT. No measurement will be made for painting, unless specifically provided for in the contract.

811.14 BASIS OF PAYMENT. No direct payment will be made for painting of any of the structures or surfaces described above unless pay items for painting are included in the contract. The contract prices for the various structures and surfaces to be painted shall include the cost of furnishing all materials, labor, etc., to properly complete, in accordance with these specifications, all painting required.

Section 812

Untreated and Treated Timber

812.01 DESCRIPTION. This work shall consist of furnishing lumber of the sizes and grade specified and of furnishing timber of the stress-grade, sizes and dimensions for the different uses specified, treated, or untreated, as called for in the contract, and of preparing, framing, assembling and erecting the same, including painting where specified, and including also all hardware required by the plans and specifications, all in accordance with these specifications and in conformity with the structure design and details as shown on the plans, or designated by the engineer.

812.02 MATERIALS. All materials shall meet the requirements of the following subsections of Part IX Materials.

Structural Timber and Lumber	914.01
Timber Piling	914.02
Timber Preservatives	914.03
Timber Treatment	914.04
Timber Connectors	915.11
Hardware and Structural Shapes	915.12
Pitch	915.19
Red Lead	908.02
White Paint	908.03
Aluminum Paint	908.04
Black Paint	908.06

812.03 SPECIES OF WOODS. The common and botanical names of the species of woods recognized in these specifications are described as follows:

Common Names	Botanical Names
Douglas Fir (Coast)	Pseudotsuga taxifolia (Coast)
Southern Pine includes:	
Loblolly Pine	Pinus taeda
Longleaf Pine	Pinus palustris
Pitch Pine	Pinus rigida
Pond Pine	Pinus serotina
Shortleaf Pine	Pinus echinata
Slash Pine	Pinus caribaea

812.04 SPECIES TO BE USED.

(a) Permanent Structures: Unless otherwise shown on the plans, or provided in the special provisions, all lumber and timber used in the construction of permanent bridges, bridge fenders, bulkheads, culverts, and timber cattle guards may be either Douglas Fir, or Southern Pine, as the contractor elects, however, the same species shall be used throughout each structure, except in bridge structures as hereinafter provided.

Caps and stringers for any bridge structure may be either fir, or pine, regardless of the species used in the remainder of the structure, however, all caps and stringers furnished for any structure shall be the same species.

Lumber and timber shall not be used in exposed structures without preservative treatment unless otherwise indicated on the plans or in the special provisions.

(b) Temporary Structures: Temporary structures may be any species and grade of timber which is satisfactory for the intended purpose. Temporary structures furnished for detours shall be constructed of sufficient strength to withstand legal load limits at all times during their use.

812.05 GRADES OF STRUCTURAL TIMBER. Structural lumber and timber used for the various structural purposes required, shall be of appropriate stress-grades selected in accordance with the design requirements for the particular structure. The material supplied shall be of equal or greater stress value than the stress-grade specified. The grade to be used shall be as shown on the plans, or as specified in the special provisions.

812.06 HARDWARE FOR TIMBER.

(a) Structural Shapes: Rods, plates and shapes shall be of structural steel, or wrought iron, as specified. Eyebars shall conform to the requirements for structural steel eyebars.

(b) Castings: Castings shall be cast steel, or gray-iron, as specified.

(c) Bolts, Drift-bolts and Dowels, etc.: Machine bolts, drift-bolts and dowels may be either wrought iron, or medium steel. Washers may be cast O-gee, or malleable castings, or they may be cut from medium steel, or wrought iron plate, as specified.

Machine bolts shall have square heads and nuts, unless otherwise specified. Nails shall be cut or round wire of standard form. Spikes shall be cut or wire spikes, or boat spikes, as specified.

Nails, spikes, bolts, dowels, washers and lag screws shall be galvanized, unless otherwise specified.

Unless otherwise specified, all hardware, except malleable iron connectors, for treated timber bridges, shall be galvanized, or cadmium plated.

812.07 STORAGE OF MATERIAL. Lumber and timber stored on the site shall be kept in orderly piles, or stacks. Untreated material shall be open-stacked on supports at least 12-inches above the ground surface to avoid absorption of ground moisture and permit air circulation, and it shall be so stacked and stripped as to permit free circulation of air between the tiers and courses. When directed, protection from the weather by suitable covering, will be required.

On glued, laminated structural members that are not to be preservatively treated, an approved end sealer shall be applied after end trimming of each completed member.

CONSTRUCTION REQUIREMENTS

812.08 TREATED TIMBER. Treated timber shall be interpreted to mean timber of the species and stress grade called for, treated as stipulated in Subsection 914.04. The various types of preservative permitted for use, and the portions of structures where the several types may be used shall be as provided on the plans, or in the special provisions.

(a) Workmanship. Workmanship shall be first class throughout. None but competent bridge carpenters

shall be employed and all framing shall be true and exact. Unless otherwise specified, nails and spikes shall be driven with just sufficient force to set the heads flush with the surface of the wood. Deep hammer marks in wood surfaces shall be considered evidence of poor workmanship and sufficient cause for removal of the workman causing them. The workmanship on all metal parts shall conform to the requirements specified for steel structures.

(b) Surfacing. All lumber and timber, except bulkhead planks and sway bracing shall be surfaced on 4 sides (S4S) unless otherwise called for on the plans.

(c) Handling. Treated timber shall be carefully handled without sudden dropping, breaking of outer fibers, bruising or penetrating the surface with tools. It shall be handled with rope slings. Cant hooks, peaveys, pikes, or hooks shall not be used.

(d) Framing and Boring. All cutting, framing and boring of treated timbers shall be done before treatment insofar as practicable. When treated timbers are to be placed in waters infested by marine borers, untreated cuts, borings, or other joint framings below highwater elevation shall be avoided.

(e) Installation of Timber Connectors. Timber connectors shall be one of the following types, as specified on the plans—the split ring, the toothed ring, the shear plate, or the spike grid. The split ring and the shear plate shall be installed in pre-cut grooves of dimensions as given herein, or as recommended by the manufacturer. The toothed ring and the spike grid shall be forced into the contact surfaces of the timbers joined by means of pressure equipment. All connectors of this type at a joint shall be embedded simultaneously and uniformly. Fabrication of all structures using connectors shall be done prior to treatment. When prefabricated from templates, or shop details, bolt holes shall not be more than 1/16-inch from required placement. Bolt holes shall be 1/16-inch larger than bolt diameter. Bolt holes shall be bored perpendicular to the face of the timber.

Timber after fabrication shall be stored in a manner which will prevent changes in the dimensions of the members before assembly.

Dimensions of material and details not otherwise specified shall meet with the approval of the engineer.

(f) Cuts and Abrasions. All cuts in treated piles or timbers, and all abrasions, after having been carefully trimmed, shall be covered with 2 applications of a mixture of 60 per cent creosote oil and 40 per cent roofing pitch, or brush-coated with at least 2 applications of hot creosote oil and covered with hot roofing pitch.

(g) Bolt Holes. All bolt holes bored after treatment shall be treated with creosote oil by means of an approved pressure bolt hole treater. Any unfilled holes, after being treated with creosote oil, shall be plugged with creosoted plugs.

(h) Temporary Attachment. Whenever, with the approval of the engineer, forms or temporary braces are attached to treated timber with nails, or spikes, the holes shall be filled by driving galvanized nails, or spikes, flush with the surface, or plugged, as required for bolt holes.

812.09 TREATMENT OF PILE HEADS.

(a) General. Pile heads, after cutting to receive the caps, and prior to placing the caps, shall be treated to prevent decay.

The heads of treated timber piles shall be protected by one of the following methods, as specified on the plans. If not otherwise specified, Method A shall be used.

(b) Method A—Galvanized Metal Covering: The sawn surface shall be thoroughly brush coated with 2 applications of hot creosote oil, after which there shall be placed 2 layers of heavy canvas, size 20" x 20", saturated with hot asphalt, followed by 24" x 24" number 28 gage galvanized metal cover. The cover shall be bent down over the pile at an angle of approximately 45°.

(c) Method B—Fabric Covering: The heads of all piles shall be covered with alternate layers of hot pitch and loosely woven fabric similar to membrane waterproofing, using 4 applications of pitch and 3 layers of fabric. The cover shall measure at least 6-inches more in dimension than the diameter of the pile and shall be neatly folded down over the pile and secured by large headed galvanized nails, or by binding with not less than 7 complete turns of galvanized wire securely held in place by large-headed galvanized nails and staples. The edges of the fabric projecting below the wire wrapping shall be trimmed to present a workmanlike appearance.

The heads of untreated piles shall be given one of the following treatments, as may be specified, or directed.

(1) The sawed surface shall be thoroughly brush coated with 2 applications of hot creosote oil.

(2) The sawed surface shall be heavily coated with red lead paint, after which it shall be covered with cotton duck, of at least 8-ounce weight, which shall be folded down over the sides of the pile and firmly secured thereto with large-headed roofing nails. The edges of the duck shall be trimmed to give a workmanlike appearance. The duck shall then be waterproofed by being thoroughly saturated and coated with one or more applications of red lead paint.

812.10 HOLES FOR BOLTS, DOWELS, RODS AND LAG SCREWS. Holes for round drift-bolts and dowels shall be bored with a bit 1/16 inch less in diameter than the bolt or dowel to be used. The diameter of holes for square drift-bolts, or dowels, shall be equal to the least dimension of the bolt, or dowel.

Holes for machine bolts shall be bored with a bit the same diameter as the bolt, except as otherwise provided.

Holes for rods shall be bored with a bit 1/16 inch greater in diameter than the rod.

Holes for lag screws shall be bored with a bit not

larger than the body of the screw at the base of the thread.

812.11 BOLTS AND WASHERS. A washer, of the size and type specified, shall be used under all bolt heads and nuts which would otherwise come in contact with wood.

The nuts of all bolts shall be effectually locked after they have been finally tightened.

812.12 COUNTERSINKING. Countersinking shall be done wherever smooth faces are required. Horizontal recesses formed for countersinking shall be painted with hot creosote oil, and, after the bolt, or screw, is in place, shall be filled with hot pitch.

812.13 FRAMING. All lumber and timber shall be accurately cut and framed to a close fit in such manner that the joints will have even bearing over the entire contact surfaces. Mortises shall be true to size for their full depth and tenons shall fit snugly. No shimming will be permitted in making joints, nor will open joints be accepted.

812.14 PILE BENTS. The piles shall be driven as indicated on the plans and in accordance with the applicable requirements of Section 804.

812.15 FRAMED BENTS.

(a) Mud Sills: Untreated timber used for mud sills shall be of heart cedar, heart cypress, redwood, or other durable timber. Mud sills shall be firmly and evenly bedded to solid bearing and tamped in place.

(b) Concrete Pedestals: Concrete pedestals for the support of framed bents shall be carefully finished so that the sills, or posts, will take even bearing on them. Dowels of not less than ¾-inch diameter and projecting at least 6 inches above the tops of the pedestals, shall be set in them when they are cast, for anchoring the sills or posts.

(c) Sills: Sills shall have true and even bearing on mud sills, piles or pedestals. They shall be drift-bolted to mud sills or piles with bolts of not less than ¾-inch diameter and extending into the mud

sills or piles at least 6 inches. When possible, all earth shall be removed from contact with sills so that there will be free air circulation around them.

(d) Posts: Posts shall be fastened to pedestals with dowels of not less than ¾-inch diameter, extending at least 6 inches into the post.

Posts shall be fastened to sills by one of the following methods, as indicated on the plans:

(1) By dowels of not less than ¾-inch diameter, extending at least 6 inches into posts and sills.

(2) By drift-bolts of not less than ¾-inch diameter driven diagonally through the base of the post and extending at least 9 inches into the sill.

(e) Design and Construction: Where framed structures will be subjected to earthquake, wind, tractive, or centrifugal loads, the connections between members thereof shall be so designed and constructed as to resist the forces resulting therefrom.

812.16 CAPS. Timber caps shall be placed, with ends aligned, in a manner to secure an even and uniform bearing over the tops of the supporting posts, or piles. All caps shall be secured by drift-bolts of not less than ¾-inch diameter, extending at least 9 inches into the posts or piles. The drift-bolts shall be approximately in the center of the post or pile.

812.17 BRACING. The ends of bracing shall be bolted through the pile, post, or cap with a bolt of not less than 5/8-inch diameter. Intermediate intersections shall be bolted, or spiked, with wire, or boat spikes, as indicated on the plans. In all cases, spikes shall be used in addition to bolts.

812.18 STRINGERS. Stringers shall be sized at bearings and shall be placed in position so that knots near edges will be in the top portions of the stringers.

Outside stringers may have butt joints with the ends cut on a taper, but interior stringers shall be lapped to take bearing over the full width of the floor beam, or cap, at each end. The lapped ends of untreated stringers shall be separated at least ½-inch for the

circulation of air and shall be securely fastened by drift-bolting where specified. When stringers are 2 panels in length, the joints shall be staggered.

Cross-bridging between stringers shall be neatly and accurately framed and securely toe-nailed with at least 2 nails in each end. All cross-bridging members shall have full bearing at each end against the sides of stringers. Unless otherwise specified in the contract, cross-bridging shall be placed at the center of each span.

812.19 PLANK FLOORS. Plank shall be of the grade required as specified. See Subsection 812.05.

Unless otherwise specified, they shall be surfaced 4 sides (S4S).

Single plank floors shall consist of a single thickness of plank supported by stringers, or joists. The planks shall be laid heart side down, with ¼-inch openings between them for seasoned material and with tight joints for unseasoned material. Each plank shall be securely spiked to each joist. The planks shall be carefully graded as to thickness and so laid that no 2 adjacent planks shall vary in thickness by more than 1/16-inch.

Two-ply timber floors shall consist of 2 layers of flooring supported on stringers, or joists. The lower course shall be pressure-treated with creosote oil. The top course may be laid either diagonal, or parallel to the centerline of roadway, as specified and each floor piece shall be securely fastened to the lower course. Joints shall be staggered at least 3 feet. If the top flooring is placed parallel to the centerline of the roadway, special care shall be taken to securely fasten the ends of the flooring. At each end of the bridge, these members shall be beveled.

812.20 LAMINATED OR STRIP FLOORS. The strips shall be of the grade required as specified. See Subsection 812.05. The strips shall be placed on edge at right angles to the centerline of roadway. Each strip shall be spiked to the preceding strip at each end and at approximately 18-inch intervals, with the spikes driven alternately near the top and bottom edges. The

spikes shall be of sufficient length to pass through 2 strips and at least half-way through the third strip.

If timber supports are used, every other strip shall be toe-nailed to every other support. The size of the spikes shall be as shown on the plans. When specified on the plans, the strips shall be securely attached to steel supports by the use of approved galvanized metal clips. Care shall be taken to have each strip vertical and tight against the preceding one, and bearing evenly on all the supports.

812.21 COMPOSITE WOOD-CONCRETE DECKS.

(a) Slab Spans: Where the tensile strength of wood and the compressive strength of concrete are to be used compositely, the joining of the 2 materials shall be such as to resist all horizontal shear at that plane, and provision shall be made to prevent separation of the materials.

The horizontal shear may be resisted by metal devices set into and projecting above the top of the laminated strips, or by fabricating the upper edge of the strips in a serrated manner.

Separation of the materials may be resisted by nails driven at an angle in the upper edge of the strips, or by certain suitable devices, or by grooves, or other working of upstanding strips.

(b) "T" Beams: Spans consisting of concrete slabs placed on wood stringers may be designed as "T" beams when the 2 materials are suitably joined so as to resist horizontal shear at their juncture and the materials are in some wise bonded permanently together.

A horizontal shear joint may be made using metal devices, or by a serrated working of the tops of the stringers.

Separation of the concrete from the stringers may be prevented by driving nails in the top of the stringers at an angle, or by other suitable metal devices, or by grooving the sides of the stringers near the top, or other working of the wood, and then forming the concrete into the pattern worked in the wood.

812.22 WHEEL GUARDS AND RAILING. Wheel guards and railing shall be accurately framed in accordance with the plans and erected true to line and grade.

Unless otherwise specified, wheel guards, rails and rail posts shall be surfaced four sides (S4S).

Wheel guards shall be laid in sections not less than 12 feet long.

812.23 TRUSSES. Trusses, when completed, shall show no irregularities of line. Chords shall be straight and true from end to end in horizontal projection and, in vertical projection, shall show a smooth curve through panel points conforming to the correct camber. All bearing surfaces shall fit accurately. Uneven or rough cuts at the points of bearing shall be cause for rejection of the piece containing the defect.

812.24 TRUSS HOUSINGS. The carpentry on truss housings shall be equal in all respects to the best house carpentry. The finished appearance of the housing is considered of primary importance and special care shall be taken to secure a high quality of workmanship and finish on this portion of the structure. Workmen wearing shoes with caulks will not be permitted on the roof.

812.25 ERECTION OF HOUSING AND RAILINGS. Unless otherwise directed, housing and railings shall be built after the removal of the falsework and the adjustment of the trusses to correct alignment and camber.

812.26 PAINTING. Rails and rail posts, untreated timber, or timber treated with preservative salts shall be painted with 3 coats of paint, as specified in Section 811.

Parts of the structure, other than rails and rail posts, which are to be painted, shall be designated on the plans, or in the special provisions.

Metal parts, except hardware, shall be given one coat of shop paint and, after erection, 2 coats of field paint, as specified in Section 811.

812.27 METHOD OF MEASUREMENT. The quantity

to be paid for shall be the number of thousand feet board measure of lumber and timber, complete in place and accepted. Measurements of lumber and timber will be computed from the net dimensions shown on the plans, unless changes in such dimensions have been authorized in writing by the engineer. The dimensions shown on the plans shall be interpreted as nominal sizes and shall be used in the computations. The measurement of timber will include only such timber as is a part of the completed and accepted work, and will not include timber used for erection purposes, such as falsework, bracing, sheeting, etc.

No measurement will be made for hardware required to construct the work in accordance with the plans.

Metal parts, not classified on the plans as "Hardware," will be measured as structural carbon steel (A 36) as provided in Subsection 807.58.

812.28 BASIS OF PAYMENT. The accepted quantities measured as provided above, shall be paid for at the contract unit price per thousand feet board measure for "Untreated Timber", or "Treated Timber", as the case may be, complete in place. Structural carbon steel (A 36) will be paid for as provided in Subsection 807.59.

Payment will be made under:

Item No.	Pay Item	Pay Unit
812(1)	Untreated Timber	MFBM
812(2)	Treated Timber	MFBM

Section 813

Concrete Approach Slabs

813.01 DESCRIPTION. This work shall consist of the construction of concrete approach slabs for bridges and overpasses, in accordance with the details, and at the locations and of the dimensions shown on the plans.

813.02 MATERIALS. Materials shall meet the requirements of the following applicable subsections of Part IX Materials.

Carbon Steel (A 36)	913.01
Asphalt Mineral Filler	905.01
Premoulded Joint Filler	905.02
Emulsified Asphalt	902.02
Deformed Reinforcing Steel	909.01

Concrete for approach slabs and bolster blocks, under approach slabs, shall be Class A meeting the applicable requirements of Section 805, or Portland Cement Concrete Pavement meeting the requirements of Section 601.

Cotton Seed Hulls shall be of a commercial type commonly purchased on the open market.

813.03 CONCRETE.

(A) Class "A" concrete shall be constructed in accordance with applicable requirements of Section 805.

(B) Portland Cement Concrete Pavement shall be constructed in accordance with the applicable requirements of Section 601.

813.04 REINFORCING STEEL. Reinforcing steel shall be placed in accordance with the applicable requirements of Section 806.

813.05 STRUCTURAL STEEL. When required by the plans, structural steel shall be Structural Carbon Steel (A 36), unless otherwise noted. Structural steel shall

be placed in accordance with the applicable requirements of Section 807.

813.06 BOLSTER BLOCKS. Bolster blocks, when required, shall be constructed in accordance with the requirements of these specifications and as indicated on the plans. The contractor shall place 3 layers of approved tar paper, or one coat of paint or heavy grease between the bolster block and the pavement slab and expansion joint adjacent to the approach slab, all as shown on the plans.

813.07 ROADWAY FINISH. The roadway finish shall be performed as specified in Subsection 601.15.

813.08 MUD PUMP CONNECTIONS. When mud pump connections are specified, they shall be placed as provided on the plans. In the event a metal cap is not fabricated, the contractor shall fill each connection with firmly packed earth to within 2 inches from the top, then fill the remainder of the hole with asphalt mineral filler.

813.09 EXPANSION JOINTS.

(a) Expansion joints of premolded joint filler or asphalt mineral filler shall be constructed in accordance with the details shown on the plans.

(b) Expansion joints requiring the use of cotton seed hulls and emulsified asphalt shall be constructed in reasonably close conformity with the details shown on the plans. The mixture shall be composed of approximately 0.9 gallon of Emulsified Asphalt, EA-4, per cubic foot of cotton seed hulls, measured loose. The mixture shall be permitted to age a minimum of 48 hours before use.

813.10 METHOD OF MEASUREMENT. Concrete approach slabs will be measured by the square yard, complete in place and accepted. The width for measurement will be the width from outside to outside of completed approach slab, as constructed in accordance with the plans or as directed by the engineer. The length will be the actual center line length measured along the riding surface from the centerline of joint adjacent to the bridge end to the beginning of

the roadway slab, and shall include the full width of expansion joints at the outer end of approach slab.

No measurement will be made of concrete in bolster blocks constructed under the approach slabs.

Reinforcing steel shall be measured as "Deformed Reinforcing Steel" as provided under Subsection 806.10.

Structural steel shall be measured as "Structural Carbon Steel (A 36)" as provided under Subsection 807.58.

813.11 BASIS OF PAYMENT. The accepted quantity of concrete approach slabs will be paid for at the contract unit price per square yard complete in place.

Payment will be made under:

Item No.	Item	Pay Unit
813(1)	Concrete Approach Slabs	Square Yard

Payment for reinforcing steel will be made under Item 806 (1), as provided under Section 806.11.

Payment for structural steel will be made under Item 807 (1), as provided under Subsection 807.59.

Section 814
Drilled Shaft Foundations

814.01 DESCRIPTION. This work shall consist of the construction of foundations of reinforced concrete shafts with or without bell type concrete footings. Concrete shafts shall be placed in drilled excavation when the shafts are without bell type footings and in drilled and under-reamed excavation when shafts are with bell type footings. Such foundations shall be constructed in accordance with these specifications and in conformance with the details and governing dimensions shown on the plans.

814.02 MATERIALS. All concrete materials and their preparations shall be in accordance with the requirements of Section 805. All concrete shall be Class "A" unless otherwise shown on the plans.

Reinforcing steel shall conform to the requirements of Section 806. The sizes and dimensions shall be as shown on the plans.

814.03 CONSTRUCTION METHODS.

(1) Excavation. The contractor shall do all excavation required for the shafts and bell footings, through whatever substances encountered, and to the dimensions and elevations shown on the plans or required by the site conditions. Unless otherwise shown on the plans, all shafts shall be bored plumb to a tolerance of 1½ inches for depths up to and including 10 feet plus an additional tolerance of 0.05 inch per foot for depths in excess of the first 10 feet. When bells are required, they shall be excavated so as to form a bearing area of the size and shape shown on the plans. Shafts and bells may be excavated either by hand or by mechanical methods. Blasting methods shall be used only with permission of the engineer and when used shall be so conducted as to avoid disturbance of the formations below or outside the limits of the proposed shaft concrete.

The plans indicate the expected depths and elevations at which satisfactory bearing material will be encountered, and this information will be used as a basis for the contract. If satisfactory foundation materials are not encountered at plan elevations, the footings may be raised or lowered as determined by the engineer. Alterations in plan depths shall be made as judged proper to satisfactorily comply with the design requirements.

Casings will be required for shaft excavations when such provision is necessary to prevent caving of the material or when necessary to shut off seepage water. Casings shall be of metal and of ample strength to withstand handling stresses, the pressure of concrete and of the surrounding earth or backfill materials, and shall be watertight. The inside diameter of casing shall not be less than the nominal size of shaft; otherwise, the size of casing and the size of drilled excavation in which the casing is to be placed will be left to the discretion of the contractor, except as noted below. No extra compensation will be allowed for the concrete required to fill an oversize casing or oversize excavation.

When the drilling operation reaches a point where caving conditions or excess ground water is encountered, no further drilling will be allowed until a construction method is employed which will prevent any caving that tends to make the excavation appreciably larger than the size of casing to be used. Drilling in a mud slurry without removal of cuttings, or other construction methods which will control the size of excavation, will be permitted.

If the elevation of the top of shaft is below ground level at the time of concrete placement, an oversize casing from ground elevation to a point below the top of the shaft shall be required to control caving of any material into the freshly placed concrete.

Any excavation for the footing bells or shafts beyond the lines required by the plan dimensions, where casings are not required, shall be backfilled

with Class "A" concrete at the contractor's expense. Where casings are used, the contractor will be permitted to backfill around the upper portion of the casing with pea gravel or other granular material. Where a double casing is required for a portion of the shaft, no material shall be placed between the casings, but this area will be filled with Class "A" concrete.

Under normal operations when the casing is to be removed, the removal shall not be started until all concrete placement is completed in the shaft. Movement of the casing for short pulls of a few inches, or rotating of the casing to insure the breaking of bond of the concrete to the casing will be permitted. When unusual conditions warrant, the casing may be pulled in partial stages. In all cases a sufficient head of concrete shall be maintained at all times above the bottom of the casing to overcome hydrostatic pressure. Extraction of the casing shall be at a slow, uniform rate and the pull shall be in a truly vertical direction. If any upward movement of the concrete or steel inside the casing occurs at any time during the pulling operation, the following criteria shall govern:

(a) If the upward movement is one inch or less, the casing may be left in place and the shaft used if the concrete is vibrated or rodded to reconsolidate the concrete. Vibration or rodding shall not be used to attempt to break the casing loose for extraction unless the entire shaft is to be replaced.

(b) If the upward movement is greater than one inch, all of the material shall be removed and the entire drilled shaft operation shall be redone.

Placing of drilled shaft concrete under water shall not be done without the permission of the engineer. If such permission is granted, underwater concrete shall be placed in accordance with Section 805 and limited to placement with a tremie.

Material excavated from shafts and bells and not used in the backfill around the completed bents or piers shall be disposed of as directed. The disposal

of such material shall be in such manner as not to obstruct the stream or otherwise impair the efficiency or appearance of the structure or other parts of the work.

At the time concrete is placed, the excavation shall be free from accumulated seepage water and all loose material shall be removed from the base area. The contractor shall provide suitable access and lighting for the engineer to inspect the completed foundation excavation and check the dimensions and alignment of drilled shafts and the under-reamed excavation when under-reaming is required.

At any time when a person is in the hole, provisions shall be made for pumping fresh air to the workman. Any required lighting shall be by electric lights. Any mechanical equipment used in the excavation shall be operated by air or electricity. The use of gasoline driven engines placed in the excavation for pumping or drilling will not be permitted.

In order that the engineer may judge the adequacy of a proposed foundation, the contractor, if requested, shall make soundings or take cores at his expense to determine the character of the supporting materials. The depth of such soundings or cores will not be required to exceed 5 feet below the proposed footing grade. It is the intent of this provision that soundings shall be made or cores taken at the time the excavation in each foundation is approximately complete.

When the plans require drilled shafts in the end bents, the embankment at the bridge ends shall be made to grade as shown and thoroughly compacted as provided in the governing specifications prior to drilling for end bent shafts.

(2) Reinforcing Steel. The reinforcing steel cage for the shaft consisting of longitudinal bars and spiral hooping or lateral ties shall be completely assembled and placed into the shaft as a unit. Generally, the reinforcing steel unit shall not be placed until immediately before concreting operations are to be started.

The longitudinal bars shall be tied or tack-welded to the spiral hooping at intervals not to exceed 12 inches on centers to provide a rigid unit.

For cased shafts where the reinforcing steel cage is over 30 feet in length, the longitudinal bars shall be tied or tack-welded at each intersection of the spiral hooping for a distance of L/5 from the bottom of the cage, where L is the length of the spiral cage.

The cage of reinforcing steel shall be supported from the top by some positive method, to prevent slumping downward during extraction of the casing.

In uncased shafts, side spacer blocks of concrete shall be used at intervals along the shaft to insure concentric spacing for the entire length of shaft. In cased shafts concrete spacer blocks shall not be used. Metal "chair" type spacers shall be placed vertically at intervals around the steel cage to insure concentric spacing inside the casing.

(3) Concrete. The work shall be performed in accordance with the provisions of Section 805 and in conformance with the requirements herein.

Preferably, concrete shall be placed immediately after all excavation is complete and reinforcing steel placed.

Concrete placing shall be continuous from the beginning of placing in the shaft or footing bell to the top of shaft or to construction joint as may be indicated on the plans. Time intervals will be allowed for pulling casings, for placing forms, and other operations necessarily carried on in sequence with the placing operations. The reinforcing steel cage shall be held vertical in some manner to restrain the steel from slumping during the concrete placement operation.

Concrete shall be placed through a suitable tube to prevent segregation of concrete materials and unnecessary splashing on the reinforcing steel cage. The tube shall be made in sections to permit the discharge and raising as the placement progresses. A non-jointed pipe may be used if sufficient open-

ings of the proper size are provided to allow for the flow of concrete into the shaft.

Wherever a casing is used, the casing shall be smooth and well oiled and shall extend sufficiently above the grade of the finished shaft to provide excess concrete to be placed for the anticipated slump due to the casing removal. Where a casing is to be pulled, the concrete placed in casing shall be of such workability as to require no vibrating or rodding.

Where a cap block or groundline strut is shown on the plans to be placed at the top of the drilled shaft, and the cap or strut is shown to be placed monolithic with the drilled shaft, a time interval will be allowed for placing the required form and reinforcing after any necessary casing removal.

After a placement is completed, the top surface shall be cured and any construction joint area shall be treated as prescribed in Section 805.

814.04 TEST HOLES. When shown on the plans, or when ordered by the engineer in writing, test holes will be required to establish elevations for "belling", to determine elevation of ground water, or to determine other soil characteristics.

The diameter and depth of test hole or holes shall be as shown on the plans or as directed by the engineer.

814.05 TEST BELLS. When shown on the plans, or when ordered by the engineer in writing, the underreaming of bells, on specified test holes, will be required to establish the ability to under-ream in the soil strata present.

The diameter and shape of the test bell shall be as shown on the plans or as directed by the engineer.

814.06 METHOD OF MEASUREMENT. Acceptable drilled shafts in place of the specified diameter will be measured by the linear foot. At interior bents and piers, shafts will be measured from a point 6 inches below the ground elevation at the center of shaft unless otherwise indicated on the plans. At high-

way grade separations and at railroad underpasses, the ground elevation shall be the completed roadway section under the structure. At stream crossings and at railroad overpasses, the ground elevation shall be considered as the elevation existing at the time drilling begins. At abutment bents the length of shaft shall be measured from the bottom of cap elevation.

Footing bells, constructed to the specified dimensions, or to the altered dimensions as authorized by the engineer will be measured by the cubic yard of concrete in the acceptable footings placed. The bell shall consist of the authorized footing volume outside the dimensions of the drilled shaft, which for the purpose of measurement will be considered as extending to the bottom of the bell.

Test holes of the specified diameter will be measured from the elevation of the ground at the time drilling begins, by linear foot of acceptable test hole drilled.

Test bells of the specified diameter and shape will be measured by each test bell acceptably underreamed.

814.07 BASIS OF PAYMENT. Drilled shafts will be paid for at the unit price bid per linear foot of the specified diameter of "Drilled Shafts", subject to the following limitations for overruns authorized by the engineer:

(1) Payment for individual completed shaft lengths up to and including 5 feet in excess of the maximum plan length shaft as defined herein, will be made at the unit price bid per linear foot of the specified diameter of "Drilled Shafts".

(2) Payment for that portion of individual completed shaft length in excess of 5 feet and up to and including 15 feet more than the maximum plan length shaft as defined herein, will be made at a unit price equal to 115 per cent of the unit price bid per linear foot of the specified diameter of "Drilled Shafts".

(3) Payment for individual completed shaft lengths

over 15 feet in excess of the maximum plan length shafts as defined herein, will be in accordance with Subsection 109.04.

(4) For extra depth drilling for interior bents and piers, the maximum plan length shaft will be considered to be maximum length shaft, regardless of diameter, for all interior piers and bents of all bridges included in the contract.

(5) For extra depth drilling for abutment bents, the maximum plan length shaft will be considered to be the maximum length shaft, regardless of diameter, for all abutment bents of all bridges included in the contract.

Footing bells, constructed to the specified dimensions or to the altered dimensions as authorized by the engineer, will be paid for at the contract unit price bid per cubic yard for "Bell Footings". Authorized increase in footing bell diameters beyond 3 times the nominal shaft diameter, unless specified on plans, shall be considered as beyond the scope and intent of these specifications, and payment for such increased footing bells shall be in accordance with Subsection 109.04.

Test holes, of the specified diameter, will be paid for at the contract unit price bid per linear foot for "Test Hole".

Test bells, of the specified diameter, will be paid for at the contract unit price bid for each "Test Bell".

Test holes or test bells required by the engineer, but not otherwise specified by the contract plans, will be paid for in accordance with Subsection 109.04.

The foregoing unit prices shall be full compensation for making all excavations, for drilling all test holes and test bells, doing any necessary pumping, placing, and removing any required casings, furnishing, and placing all concrete and reinforcing steel except as noted below and all backfilling. Where the bottom of drilled shaft is ordered to be placed at an elevation below plan grade and a splice of reinforcement is required, payment will be made at the unit

price per pound for "Reinforcing Steel" for the extra reinforcement required to make one 20 diameter lap splice per bar. No extra payment will be made for casings left in place.

Payment will be made under:

Item No.	Pay Item	Pay Unit
814(1)	Drilled Shaft (Diameter)	Linear Foot
814(2)	Bell Footing	Cubic Yard
814(3)	Test Hole (Diameter)	Linear Foot
814(4)	Test Bell (Diameter)	Each

PART IX
MATERIALS

PREFACE

Unless otherwise specifically stated in these specifications, on the plans or in the special provisions all sampling methods and testing methods shall be in accordance with the following documents; precedence shall be in the order as written:

FIRST—Louisiana Department of Highways "Materials Sampling Manual" and "Testing Procedures Manual".

SECOND—"American Association of State Highway Officials" (AASHO).

THIRD—"American Society for Testing Materials" (ASTM).

Section 901
Portland Cement

901.01 PORTLAND CEMENT. Cement shall conform to the requirements of the following specifications for the type specified or permitted.

Type	Specifications
Portland Cement	AASHO M 85
Masonry Cement	AASHO M 150

Different brands or types of cement, or the same brand or type of cement from different mills, shall not be mixed during use nor shall they be used alternately unless permitted.

The contractor shall provide suitable means for storing and protecting cement against dampness and contamination. Cement which, for any reason, has become partially set or which contains lumps of caked cement shall be rejected. Cement salvaged from discarded or used bags shall not be used.

Section 902

Bituminous Materials

902.01 GENERAL. All storage tanks, piping, retorts, booster tanks, distributors and other equipment used in delivering, storing or handling asphalt cement shall be kept clean and in good operating condition at all times and shall be operated in such manner as to avoid any possible contamination of the contents with foreign materials.

902.02 ASPHALT CEMENT. Asphalt cement of the specified grade shall meet the requirements contained in Table I.

All testing of asphalt cement, unless otherwise directed, shall be in accordance with the test methods given in Table I.

902.03 EMULSIFIED ASPHALT. Emulsified asphalt of the specified grade shall meet the requirements contained in Tables II and III.

All testing of emulsified asphalt, unless otherwise directed, shall be in accordance with the test methods given in Tables II and III.

902.04 CUTBACK ASPHALT. Cutback asphalt of the specified grade shall meet the requirements contained in Table IV.

All testing of cutback asphalt, unless otherwise directed, shall be in accordance with the test methods given in Table IV.

902.05 UNDERSEALING ASPHALT. Undersealing asphalt shall meet the requirements contained in Table V.

All testing of undersealing asphalts, unless otherwise directed, shall be in accordance with the test methods given in Table V.

TABLE I

ASPHALT CEMENT

Test Method		AC 3	AC 5	AC 7	AC 8
Penetration @ 77° F, 100g, 5 Sec.	AASHO T 49	60-70	85-100	120-150	150-200
Flash Point, C.O.C. °F.	AASHO T 48	450+	450+	425+	425+
Thin Film Oven Test, Loss % @ 325° F, 5 hrs.	AASHO T 179	0.80—	1.00—	1.30—	1.50—
Penetration of Residue % Original @ 77° F 100 g. 5 sec.	AASHO T 49	60+	57+	53+	50+
Solubility in CS_2	AASHO T 44	99.5+	99.5+	99.5+	99.5+
Homogeneity Test	AASHO T 102	Neg.	Neg.	Neg.	Neg.

TABLE II

ANIONIC EMULSIFIED ASPHALTS

	Test Method	RS-1 (EA-1) Min.	RS-1 (EA-1) Max.	RS-2 (EA-2) Min.	RS-2 (EA-2) Max.	MS-2 (EA-4) Min.	MS-2 (EA-4) Max.
Viscosity, SSF at 77° F	AASHO T 59	20	100	-----	-----	100	-----
at 122° F	AASHO T 59	-----	-----	75	400	-----	-----
Residue by Distillation, %	AASHO T 59	57	-----	62	-----	62	-----
Settlement, 5 days, %	AASHO T 59	-----	3	-----	3	-----	3
Demulsibility							
35 ml, of 0.02 N, $CaCl_2$, %	AASHO T 59	60	-----	50	-----	-----	-----
Cement Mixing	AASHO T 59	-----	-----	-----	-----	-----	2
Adhesion	LDH TR 311	-----	-----	-----	-----	75	-----
Sieve Test, % (Retained on No. 20)	AASHO T 59	-----	0.10	-----	0.10	-----	0.10
Tests on Residue:							
Penetration @ 77° F, 100 g, 5 sec.	AASHO T 49	100	200	100	200	100	200
Solubility, %, CCl_4	AASHO T 44[1]	97.5	-----	97.5	-----	97.5	-----
Ductility, @ 77° F, cm.	AASHO T 51[2]	40	-----	40	-----	40	-----

[1]Except that CCl_4 is used instead of CS_2, as solvent. Method No. 1, AASHO T 44.
[2]Residue shall first be screened through a No. 50 mesh sieve while still hot and kneaded until uniform and homogenous.

TABLE III

CATIONIC EMULSIFIED ASPHALTS

		Rapid Setting (Application Grade) RS-3K		Medium Setting (Mixing Grade) SM-K	
	Test Method	Min.	Max.	Min.	Max.
Viscosity, SSF at 122° F	AASHO T 59	100	400	50	500
Residue by Distillation, %	AASHO T 59	65	.....	60	.....
Oil Distillate by Volume, %	AASHO T 59[1]	.....	5	.....	20
Particle Charge	LDH TR 311	Positive		Positive	
Sieve Test, % (Retained on No. 20)	AASHO T 59[2]	.....	0.10	.....	0.10
Adhesion, Wet Gravel Coating, % Coated	ASTM D 244	.....	.....	60	.....
Settlement, 5 days %	AASHO T 59	.....	3	.....	3
Tests on Residue:					
Penetration at 77° F, 100 g, 5 sec.	AASHO T 49	100	250	100	250
Solubility, % CCl_4	AASHO T 45	97.0	.....	97.0	.....
Ductility, @ 77° F, cm.	AASHO T 51[3]	80	.....	40	.....
Viscosity SSF @ 275° F	ASTM E 102	125	.....	.....	.....

[1]The oil portion of distillate, by volume shall be expressed as a percentage of the total volume of the emulsion.
[2]Use distilled water in all operations of AASHO T 59 for this test instead of 2% Sodium oleate solution.
[3]Ductility to be tested at 77° F for 80-200 penetration or at 60° F for 200-250 penetration. Residue shall first be screened through a No. 50 mesh sieve while still hot and kneaded until uniform and homogenous.

TABLE IV

CUTBACK ASPHALT

	Test Method	MC-30		MC-70		MC-250		RC-70		RC-250		RC-800	
		Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.
Flash Point Open Tag, ° F	AASHO T 79	100	.....	100	.....	150	.....	.....	.....	80	.....	80	.....
Viscosity, SSF	AASHO T 72												
@ 77° F, sec		75	150	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
@ 140° F, sec.		.....	.....	35	70	125	250	35	70	125	250	400	800
Distillation test, distillate, percentage by volume of total distillate to 680° F;	AASHO T 78												
to 374° F		.....	.....	.....	.....	.....	.....	10	.....	.....	.....	.....	.....
to 437° F		.....	25	.....	20	.....	10	50	.....	35	.....	15	.....
to 500° F		40	70	20	60	15	55	70	.....	60	.....	45	.....
to 600° F		75	93	65	90	60	87	85	.....	80	.....	75	.....
Residue from distillation to 680° F; percentage volume by difference		50	.....	55	.....	67	.....	55	.....	65	.....	75	.....
Tests on Residue:													
Penetration @ 77° F, 100 g., 5 sec.	AASHO T 49	120	250	120	250	120	250	80	120	80	120	80	120
Ductility @ 77° F, for residues of less than 200 pen.: @ 77° F, cm.	AASHO T 51	100	.....	100	.....	100	.....	.....	.....	.....	.....	.....	.....
Ductility @ 77° F, cm.	AASHO T 51	.....	.....	.....	.....	.....	.....	100	.....	100	.....	100	.....
Ductility @ 60° F, for residues of 200-300 pen. @ 77° F, cm.	AASHO T 51	100	.....	100	.....	100	.....	.....	.....	.....	.....	.....	.....
Solubility % CCl_4	AASHO T 45	99.5	.....	99.5	.....	99.5	.....	99.5	.....	99.5	.....	99.5	.....

TABLE V

UNDERSEALING ASPHALT

	Test Method	
Softening Point (Ring & Ball), °F	AASHO T 53	160°-200°
Penetration of Original Sample:		
At 32° F, 200g., 60 sec.	AASHO T 49	10+
At 77° F, 100g., 5 sec.	AASHO T 49	15-40
At 115° F, 50g., 5 sec.	AASHO T 49	90—
Ductility at 77° F, cms.	AASHO T 51	2+
Flash Point (Cleveland Open Cup) °F	AASHO T 48	425+
Solubility CCl_4 %	AASHO T 44*	99.0
Loss @ 325° F, 5 hrs., %	AASHO T 47	1.0—
Penetration of residue % of original	AASHO T 49	70+

General Requirements

The asphalt shall be prepared by the refining of petroleum. It shall be uniform in character and shall not foam when heated to 350° F.

*Except that carbon tetrachloride is used instead of carbon disulphide as solvent, Method No. 1 in AASHO Method T 44.

Section 903

Aggregates

903.01 GENERAL. This section covers the specifications for aggregates in general use by the Department.

In order to determine the acceptability of these materials it will be necessary to perform all of the applicable tests, on each sample submitted, as specified, with the following modifications:

(a) Los Angeles abrasion test and Soundness test, where specified, shall be run on each new source. Periodic tests shall be run thereafter, except that, when the material is questionable, tests shall be run.

The abrasion and soundness tests shall be in accordance with AASHO Designation: T 96 and T 104 of the Testing Procedures Manual.

A permanent record of these test results, on each source, shall be maintained at the Department's Central Laboratory.

When submitting samples of aggregates for testing it is essential that the supplier and geographical source of the material be given.

(b) Tests for deleterious substances shall be run only when it is evident by observation that the sample is contaminated, except that it is required to run the colorimetric test on each sand sample submitted for a mix design.

903.02 FINE AGGREGATE. This specification covers fine aggregate for Portland cement concrete of all classes and types, and for mortar.

Sand shall consist of clean, hard, durable grains, graded from coarse to fine; it shall be substantially free from lumps of clay and all vegetable or other deleteriouse substances. The maximum percentages

of deleterious substances shall not exceed the following values:

	Per Cent (By Weight)
Material Passing the No. 200 Sieve	3.0
Coal or lignite	0.25
Clay lumps	0.5

Fine Aggregate shall be uniformly graded from coarse to fine and shall conform to the following grading requirements:

Sieve Size	Per Cent Passing (By Weight)
3/8"	100
No. 4	95 to 100
No. 16	45 to 90
No. 50	7 to 30
No. 100, not more than	7
SAND FOR MORTAR:	
No. 8	100
No. 50	15 to 40
No. 100	0 to 10

Fine aggregate subjected to the colorimetric test for organic impurities and producing a color darker than the Reference Standard Color Solution, shall be subjected to the mortar strength test before acceptance.

Strength: Fine aggregate when subjected to the mortar strength test, shall show a strength of 95 per cent of the reference mortar.

The test for determining the amount of material passing the No. 200 sieve shall be made prior to and on the same sample as is used for sieve analysis.

Tests shall be in accordance with the following procedures of the Testing Procedures Manual:

Material Passing No. 200 Sieve	AASHO T 11
Colorimetric Test	AASHO T 21
Clay Lumps	AASHO T 112
Sieve Analysis	AASHO T 27
Mortar Strength Test	AASHO T 71
Coal and Lignite	AASHO T 113

903.03 COARSE AGGREGATE FOR CONCRETE. Coarse aggregate shall consist of gravel, crushed stone, crushed slag, or a combination of gravel and crushed stone, or light-weight aggregate.

(a) Gravel, crushed stone, crushed slag, or a combination of gravel and crushed stone:

Crushed slag aggregate shall be used for paving concrete only and shall be thoroughly clean and reasonably free from an excess of thin or elongated pieces or frozen lumps. It shall show a per cent loss of not more than 40 by the Los Angeles abrasion test. The crushed slag shall weigh not less than 75 pounds per cubic foot. Because of its high absorption property, slag in stock piles shall be kept uniformly wet.

All gravel shall consist of clean, tough, durable stone of high resistance to abrasion, reasonably free of clay coating of any character. "Run of Bank" gravel or gravel which contains disintegrated or soft stone or shale, or excess of flat pieces shall not be used. The gravel shall show a per cent loss of not more than 40 by the Los Angeles abrasion test.

When subjected to 5 cycles of the magnesium sulfate soundness test the weighted loss shall not exceed 15 per cent.

The maximum amounts of deleterious substances shall be as follows:

	Test Method	Per Cent by Weight
Removed by Elutriation	AASHO T 11	1.0
Clay Lumps	AASHO T 112	0.5
Soft Fragments	AASHO T 189	5.0
Iron Ore (Included in soft fragments) Max. retained 3/4 in—0.5% Max. passing 3/4 in—1.0%		1.5
Coal and Lignite	AASHO T 113	1.0
Sticks (wet)		0.25
Totals, clay lumps, soft fragments, coal and lignite, and sticks shall not exceed		5.0

Aggregate used in hand rails shall be free from lignites

Crushed stone shall be obtained from clean, tough, sound, durable stone. The particles of stone shall be reasonably free from dust, vegetable or other deleterious matter, and shall show a per cent loss of not more than 40 by the Los Angeles abrasion test. Not more than 3 per cent of the stone by weight shall be removed by washing over a number 8 sieve.

The weighted loss shall not exceed 15 per cent when subjected to 5 cycles of the magnesium sulfate soundness test.

All coarse aggregate (gravel and/or crushed stone or crushed slag) shall be graded from coarse to fine, and when tested in accordance with AASHO Designation: T 27 as contained in the Testing Procedures Manual shall meet one of the following gradation requirements:

	Per Cent Passing (By Weight)			
U. S. Seive	Grade A	Grade B	Grade D	Grade E
2½''	.....	.....	100	*
2''	.....	100	90 to 100	
1½''	100	85 to 100	.....	
1''	90 to 100	.....	40 to 80	
¾''	40 to 88	40 to 88	.....	
½''	15 to 55	.....	.....	
No. 4	0 to 6	0 to 6	0 to 6	

*Graduation of Grade E Aggregate is given below.

For Grade E Mix the smaller size or larger size coarse aggregate may consist of either gravel or crushed stone conforming to the quality requirements of these specifications.

The individual grading of the 2 sizes of coarse aggregate shall be combined to meet the following gradation requirements:

GRADE E

U. S. Sieve	Per Cent (By Weight)
Passing 2½''	100
Passing 2½'' retained on 1½''	25 to 40
Passing 1½'' retained on ¾''	20 to 45
Passing ¾'' retained on Number 4	20 to 35
Passing No. 4, not more than	5

Unless written permission is obtained from the engineer, the individual sizes of coarse aggregate will be restricted as follows: The smaller size coarse aggregates for Grade E shall not have more than 10 per cent retained on the one inch sieve, not less than 5 per cent retained on the ¾ inch and not more than 8 per cent passing No. 4. The larger size coarse aggregate for Grade E shall have 45 to 60 per cent retained on the 1½ inch sieve and shall not have more than 20 per cent passing the one inch sieve.

(b) Lightweight Coarse Aggregate: This specification covers lightweight coarse aggregate intended for use in structural concrete for which prime considerations of the concrete are lightness in weight, suitable compressive strength, durability, and constancy of volume.

The 2 general types of lightweight coarse aggregate are: aggregate prepared by expanding clay or shale by the rotary kiln process, or aggregate prepared by crushing, screening and cleaning natural lightweight materials such as pumice, scoria, or tuff.

In order for a source of lightweight aggregate to be approved, preliminary samples shall be submitted for testing at least 110 days prior to anticipated use. All tests described herein shall be performed on the preliminary sample. Thereafter, only the tests for gradation, unit weight, and fineness modulus will be performed for job control. However, a routine production sample will be taken each month as long as material is being supplied to jobs being constructed for or by the Department, and all tests described herein will be performed. These samples will be taken from a stockpile or from a particular days run. However, if samples are taken from a days run, the responsibility of shipping material to a job which may fail the long range tests will be upon the supplier. All testing shall be in accordance with LDH Designation: TR 107.

Grading.

(1) Lightweight aggregate shall be graded from coarse to fine, and shall meet the following gradation requirements:

PER CENT PASSING—U. S. SIEVES (By Weight)

Grade	3/4 in.	1/2 in.	3/8 in.	No. 4	No. 8
Y	100	90 to 100	40 to 70	0 to 15	0 to 5

(2) Uniformity of Grading. Samples of coarse aggregate representing the normal product of the plant shall be furnished by the producer for acceptance tests. Other samples shall be taken from shipments at intervals stipulated by the engineer. If the fineness modulus of the aggregate in any shipment differs by more than 7 per cent from that of the sample submitted for acceptance tests, the aggregate in the shipment may be rejected.

Unit Weight.

(1) The unit weight of lightweight coarse aggregate shall not exceed 55 pounds per cubic foot, dry loose measurement.

(2) Uniformity of Weight. If the unit weight of any shipment of lightweight coarse aggregate differs by more than 10 per cent from that of the sample submited for acceptance tests, the aggregate in the shipment may be rejected.

Durability. The loss of lightweight coarse aggregate in 5 cycles of the accelerated soundness test shall not be greater than 10 per cent when magnesium sulfate is used. In lieu of this sulfate soundness test, a freezing and thawing test may be made on concrete prepared with the aggregate. The mix design shall be as directed by the engineer. Concrete having a cement factor of 6.0, 7.0 or 8.0 bags per cubic yard shall, after 300 cycles of freezing and thawing, have a durability factor of at least 75, 80 or 85 respectively. Intermediate values may be obtained by interpolations.

Abrasion Resistance. Lightweight coarse aggregate shall show an abrasion loss of not more than 40 per cent by the Los Angeles abrasion test.

Concrete Making Properties. Concrete specimens prepared with light weight coarse aggre-

gate and concrete sand shall have the following properties or meet the following requirements.

(1) Compressive Strength and Unit Weight. Concrete cylinders, 6 inches in diameter by 12 inches high, prepared with plastic concrete having unit weights not exceeding those given in the following table, shall at an age of 28 days have at least the minimum compressive strength and not more than the maximum dry unit weights shown. Intermediate values for unit weight and corresponding values for strength may be obtained by interpolation.

COMPRESSIVE STRENGTH AND UNIT WEIGHT OF CONCRETE

Plastic, Max. lbs. per Cu. Ft.	Dry, Max. lb. per Cu. Ft.	Compressive Strength 28 days, Min., psi
120	115	4000
115	110	3000

(2) Drying Shrinkage. The drying shrinkage of concrete specimens prepared and tested in accordance with Paragraph 2(i)-(1) of LDH Designation: TR 107 shall not exceed 0.10 per cent or as tested in accordance with Paragraph 2(i)-(2) of LDH Designation: TR 107 shall not exceed 0.07 per cent.

903.04 BASE COURSE AGGREGATES.

(a) Sand Clay Gravel. Sand clay gravel shall be composed of either a natural mixture of sand, clay and gravel, or an artificial mixture prepared by either the mixing of washed sand gravel and binder; washed gravel or crushed stone, sand and binder; or by the addition of washed gravel or crushed stone to natural sand clay gravel.

The mixture as determined by visual inspection shall be reasonably free from vegetable or other injurious matter.

When tested in accordance to test methods AASHO Designations: T 11 and T 27 of the Testing Proce-

dures Manual, combined materials shall meet the following requirements:

U. S. Sieve	Per Cent Passing (By Weight) Grade A	Grade B
2½"	100	100
1½"	85 to 100	85 to 100
No. 4	40 to 60	50 to 75
No. 40	20 to 45	20 to 50
No. 200	10 to 20	12 to 25

The fraction of sand clay gravel passing the No. 40 sieve, when tested in accordance with test methods AASHO Designations: T 89 and T 90 of the Testing Procedures Manual, shall show the following physical characteristics:

	Grade A	Grade B
Liquid Limit (Maximum)	25	25
Plasticity Index (Maximum)	6	6

In the event either Grade "A" or Grade "B" is to be used for cement stabilization, the maximum allowable liquid limit will be 35 and the maximum allowable plasticity index will be 12.

As a matter of information, but not limitation, the contractor is advised that the several materials may be combined in approximately the following proportions:

	Grade A	Grade B
Gravel or Crushed Stone, per cent	45	35
Sand, per cent	40	47½
Binder, per cent	15	17½

However, the exact proportion by volume shall be determined in the laboratory from test samples to be furnished.

Washed gravel used in preparing an artificial mixture shall conform to the requirements of Subsection 903.05(a).

Washed sand gravel used in preparing an artificial mixture shall conform to the requirements of Subsection 903.05(b).

The binder material used either for preparation of

an artificial mix or as an additive to pit run sand clay gravel, and shall not have a plasticity index in excess of the plasticity index indicated above for the terminal product.

Crushed stone used in preparing an artificial mixture shall conform to the requirements of Subsection 903.05(c).

(b) Clam and Reef Shell. Shell shall consist of either a natural or artificially prepared mixture of dead clam and dead reef shell. The shell shall be reasonably free from objectionable matter such as sticks, mud, clay lumps or other foreign materials. However, foreign matter such as clay and silt as determined by LDH Designation: TR 109, as contained in the Testing Procedures Manual, will be permitted in an amount not exceeding 10 per cent by weight when dry, provided such material is dispersed throughout the mass and provided also that the plasticity index of the completed mix shall not exceed 6 and the liquid limit shall not exceed 25 when tested in accordance with AASHO Designations: T 89 and T 90 of the Testing Procedures Manual.

The shell base shall be composed of a mixture of 65 per cent clam and 35 per cent reef shell by volume. A tolerance of plus or minus 10 per cent will be permitted. In the event that a natural mixture of clam shell and reef shell is used, any variations of the mixture outside the above limits shall be corrected by the addition of clam or reef shell, as the case may be, meeting the following requirements:

Clam shell shall meet the requirement of Subsection 903.05(d).

Reef shell shall consist of dead oyster shell and shall not contain cannery or live shell and shall be thoroughly washed over a screen the mesh of which shall not be smaller than ¼ inch. The foreign matter content, as determined by LDH Designation: TR 109 shall not exceed 10 per cent by weight when dry.

(c) Reef shell and sand. The reef shell and sand

shall consist of either a natural or artificial mixture composed of 65 per cent reef shell and 35 per cent sand. A tolerance of plus or minus 5 per cent will be permitted in the shell or sand.

The reef shell may be either whole or crushed, and shall be reasonably free from objectionable matter such as sticks, mud, clay and other deleterious substances; in no event shall the foreign matter content, as determined by LDH Designation: TR 109, exceed 10 per cent by weight when dry.

Sand shall consist of loam, sandy loam, or sand of a siliceous nature, which when tested by AASHO Designations: T 11 and LDH Designation: TR 423 of the Testing Procedures Manual, shall meet the following gradation requirements:

U. S. Sieve	Per Cent Passing (By Weight)
No. 40	65 to 100
No. 200	10 to 60

The sand shall not contain more than a total of 4 per cent by weight of grass and other foreign matter. When tested by AASHO Designations: T 89 and T 90 of the Testing Procedures Manual, the sand shall meet the following physical characteristics:

Liquid Limit (Maximum)	25
Plasticity Index (Maximum)	6

The materials in the mix when combined and tested by AASHO Designations: T 89 and T 90 of the Testing Procedures Manual, shall show the following physical characteristics.

Liquid Limit (Maximum)	25
Plasticity Index (Maximum)	6

(d) Clam Shell and Sand. The clam shell and sand shall consist of either a natural or artificial mixture composed of 65 per cent clam shell and 35 per cent sand. A tolerance of plus or minus 5 per cent will be permitted in the shell or sand.

The clam shell may be either whole or crushed, and shall be reasonably free from objectional matter

such as sticks, mud, clay and other deleterious substances; in no event shall the foreign matter content as determined by LDH Designation: TR 109 exceed 10 per cent by weight when dry.

Sand shall meet the requirements for same contained in (c) hereinabove.

The materials in the mix when combined and tested by AASHO Designations: T 89 and T 90 of the Testing Procedures Manual, shall show the following physical characteristics.

Liquid Limit (Maximum)	25
Plasticity Index (Maximum)	6

(e) Clam and reef shell and sand. The clam and reef shell and sand shall consist of either a natural or artificial mixture composed of 35 per cent clam shell, 30 per cent reef shell and 35 per cent sand. A tolerance of plus or minus 5 per cent in the total shell or the sand will be permitted.

The clam shell shall meet the requirements of same contained in Subsection 903.05(d).

The reef shell shall meet the requirements for same contained in (c) hereinabove.

Sand shall meet the requirements for same contained in (c) hereinabove.

The materials in the mix when combined and tested by AASHO Designations: T 89 and T 90 of the Testing Procedures Manual, shall show the following physical characteristics.

Liquid Limit (Maximum)	25
Plasticity Index (Maximum)	6

903.05 SURFACE COURSE AGGREGATES.

(a) Washed gravel. Washed or screen gravel shall consist of hard, durable particles of stone graded from coarse to fine, reasonably free of sticks and other deleterious matter, and when tested in accordance with AASHO Designation: T 27 of the Testing Procedures Manual, shall meet the following requirements:

U. S. Sieve	Per Cent Passing (By Weight)
1½"	95 to 100
No. 4	0 to 15
Clay & Silt (By AASHO T 11)	2 per cent maximum

Washed gravel, when tested by the Los Angeles abrasion test, shall show a per cent loss of not more than 45.

(b) Washed Sand Gravel. Washed or screened sand gravel shall consist of clean, hard, durable particles of stone uniformly graded in size from coarse to fine, reasonably free of sticks and other deleterious matter, and when tested in accordance with AASHO Designations: T 11 and T 27 of the Testing Procedures Manual, shall meet the following requirements:

U. S. Sieve	Per Cent Passing (By Weight)
1½"	95 to 100
No. 4	25 to 40
No. 100	0 to 8
Clay and Silt (By AASHO T 11)	3 per cent maximum

Washed sand gravel, when tested by the Los Angeles abrasion test, shall show a per cent loss of not more than 45.

(c) Crushed Stone. Crushed stone shall consist of fragments of hard, durable particles of stone, excluding schist, shale or slate, showing a per cent loss of not more than 45 by the Los Angeles abrasion test, containing not more than 5 per cent of soft, friable material, and shall be free from an excess of flat or elongated pieces. When tested by AASHO Designation: T 27 of the Testing Procedures Manual, the material shall meet the following requirements:

U. S. Sieve	Per Cent Passing (By Weight)
1½"	95 to 100
¾"	65 to 95
No. 4	0 to 15

(d) Clam Shell. The shell shall consist of dead clam shell, thoroughly washed over a screen, the mesh

of which shall not be smaller than ¼ inch. The foreign matter content, as determined by LDH Designation: TR 109 of the Testing Procedures Manual, shall not exceed 10 per cent by weight when dry.

(e) Sand Clay Gravel. Sand clay gravel shall meet the requirements of Subsection 903.04(a) with the following exceptions:

The fraction passing the No. 40 mesh sieve (either grade), when tested by AASHO Designations: T 89 and T 90 of the Testing Procedures Manual, shall meet the following physical characteristics:

Liquid Limit (Maximum)	35
Plasticity Index (Maximum)	10

The binder material used either for preparation of an artificial mix or as an additive to pit run sand clay gravel, shall not have a plasticity index in excess of the plasticity index indicated above for the terminal product.

When tested by the Los Angeles abrasion test, sand clay gravel shall show a per cent loss of not more than 45.

(f) Reef Shell. The reef shell shall be either whole, crushed, or a combination thereof, and shall be reasonably free from objectionable matter such as sticks, mud, clay and other deleterious substances; in no event shall the foreign material content as determined by LDH Designation: TR 109 of the Testing Procedures Manual, exceed 10 per cent by weight when dried.

(g) Binder. Binder shall meet the requirements for sand in Subsection 903.04(c) except that the maximum allowable liquid limit shall be 35 and the maximum allowable plasticity index shall be 10.

903.06 Bituminous Surface Treatment Aggregates. Aggregates for bituminous surface treatment may be uncrushed gravel, crushed aggregate (gravel, stone or slag), a combination of crushed and uncrushed gravel, or expanded clay aggregate.

Crushed Gravel. Crushed gravel shall consist of

clean, tough, durable stone and shall be crushed and screened to conform to the gradation specified. A minimum of 80 per cent of the crushed gravel retained on the No. 10 sieve shall have one or more fractured faces. Crushed gravel shall not show an abrasion loss of more than 40 per cent by the Los Angeles abrasion test and shall show a soundness loss of not more than 15 per cent by weight when subjected to 5 cycles of magnesium sulfate soundness test.

Crushed stone. Crushed stone shall consist of clean, tough, sound, durable particles of stone. The particles of stone shall be reasonably free from dust, vegetable or other deleterious matter and shall not show an abrasion loss of more than 40 per cent by the Los Angeles abrasion test. The stone shall be reasonably free from an excess of flat or elongated particles and shall show a soundness loss of not more than 15 per cent by weight when subjected to 5 cycles of the magnesium sulfate soundness test.

Crushed Slag. Crushed slag shall be air-cooled, blast furnace slag, and shall consist of angular fragments reasonably uniform in density and quality and reasonably free from flat or elongated particles, dirt or other deleterious substances. The slag shall not contain more than 10 per cent by weight of glassy particles. The crushed slag shall have a weight per cubic foot of not less than 70 pounds. Slag shall show an abrasion loss of not more than 40 per cent by the Los Angeles abrasion test.

Uncrushed Gravel. This aggregate shall consist of uncrushed gravel. The gravel shall be clean, tough, durable stone reasonably free from sticks and clay coating. Gravel shall be reasonably free from an excess of flat or elongated particles of stone and shall show an abrasion loss of not more than 40 per cent by the Los Angeles abrasion test and shall show a soundness loss of not more than 15 when subjected to 5 cycles of magnesium sulfate soundness test.

Expanded Clay Aggregate. This aggregate shall be manufactured by the rotary kiln process and shall

consist of angular fragments reasonably uniform in density and reasonably free from flat or elongated particles or other deleterious substances. Expanded clay aggregate shall show an abrasion loss of not more than 40 per cent by the Los Angeles abrasion test. The soundness loss shall not exceed 10 per cent by weight when subjected to 5 cycles of the magnesium sulfate soundness test using No. 4 to 3/8 inch and 3/8 inch to 3/4 inch size aggregate.

All the above types, when tested with laboratory sieves, shall conform to the gradation requirements specified for the various sizes in Table VI.

TABLE VI

Per Cent Passing (By Weight)

U. S. Sieve	Coarse Aggregate Size 1	Fine Aggregate Size 2	Seal Coat Aggregate Size 3
1"	100	----------	----------
3/4"	90 to 100	----------	----------
1/2"	20 to 55	100	----------
3/8"	0 to 15	85 to 100	100
No. 4	0 to 5	10 to 30	85 to 100
No. 8	----------	0 to 10	10 to 40
No. 16	----------	0 to 5	0 to 10
No. 50	----------	----------	0 to 5

903.07 AGGREGATES FOR ASPHALTIC CONCRETE.

(a) Type 1 Mixture: The aggregate shall consist of crushed gravel, crushed stone, crushed slag, sand and mineral filler, or a combination of these materials, conforming to the graduation requirements contained in Table VII. These materials shall meet the following requirements:

Crushed gravel shall consist of clean, hard, tough, durable stone fragments and shall be screened and crushed to sizes as necessary to meet the grading requirements specified herein. Gravel shall not show an abrasion loss of more than 40 per cent by the Los Angeles abrasion test, and shall show a soundness loss of not more than 15 per cent by weight, when subjected to 5 cycles of magnesium sulfate soundness test. Crushed stone stall consist of clean,

hard, tough, durable fragments, reasonably free from flat, elongated, soft or disintegrated pieces, dirt, or other objectionable matter. Crushed stone shall not show an abrasion loss of more than 40 per cent by the Los Angeles abrasion test and shall show a soundness loss of not more than 15 per cent by weight when subjected to 5 cycles of magnesium sulfate soundness test.

Crushed slag shall be air-cooled, blast furnace slag, and shall consist of angular fragments reasonably free from flat or elongated pieces, dirt or other objectionable matter. Crushed slag shall not show an abrasion loss of more than 40 per cent by the Los Angeles abrasion test. The slag shall not contain more than 10 per cent by weight of glassy particles and the crushed slag shall have a minimum dry weight of 70 pounds per cubic foot.

Sand shall consist of clean, hard, durable grains, graded from coarse to fine, and shall be reasonably free from vegetable matter or other deleterious substance. The fraction passing the No. 40 sieve shall be non-plastic.

The sand equivalent value of the fraction passing No. 4, of the fine bin, shall not be less than 35.

For Type 1 Mixes, a minimum of 50 per cent of the material passing the No. 200 sieve shall be mineral filler as set forth in the job mix. In no event shall the fraction of mineral filler be less than 2 per cent of the mixture.

Mineral filler shall consist of limestone dust, hydrated lime, silica dust, shell dust, Portland cement, or cement stack dust.

The blending of pulverized anhydrous calcium sulfate (anhydrite) with the above mineral fillers will be permitted provided the anhydrite does not constitute more than 30 per cent of any blend with one or more of the other approved fillers.

The quantity of anhydrite in a blended filler shall be determined by LDH Designation: TR 501.

The anhydrite shall not be contaminated with clay

or other plastic mineral matter and shall conform in all respects to the requirements applying to mineral fillers in general.

That portion of the pulverized anhydrite passing the No. 200 standard sieve shall not constitute more than 25 per cent of the total material passing the No. 200 sieve, including natural fines, in any bituminous paving mixture.

Anhydrite shall not constitute more than 2 per cent of the total aggregate, including all sizes, for any bituminous paving mixture.

The cement stack dust shall consist of material collected from waste rotary kiln gases discharged through a collector of a cement plant.

Limestone dust, silica dust, shell dust, cement stack dust, or a blend of one of these fillers with anhydrite dust or a blend of anhydrite with hydrated lime or Portland cement, shall be obtained from sources approved by the laboratory and shall meet the following gradation requirements.

U. S. Sieve	Per Cent Passing (By Weight)
No. 30	100
No. 80	95 to 100
No. 200	70 to 100
No. 270	60 to 100

Whenever anhydrite blended filler or cement stack dust is proposed for use in bituminous mixtures, the laboratory shall prepare periodically mixtures of aggregate filler and asphalt in the proportions required to meet the job mix formula and this mixture shall have an index of retained Marshall stability of 75 percent or more as determined by LDH Designation: TR 313.

After approval of the source and preliminary samples of limestone, silicia, shell dust or cement stack dust is furnished for mineral filler for the project, the laboratory, in an effort to expedite the release of shipments, will approve individual shipments on sieve analysis only.

Whenever Portland cement or hydrated lime is used, tests for gradation requirements will not be made.

(b) Type 2 Mixture: The aggregate shall consist of whole clam shell, crushed clam shell, sand and, if required, mineral filler, or a combination thereof; or graded or crushed reef shell, sand and, if required, mineral filler, conforming to the gradation requirements contained in Table VII. These materials shall meet the following requirements:

Shell shall consist of dead clam shell or dead reef shell. It shall be reasonably free from objectionable material such as sticks or coating of mud or other foreign matter. However, foreign matter such as sand, silt or clay will be permitted in an amount not exceeding 5 per cent by weight when dry, as determined by LDH Designation: TR 109, provided such material is dispersed throughout the mass.

Sand and mineral filler shall meet the requirements for these materials contained in (a) hereinabove.

(c) Type 3 Mixture: The aggregate shall consist of the following:

(1) Wearing Course Mixture-Crushed stone, sand and mineral filler conforming to the gradation requirements given in Table VII.

(2) Binder Course—The aggregate shall be the same as Type 1 binder course, described in paragraph (a) of this Subsection, conforming to the gradation requirements given in Table VII.

(3) Base Course—Crushed or uncrushed gravel, crushed stone, crushed slag, or a combination of these materials, sand and mineral filler conforming to the gradation requirements given in Table VII.

All materials for Type 3 mixes shall meet the following requirements:

Crushed and uncrushed gravel and slag shall conform to the requirements given in paragraph (a) of this subsection.

Crushed stone as described in ASTM Designation:

C 125 shall meet the requirements given in paragraph (a) and shall be well graded from coarse to fine.

The sand and the mineral filler shall meet the requirements given in paragraph (a). Type 3 wearing and base course mixture shall have a minimum of 2 per cent mineral filler. The binder course shall meet the requirements given for Type 1 mixture, paragraph (a).

(d) Type 4 Mixture: The aggregate shall consist of expanded clay aggregate, sand, and when required, mineral filler, conforming to the gradation requirements contained in Table VII. These materials shall meet the following requirements.

Expanded clay aggregate shall be manufactured by the rotary kiln process and consist of angular fragments reasonably uniform in density and reasonably free from flat or elongated pieces, or other deleterious substances. Expanded clay aggregate shall not show an abrasion loss of more than 40 per cent by the Los Angeles abrasion test. The expanded clay aggregate shall have a dry weight per cubic foot of not more than 67 pounds. The loss on soundness shall not exceed 10 per cent after 5 cycles by the magnesium sulfate soundness test.

Sand and mineral filler shall conform with the requirements for these materials contained in (a) hereinabove.

(e) All the properties listed in the preceding sections shall be tested using the following test procedures as contained in the Testing Procedures Manual.

LDH Designation: TR 102	Method of Test for Sieve Analysis of Mineral Filler
AASHO Designation: T 27	Method of Test for Sieve Analysis of Fine and Coarse Aggregates
AASHO Designation: T 96	Method of Test for Abrasion of Coarse Aggregate by Use of the Los Angeles Machine

TABLE VII

Type	1		2	3			4
	WC	BC	WC & BC	WC	BC	Base	WC & BC
U. S. Sieve	Per Cent Passing (By Weight)						
1-1/2"	----------	----------	----------	----------	----------	100	----------
1-1/4"	100	100	----------	----------	100	----------	----------
1"	100	90-100	100	100	90-100	80-100	----------
3/4"	100	75-100	90-100	85-100	75-100	70-95	100
1/2"	90-100	55-90	80-100	70-95	55-90	55-85	85-100
3/8"	80-100	----------	----------	----------	----------	----------	----------
No. 4	55-80	35-60	50-80	45-70	35-60	35-60	55-85
No. 10	35-60	20-45	35-65	30-55	20-45	20-45	35-75
No. 40	15-40	10-30	15-40	15-40	10-30	10-30	20-55
No. 80	8-25	5-25	10-25	8-25	5-25	5-25	10-30
No. 200	4-12	2-10	4-12	4-12	2-10	2-10	4-15
Bitumen, %	4.5-7.0	3.5-6.0	4.5-7.5	3.5-7.0	3.0-6.0	3.0-6.0	5.0-10.0
Mineral Agg., %	93.0-95.5	94.0-96.5	92.5-95.5	93.0-96.5	94.0-97.0	94.0-97.0	90.0-95.0
% Crushed Retained on #4	75 min.	60 min.	----------	80 min.	60 min.	As needed	----------

NOTE: The aggregate gradation based on the composite weight of the aggregate and the proportions by weight of the mineral aggregate and bituminous material and various type mixtures shall be as above.

AASHO Designation: T 104	Method of Test for Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate
AASHO Designation: T 176	Method of Test for Sand Equivalent
LDH Designation: TR 306	Percentage of Crushed Particles in Extracted Aggregate
LDH Designation: TR 307	Bitumen Content by Reflux Extractor
LDH Designation: TR 308	Bitumen Content by Centrifuge
LDH Designation: TR 309	Mechanical Analysis of Extracted Aggregate
AASHO Designation: T 89	Methods of Determining Liquid Limit of Soils
AASHO Designation: T 90	Methods of Determining the Plastic Limit of Soils and of Calculating the Plasticity Index of Soils
LDH Designation: TR 104	Method of Test for Per Cent of Oil in Fine Aggregate

Section 904
Masonry Units

904.01 SEWER BRICK. Sewer brick may be made from clay or shale or may be concrete meeting the following requirements.

Brick made from clay or shale shall meet the requirements of AASHO Designation: M 91. Brick for use in inlets, pipe junctions, catch basins, arches, manholes, and for backings, shall be Grade NA.

Concrete brick shall meet the requirements of ASTM Designation: C 139 except that the minimum thickness of each unit shall not be less than 3 5/8 inches.

904.02 BUILDING BRICK.

(a) Building brick made from clay or shale for use in brick masonry shall conform to the requirements of AASHO Designation: M 114, Grade SW.

(b) Concrete building brick for use in masonry buildings shall conform to the requirements of ASTM Designation: C 55, Grade A.

904.03 CONCRETE BUILDING BLOCK. Concrete hollow load-bearing building block shall conform to the requirements of ASTM Designation: C 90.

Section 905
Joint Materials

905.01 POURED FILLERS.

(a) Hot Poured Elastic Type. Hot poured elastic type sealer is intended for sealing joints in concrete pavements, bridges and other structures and shall conform to the requirements of AASHO Designation: M 173.

(b) Asphalt Mineral Filler. Asphalt mineral filler shall be homogeneous and shall be composed of bitumen and mineral filler. The bitumen shall be free from impurities. The asphalt mineral filler shall conform to the following requirements:

	Test Method	Min.	Max.
Softening Point Ring and Ball, °F	AASHO T 53	125	145
Penetration at 32° F, 200g., 1 min.	AASHO T 49	15	.....
Penetration at 77° F, 100g., 5 sec.	AASHO T 49	50	70
Ductility at 77° F, cm.	AASHO T 51	15	.....
Bitumen Soluble in Carbon Disulphide, %	AASHO T 44	45	55
Mineral Filler, %	AASHO T 44	45	55
Water	AASHO T 55	.....	2

(c) Polysulfide-Base Joint Sealing Compound (Cold applied). The joints shall consist of a 3-component system composed of a flexible primer, and a premoulded polyurethane foam seat and a polysulfide elastomer wearing and weathering surface conforming to ASA-A116.1 Specifications.

The adhesive primer shall be based on an epoxy adhesive capable of providing an effective seal for concrete and other porous surfaces. It shall also contain bonding properties capable of bonding the joint surfaces with foam seat and the elastomer into an integral unit under an extension or compression of 200 per cent.

The premoulded foam seat shall be moisture resistant and resistant to any damage that may be caused by extreme temperature changes. It shall provide a uniform height of bed for the poured elastomer. The

premoulded foam seat shall be 50 per cent greater in uncompressed width than the joint to be filled.

The polysulfide elastomer wearing and weathering surface shall provide a durable seal which is moisture resistant and resistant to damage that may be caused by extreme temperature changes.

The supplier of the joint material shall submit to the engineer a certified test report covering each shipment to the project. The test report shall certify that the composition of the polysulfide elastomer and the adhesive primer are in accordance with the the specifications and it shall give the actual values of pot life, tack free time and bond strength of the adhesive primer. The report shall also show the values of pot life and curing time for the polysulfide elastomer.

905.02 PREFORMED FILLERS.

(a) Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types): This specification covers preformed strips which have been formed from cane or other suitable fibers of a cellular nature, securely bound together and uniformly saturated with a suitable bituminous binder, or strips which have been formed from clean granulated cork particles securely bound together by a suitable bituminous binder and encased between 2 layers of bituminous saturated felt.

The type shall be as specified and shall conform to the requirements of ASTM Designation: D 1751.

(b) Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction (Nonextruding and Resilient Nonbituminous Types): This specification covers preformed expansion joint filler of the following types:

Type I	Sponge Rubber
Type II	Cork, and
Type III	Self-Expanding Cork

The type shall be as specified and shall conform to the requirements of ASTM Designation: D 1752.

(c) Preformed Expansion Joint Filler for Concrete (Bituminous Type): This specification covers bituminous preformed expansion joint filler consisting of bituminous (asphalt or tar) mastic composition, formed and encased between 2 layers of bituminous impregnated felt. The preformed filler shall conform to the requirements of ASTM Designation: D 994.

(d) Preformed Compression Joint Seal for Concrete:

(1) Seal: The joint seal shall be an approved preformed, elastic polychloroprene joint seal, which shall be compatible with concrete and steel, and shall be resistant to abrasion, oxidation, oils, gasoline, salt and other substances that may be spilled on or applied to the surface.

The seal shall be so shaped and installed that at minimum opening, it shall be so completely compressed as to be substantially solid and have a minimum of air spaces. It shall also be so shaped that in its compressed condition the center of the roadway face shall be depressed below the adjacent areas of the installed seal. The seal shall be furnished in sufficient number of widths to accomplish this kind of closure. Width of preinstalled joint seal shall be determined on the basis of a temperature range of 20° F to 120° F.

The seal shall conform to the following ASTM requirements and in addition must be compounded using the low crystallizing polychloroprene base.

The seal shall be marked "Top" at intervals of 15 feet.

The Preformed Compression Joint Seal shall conform to the specification requirements using ASTM procedures as a method of testing.

Property	ASTM Test Procedure	Transverse or Longitudinal Requirement
Tensile Strength, psi, Min.	D-412	2000
Elongation at Break, % Min.	D-412	250
Hardness Type A Durometer	D-676	55±5
Permanent Set at Break, % Max.	D-412	10
Compression Set, % Max.	D-395 Method B.	
22 Hrs./158° F.	Paragraph 5(b)	15
70 Hrs./212° F.		40

Oven Aging, 70 Hrs./212° F	D-573	
Tensile Strength, Change Max. %		—30
Elongation, Change, Max. %		—40
Hardness, Points Change, Max.		+10
Oil Swell,		
Oil No. 3, 70 Hrs./212° F	D-471	
Volume Change, Max. %		+80
Ozone Resistance, 20% Strain	D-1149	
300 pphm in air 70 Hrs./100° F (Wipe with solvent to remove surface contamination)		No Cracks
Low Temp. Stiffening	D-1053	
Temperature to reach 10,000 psi modulus, Min. ° F		—30

All test sections used in the testing methods, shall be cut and buffed from the actual extruded compression joint seal. Each lot of the joint seal shall be identified with the manufacturer's name or trade mark and shall be accompanied by the manufacturer's affidavit attesting conformance with the specification.

(2) Lubricant-Adhesive: The lubricant-adhesive shall conform to the following requirements:

The lubricant-adhesive shall be a one component polychloroprene compound containing only soluble phenolic resins blended together with anti-oxidents and acid acceptors in an aromatic hydrocarbon solvent mixture and shall have the following physical properties:

Average net weight per gallon—7.84 lbs., ± 5%.
Solids content—24-26% by weight.
Brookfield Viscosity @ 77° F, # 2 Spindle at 10 RPM—7,000-7,500 cps.
The adhesive shall remain fluid from 5° F to 120° F.
Film strength (ASTM D 412)—2,300 min. tensile strength, 750% min. elongation before breaking.

Test specimens composed of 2 pieces of 0.064 gauge 6061 aluminum alloy bonded together with

the adhesive on a joint 1″ wide with ½″ lap and aged 14 days shall show the following minimum strength when tested by the laboratory:

Dynamic Strength	1,300 psi @ 70° F 1,300 psi @ 0° F
Static (1 Minute)	700 psi @ 70° F 700 psi @ 0° F

Each lot of the adhesive shall be delivered in containers plainly marked with the manufacturer's name or trade mark and date of manufacture and shall be accompanied by the manufacturer's affidavit attesting conformance with this specification.

905.03 WOOD FILLERS. Wood filler shall be furnished to dimensions specified on the plans and shall meet the requirements of AASHO Designation: M 90, with the following exceptions: Other species of wood, meeting the specifications, may be used in lieu of redwood.

Wood filler furnished for expansion joints and construction joints shall conform to the above requirements.

Wood filler furnished for dummy joints shall conform to the above requirements except the test for compression and weight per cubic foot will not be required.

905.04 JOINT MORTAR. Pipe joint mortar shall consist of one part Portland cement and 2 parts approved sand with water as necessary to obtain the required consistency. Mortar shall be used within 30 minutes after its preparation.

905.05 RUBBER GASKETS. The rubber gaskets for use in pipe joints shall conform to the requirements of AASHO Designation: M 198.

Each pipe manufacturer or supplier shall furnish certified test reports covering each shipment of gaskets to the Department stating that the gasket conform in all respects to the above specifications.

905.06 JOINT MATERIAL FOR APPROACH SLABS. Expansion Joint material for approach slabs shall be composed of a mixture of approximately 0.9 gallons of

EA-4 Emulsified Asphalt conforming to the requirements of Subsection 902.03, Table II, per one cubic foot of cotton seed hulls. (One cubic foot of hulls weighs approximately 10.5 pounds measured loose).

905.07 FLEXIBLE PLASTIC GASKET. The gasket sealing the joint shall be produced from blends of refined hydrocarbon resins and plasticizing compounds reinforced with inert mineral filler, and shall contain no solvents. The gasket joint sealer shall not depend on oxidizing, evaporating, or chemical action for its adhesive or cohesive strength, and shall be supplied in extruded rope form of suitable cross section and of such size as to fill the joint space when the pipes are laid. The gasket joint sealer shall be protected by a suitable removable 2-piece wrapper. The 2-piece wrapper shall be so designed that ½ may be removed longitudinally without disturbing the other half.

Flexible plastic gasket shall meet the requirements as stated in the following table:

Composition	Test Method	Typical Analysis Min.	Typical Analysis Max.
Bitumen (petroleum plastic content)	ASTM D 4	50	70
Ash-Inert Mineral Matter	AASHO T 111	30	50
Volatile Matter	ASTM D 6	....	2.0

Property	Test Method	Typical Analysis Min.	Typical Analysis Max.
Specific Gravity @ 77° F	ASTM D 71	1.20	1.35
Ductility @ 77° F (cm)	ASTM D 113	5.0	....
Softening Point	ASTM D 36	320° F	....
Penetration 32° F (300 gms) 60 sec.	ASTM D 217	75	....
77° F (150 gms) 5 sec		50	120
115° F (150 gms) 5 sec		....	150
Flash Point C.O.C. °F	ASTM D 92	600	....
Fire Point C.O.C. °F	ASTM D 92	625	....

Section 906

Concrete, Clay, Asbestos-Cement and Bituminized Fiber Pipe

906.01 NON-REINFORCED CONCRETE PIPE. Non-reinforced or plain concrete sewer pipe shall be of the size specified, and shall conform to the requirements of ASTM Designation: C 14.

906.02 REINFORCED CONCRETE PIPE. These specifications cover concrete pipe for use in the construction of pipe culverts, storm drains, and/or sanitary sewers.

All reinforced concrete pipe furnished shall conform to the requirements of ASTM Designation: C 76 amended as follows:

(a) Unless otherwise specified, Class III Reinforced Concrete Pipe, Wall B (Table III), shall be furnished.

(b) When extra strength pipe is required, Class IV Reinforced Concrete Pipe, Wall B (Table IV), shall be furnished.

(c) When pipe test specimens meet all compression and crushing strength test requirements, the absorption test requirements for concrete will be waived.

906.03 PERFORATED CONCRETE PIPE. Perforated concrete pipe shall be of the size specified and shall conform to the requirements of ASTM Designation: C 444.

906.04 CONCRETE DRAIN TILE. Concrete drain tile shall be of the Class and size specified and shall conform to the requirements of ASTM Designation: C 412.

906.05 POROUS CONCRETE PIPE. Porous concrete pipe shall be of the size specified and shall conform to the requirements of AASHO Designation: M 176.

906.06 REINFORCED CONCRETE PIPE (Vitrified Clay

Lined). Design for fully lined or half lined pipes of the specified strength and class shall be submitted by the manufacturer for approval.

The applicable requirements of Subsection 906.02 and AASHO Designation: M 65 shall govern. Liner or liner element, shall be clay of first quality, sound, thoroughly and perfectly burned, without warps, cracks, or other imperfections, and fully and smoothly salt glazed.

906.07 CLAY DRAIN TILE. Clay drain tile shall be of the size and class as specified and shall conform to the requirements of ASTM Designation: C 4.

906.08 CLAY SEWER PIPE (Standard Strength). Standard strength clay sewer pipe shall be of the size as specified, and shall conform to the requirements of ASTM Designation: C 13.

906.09 CLAY PIPE (Extra Strength). Extra strength clay pipe shall be of the size as specified and shall conform to the requirements of ASTM Designation: C 200.

906.10 CLAY PIPE PERFORATED (Standard and Extra Strength). Perforated clay pipe shall be of the size and strength class as specified, (Class I or Class II), and shall conform to the requirements of ASTM Designation: C 211.

906.11 VITRIFIED CLAY PIPE JOINTS USING MATERIALS HAVING RESILIENT PROPERTIES. Vitrified clay pipe having joints manufactured with resilient type jointing materials shall conform in every respect to ASTM Designation: C 425. The manufacturer shall supply certified test reports covering the jointing materials, when tested according to ASTM Designation: D 543.

906.12 ASBESTOS-CEMENT NON-PRESSURE SEWER PIPE. Asbestos-cement non-pressure sewer pipe shall be of the size and class as specified and shall conform to the requirements of ASTM Designation: C 428.

906.13 ASBESTOS-CEMENT PERFORATED PIPE. Asbestos-cement perforated pipe shall be of the size

as specified and shall conform to the requirements of AASHO Designation: M 189.

906.14 RUBBER RINGS FOR ASBESTOS-CEMENT PIPE. Rubber or synthetic rubber rings used for coupling asbestos-cement pipe shall be of the type specified and shall conform to the requirements of ASTM Designation: D 1869.

The manufacturer shall supply the Department with certified test reports covering the rubber or synthetic rubber rings.

906.15 HOMOGENOUS BITUMINIZED FIBER DRAIN AND SEWER PIPE. This pipe shall be of the size as specified and shall conform to the requirements of ASTM Designation: D 1861.

906.16 LAMINATED-WALL BITUMINIZED FIBER DRAIN AND SEWER PIPE. This pipe shall be of the size as specified and shall conform to the requirements of ASTM Designation: D 1862.

906.17 PERFORATED BITUMINIZED FIBER PIPE. This pipe shall be of the size as specified and shall conform to the requirements of AASHO Designation: M 177. Unless otherwise specified, either Type I or Type II couplings may be furnished.

906.18 REINFORCED CONCRETE ARCH CULVERT, STORM DRAIN AND SEWER PIPE. These specifications cover reinforced arch-shaped concrete pipe of sizes equivalent to 18 to 108-inch circular concrete pipe to be used for the conveyance of sewage, industrial waste, and storm water and for the construction of culverts.

The class of pipe shall be as specified in the contract and shall conform to the requirements of ASTM Designation: C 506.

906.19 REINFORCED CONCRETE ELLIPTICAL CULVERT, STORM DRAIN AND SEWER PIPE. These specifications cover reinforced elliptically shaped concrete pipe of sizes equivalent to 18 to 108-inch circular concrete pipe to be used for the conveyance of sewage, industrial waste and storm water, and for the construction of culverts.

Pipe designed for placement with the major axis

horizontal shall be designated as "Horizontal Elliptical Pipe." Pipe designed for placement with the major axis vertical shall be designated as "Vertical Elliptical Pipe."

The class of pipe shall be as specified in the contract and shall conform to ASTM Designation: C 507.

906.20 BITUMINIZED FIBER DRAIN AND SEWER PIPE. This pipe shall be of the size as specified and shall conform to the requirements of AASHO Designation: M 158.

Section 907
Metal Pipe

907.01 CAST IRON PIPE FOR CULVERTS. This pipe shall conform to the requirements of ASTM Designation: A 142, for the specified diameters and strength classes. Unless otherwise specified, either smooth, corrugated or ribbed pipe may be furnished. Pipe of diameter in excess of 48 inches shall conform to the ASA standard for Cast Iron Pit Cast Pipe for the specified diameter and strength class.

907.02 CAST IRON PRESSURE PIPE. Cast iron pressure pipe suitable for carrying gas, water and other liquids under pressure shall be as specified on the plans and shall conform to the applicable requirements of ASTM Designation: A 377.

907.03 CAST IRON SOIL PIPE AND FITTINGS. Cast iron soil pipe and fittings shall be as specified on the plans and shall conform to the applicable requirements of ASTM Designation: A 74.

907.04 BLACK AND HOT-DIPPED ZINC-COATED (GALVANIZED) WELDED AND SEAMLESS STEEL PIPE FOR ORDINARY USES. Steel pipe for ordinary uses shall be as specified on the plans and shall conform to the applicable requirements of ASTM Designation: A 120.

907.05 WELDED AND SEAMLESS STEEL PIPE PILES. Pipe piles shall be of the class specified and shall conform to the applicable requirements of ASTM Designation: A 252.

907.06 CORRUGATED METAL PIPE AND PIPE ARCH. These conduits and the coupling bands shall be of the dimensions and gages specified and shall conform to the requirements of AASHO Designation: M 36 for the specified sectional dimensions and gages. Shop-formed elliptical pipe and shop-strutted pipe shall be furnished where specified. Special sections, such as elbows and flared end sections, for these conduits

shall be of the same gage as the conduit to which they are joined, and shall conform to the applicable requirements of AASHO Designation: M 36.

907.07 BITUMINOUS COATED CORRUGATED METAL PIPE AND PIPE ARCH. These conduits and the coupling bands shall conform to the requirements of AASHO Designation: M 190 for the specified sectional dimensions, gages and type of bituminous coating. Coupling bands shall be fully coated with bituminous material. Shop-formed elliptical pipe and shop-strutted pipe shall be furnished where specified.

907.08 ASBESTOS BONDED CORRUGATED METAL PIPE AND PIPE ARCH. Asbestos-bonded corrugated metal pipe shall be fabricated from asbestos bonded sheets. The requirements for base metal, spelter coating, rivets, sampling, testing, brands, corrugations, end finish, bands, and workmanship shall conform to the applicable sections of AASHO Designation: M 36.

Both sides of the metal sheets shall be coated with a layer of asbestos fibers applied by pressing a sheet of asbestos fiber into the molten metallic bonding medium. Immediately after the metallic bond has solidified, the asbestos fibers shall be thoroughly impregnated with a bituminous saturant. The finished sheets shall be of first-class commercial quality free from blisters and unsaturated spots.

907.09 STRUCTURAL PLATE FOR PIPE, PIPE ARCH AND ARCH. This material shall conform to the requirements of AASHO Designation: M 167.

907.10 CORRUGATED METAL PIPE FOR UNDERDRAIN. This pipe shall conform to the requirements of AASHO Designation: M 136 for the specified diameters. Unless otherwise specified, any of the 4 types may be furnished.

907.11 BITUMINOUS COATED CORRUGATED METAL PIPE FOR UNDERDRAIN. This pipe shall conform to the requirements of AASHO Designation: M 136 and shall be coated with bituminous material to meet requirements of AASHO Designation: M 190, Type A coating, except that minimum coating thickness shall be

0.03 inch. Coupling bands shall be fully coated. The specified minimum diameter of perforations shall apply after coating.

907.12 CORRUGATED ALUMINUM PIPE AND PIPE ARCH. Corrugated aluminum pipe and pipe arch shall be of the dimensions and gages specified and shall conform to the requirements of AASHO Designation: M 196.

907.13 CORRUGATED ALUMINUM PIPE FOR UNDERDRAIN. This pipe shall conform to the requirements of AASHO Designation: M 197 for the specified diameters. Unless otherwise specified, any of the 4 types may be furnished.

907.14 BITUMINOUS COATED CORRUGATED ALUMINUM PIPE AND PIPE ARCH. The corrugated aluminum pipe and pipe arch shall meet the requirements of Subsection 907.12. Bituminous coating shall conform to the applicable requirements of AASHO Designation: M 190, Type A.

907.15 BITUMINOUS COATED CORRUGATED ALUMINUM PIPE FOR UNDERDRAIN. The corrugated aluminum pipe for underdrains shall conform to Subsection 907.13. Bituminous coating shall conform to the applicable requirements of AASHO Designation: M 190, Type A, except that the minimum coating thickness shall be 0.03 inch. Coupling bands shall be fully coated. The specified minimum diameter of perforations shall apply after coating.

Section 908

Paints

908.01 GENERAL.

(a) Packaging: All paints covered by these specifications shall be delivered in containers not larger than 5 gallon capacity, unless otherwise specified. Used containers will not be permitted unless they have been reconditioned and thoroughly cleaned.

(b) Identification: Each paint container shall bear a label with the following information thereon: Name and address of the manufacturer, trade name or trade mark, kind of paint, number of gallons, batch number, purchaser's order number and project number.

(c) Sampling: A one quart sample shall be taken at random from any or all deliveries. Acceptance or rejection of shipments of paint will be based on the analyses of these samples. If sample is taken by the manufacturer or contractor, it shall be accompanied by a notarized certificate that states the sample represents the material to be used or shipped. Also list the batch number, purchase order number, number of gallons and project number.

The contractor shall therefore secure necessary paint in ample time so that no delay to the work will be caused by the time necessarily used in testing for which 21 days should be allowed from the time the sample is collected by the inspector.

908.02 RED LEAD PAINT. Red lead paint shall conform to the requirements of AASHO Designation: M 72, Type II, except that the first field coat shall be tinted with one ounce of lamp black, paste form, to one gallon of finished paint. The lamp black shall be incorporated by the manufacturer.

908.03 WHITE READY-MIX PAINT. White Paint shall conform to the requirements of AASHO Designation: M 70, Type I, Class A.

908.04 ALUMINUM PAINT. Aluminum paint shall conform to the requirements of AASHO Designation: M 69.

908.05 FOLIAGE GREEN BRIDGE PAINT. This paint shall conform to the requirements of AASHO Designation: M 67.

908.06 BLACK BRIDGE PAINT. This paint shall conform to the requirements of AASHO Designation: M 68.

908.07 ZINC CHROMATE-IRON OXIDE READY-MIXED PAINT. This paint shall conform to the requirements of AASHO Designation: M 142.

908.08 LAMP BLACK. This material shall conform to the requirements of ASTM Designation: D 209.

908.09 PROTECTIVE COATING.

(a) Protective Coating—Non-Emulsified Type.

(1) General Requirements. This is a black, self-priming, heavy duty protective coating suitable for use when unusually severe corrosive conditions are encountered. As received, it is a heavy paste or plastic-like material. However, on stirring, it thins out to brushing or spraying consistency without the use of thinners of any kind. On standing, after stirring, it returns to its original paste-like state. It can be applied to steel, concrete or masonry surfaces in exceptionally thick films without sag.

(2) Composition. Non-Emulsified type coating is composed of a tar base pitch blended with selected solvents to a heavy paste-like consistency. Natural asphalt or petroleum shall not be used as one of the constituents.

(3) Specifications. This material shall conform to the following detailed requirements by the indicated method of test.

Test	Requirement	Method
1. Sag Test	No Sag	Applied at a rate of 60 sq. ft. per gallon to a smooth metal surface.
2. Ash, % by weight	15-25	Ignition
3. Distillation % by Wt.		ASTM D 20
0-150° C (302° F)	0	
0-235° C (455° F)	20-30	
Distillation Residue Softening Point, ° F	205-240	ASTM D 36
Penetration at 77° F, 100 g., 5 sec.	5-25	ASTM D 5

(4) Surface preparation and rate of application shall be in accordance with the manufacturer's recommendations.

(b) Protective Coating—Emulsified Type.

(1) General Requirements. This is a thick heavy duty cold applied protective coating of the water emulsion type. It may be applied to metal or concrete surfaces by means of brush, roller, or suitable spray equipment. The coating must be applied heavily in all cases and multiple coats are desirable. It may only be applied at atmospheric temperatures in excess of 45° F and in dry weather. This type can be successfully applied over the non-emulsified type, which has thoroughly dried.

(2) Composition. Emulsified type coating is comprised of an aromatic hydrocarbon base derived from coal tar and inert mineral filler dispersed in water to produce a stable colloidal suspension. It contains no volatile solvent or asphalt, either petroleum or natural. The winter grade, however, contains an antifreeze to stabilize the emulsion during cold weather shipment, and should be ap-

plied in enclosed areas only with adequate ventilation.

(3) Specifications. This material shall conform to the following detailed requirements by the indicated method of test:

	Test	Requirement	Method
1.	Consistency	Smooth, homogeneous paste suitable for brush, roller, or spray application.	Visual Examination
2.	Weight per gallon, pounds	9.5-10.5	Weighing Cup
3.	Ash, % by Weight	15-25	Ignition
4.	Water, % by weight Maximum	50	AASHO T 55
5.	Sag Test	No Sag	50 sq. ft. per gal. on a vertical smooth, primed metal surface.

(4) Surface preparation and rate of application shall be in accordance with the manufacturer's recommendations.

Section 909

Reinforcing Steel and Wire Rope

909.01 REINFORCING STEEL. Reinforcing Steel shall conform to the requirements of the following specifications:

Billet-Steel Bars for Concrete Reinforcement .....ASTM A 15

Rail-Steel Bars for Concrete Reinforcement .....ASTM A 16

Axle-Steel Bars for Concrete Reinforcement .....ASTM A 160

Fabricated Steel Bar or Rod Mats for Concrete Reinforcement .....ASTM A 184

Welded Steel Wire Fabric for Concrete Reinforcement .....ASTM A 185

Bar reinforcement for Concrete Structures shall be deformed bars except that No. 2 bars need not be deformed.

Minimum deformation requirements for deformed reinforcing steel shall be according to ASTM Designation: A 305.

Steel for all bars shall be made by one or more of the following processes: Open-hearth, electric furnace, or Bessemer. If the basic Bessemer process is used, the phosphorus content shall not exceed 0.05 per cent.

Spiral reinforcing shall be plain bars and may be either intermediate, hard or structural grade conforming to ASTM Designation: A 15, or cold drawn wire conforming to ASTM Designation: A 82 with the following amendment: For material testing over 110,000 psi tensile strength in special high strength applications such as spirals and ties, the 25 per cent minimum reduction in area shall be reduced 5 per cent

for each 10,000 minimum psi increment of tensile strength exceeding 110,000. There shall be no requirement for determination of yield strength.

909.02 TIE BARS. Tie bars shall conform to the requirements of ASTM Designations: A 15, A 16 or A 160, except that rail steel or axle steel shall not be used for tie bars that are to be bent and re-straightened during construction. Tie bars shall be deformed bars.

909.03 LOAD TRANSMISSION DEVICES. Load transmission devices shall be either dowel bars or cantilever type devices, all as shown on the plans.

(a) Dowel bars shall conform to the details on the plans and shall meet the requirements of Subsection 909.01 except that dowel bars shall not be deformed.

The sleeves for dowel bars shall be metal of an approved design to cover 2 inches of the dowel, with a closed end, and with a suitable stop to hold the end of the sleeve at least one inch from the end of the dowel bar. Sleeves shall be of such design that they do not collapse during construction.

Paint to be used for painting dowel bars shall conform to the requirements of AASHO Designation: M 72.

(b) Cantilever type devices shall be fabricated of cast malleable iron conforming to details shown on the plans. The castings forming each of the 2 sections shall be of material conforming to ASTM Designation: A 47, Grade No. 35018. Each load transmission unit of the cantilever type shall consist of 2 identical castings providing a cantilever arm on which the other half of the unit shall bear, and each casting shall have an upper tension anchor and a lower compression anchor, all constructed in accordance with the general dimensions shown on the plans. The castings shall be cleaned and ground as necessary in order that each may be in conformity with the required dimensions and assembled into a complete unit providing coincidence of bearing on both the vertical and horizontal sliding faces. The castings shall be sufficiently smooth so that there

will be no interference with smooth sliding operation.

909.04 COLD DRAWN STEEL WIRE FOR CONCRETE REINFORCEMENT. Cold drawn steel wire for concrete reinforcement shall conform to the requirements of ASTM Designation: A 82, and as detailed on the plans.

909.05 STEEL STRAND FOR PRETENSIONING. Strand for pretensioning shall conform to the requirements of ASTM Designation: A 416.

Type 270 K, 7-wire, uncoated, stress-relieved steel strand, when submitted as an alternate in accordance with the provisions of paragraph (j) of Subsection 805.23, and approved, shall conform to the requirements of ASTM Designation: A-416, except that Tables I and II thereof shall be modified as shown in following composite table:

BREAKING STRENGTH REQUIREMENTS

Nominal Dia. of Strand, Ins.	Breaking Strength of Strand, Min. Lb.	Nominal Steel Area of Strand, Sq. Ins.	Nominal Wt. of Strand, Lb. Per 1,000'	Yield Strength Requirements	
				Initial Load, Lb.	at 1% Extension, Lb. Min. Load.
3/8	23,000	.085	292	2,300	19,600
7/16	31,000	.117	400	3,100	26,350
1/2	41,300	.153	525	4,130	35,100

909.06 BARS FOR POSTTENSIONING. Bars shall be of high tensile strength steel. They shall be equipped with wedge type end anchorages which will develop the minimum specified ultimate bar stress on the nominal bar area.

The physical properties of the bar steel and the stress-strain curve determined by static tensile test shall conform to the following:

Ultimate Stress	145,000 psi minimum
Stress at 0.7% elongation	130,000 psi minimum
Stress at 0.3% elongation	75,000 psi minimum
Elongation in 20 diameters	4% minimum
Modulus of Elasticity	25,000,000 minimum
Diameter tolerance	Plus 0.02375 inch or minus 0.010 inch

909.07 PARALLEL WIRE ASSEMBLIES FOR POST-TENSION. Assemblies shall consist of parallel wire of the number and size as shown on the plans. Wire shall be high tensile, hard-drawn, stress-relieved and uncoated, delivered in coils of 54 inches minimum diameter. Ultimate strength requirements for various sizes shall be as follows:

Diameter—Inches	Min. Ult. Stress, psi
0.177	255,000
0.192	251,000
0.225	245,000
0.250	240,000
0.276	236,000

The stress-strain curve for wires shall show the following minimum characteristics based on the minimum ultimate strength requirements:

Proportional limit (0.01% offset from tangent).....55%
Yield strength (0.2% offset from tangent).....80%

Elongation at rupture shall be not less than 4 per cent in 10 inches. Diameter tolerance of wires, plus or minus 0.002 inch.

909.08 ANCHORAGES FOR POSTTENSIONED TENDONS.

(1) For Bars: Wedge type anchorages shall be used for bars. The wedge device shall develop the minimum ultimate stress specified for the nominal bar area. Wedge anchorages shall bear against anchorage plates fabricated of hot-rolled steel having physical characteristics not less than as specified for No. 1040 of the American Iron and Steel Institute AISI Specifications.

(2) For Parallel Wire Assemblies: Wedge type anchorages of the sandwich plate or conical type shall generally be used. The anchorage device shall be capable of developing the ultimate strength of the total number of wires anchored. Conical type anchorages shall be embedded within the ends of the concrete members, unless otherwise specified. Anchorages shall generally bear against embedded grids of reinforcing steel of approved type.

(3) Alternate Anchorage Types: Alternate anchorage types conforming to the general physical requirements specified above for wedge type anchorages will be considered. All anchorage types either will be required to develop the specified ultimate strength of the reinforcing tendons, or the allowable stress on the tendon will be based on anchorage strength.

Any alternate type anchorage considered will be required to show evidence of being capable of withstanding at least 3,000,000 cycles of twice the maximum live load stress variation.

909.09 REQUIRED TESTS FOR PRESTRESSING REINFORCEMENT. The following tests shall be made to determine the physical characteristics of prestressing reinforcement. Where tests are specified to be made by the manufacturer, 7 certified copies of all test results shall be submitted to the Department's Testing Engineer in Baton Rouge. It shall be the Department's privilege to have all tests witnessed by its inspectors.

(a) Strand for Pretensioning: The contractor shall make all tests as stipulated in ASTM Designation: A 416.

(b) Bars:

(1) Proof Test: During manufacture, each bar shall be proof tested to a minimum stress of 130,000 psi.

(2) Static Test: From each mill heat received, one static test shall be made by the manufacturer on an assembled bar and anchorage to determine the physical properties of the steel and the assembly, and shall conform to the minimum physical properties hereinbefore mentioned. For each 1,000 bars received on the job, one bar will be selected at random for static testing by the Department's Laboratory.

(c) Wires and Wire Anchorages: From each 10 coils of wire or fraction thereof, one sample shall be submitted to the Department's Laboratory for static

test. For each 500 anchorages or fraction thereof, one anchorage assembly shall be tested statically to destruction by the Department.

909.10 WIRE ROPE AND FITTINGS FOR HIGHWAY GUARD RAIL. The wire rope or wire cable and fittings shall conform to the requirements of AASHO Designation: M 30 for the specified diameter and strength class.

Flexible rail elements composed of multiple wires in any arrangement other than rope form shall conform in all respects to the plan details and dimensions, and to the strength requirements of special provisions for the item.

NOTE: This paragraph is intended to cover the less frequently used woven steel wire tape and woven steel wire fabric and perhaps new variants that may be offered.

909.11 WIRE ROPE. All wire ropes shall be of improved plow steel wire, uncoated.

All operating wire ropes shall be preformed wire rope.

All wire ropes, unless otherwise specified, shall be of 6 x 19 filler wire construction with hard fiber core. Each strand shall consist of 19 main wires and 6 filler wires, fabricated in one operation; 4 sizes of wires in each strand; 12 outer wires of one size, 6 filler wires of one size, 6 inner wires of one size and a core wire.

All wire ropes, unless otherwise specified, shall be Right Regular Lay, and the maximum length of rope lay shall be as follows:

Operating ropes—
6¾ times nominal wire rope diameter
Counterweight ropes—
7½ times nominal wire rope diameter

The lay of wires in the strands shall be such as to make the wires approximately parallel to the axis of the wire rope where they would come in contact with a circular cylinder circumscribed on the wire rope.

All hard fiber cores shall be pre-lubricated by the cordage manufacturer. All component parts of the wire ropes, fiber cores, wires and strands shall be lubricated during fabrication with an approved lubricant containing a rust inhibitor.

The amount by which the actual diameter of the wire rope differs from the nominal diameter, shall not be greater than the following:

Nominal Diam. Wire Rope	Undersize	Oversize
1/2″ to 3/4″	0	1/32″
13/16″ to 1-1/8″	0	3/64″
1-3/16″ to 1-1/2″	0	1/16″
1-9/16″ to 2-1/4″	0	3/32″
2-5/16″ to 2-1/2″	0	1/8″

The physical properties of the bright (uncoated) individual wires of the wire ropes, before fabrication in the wire ropes, shall be as follows, with the exception of the filler wires, which may be made to the manufacturer's standards:

(a) The unit tensile strengths of the component wires shall be as follows:

Diam. Wires	Tensile Strength—psi Minimum
.032-.060″	238,000
.061-.100″	230,000
.101-.140″	225,000
.141-.190″	218,000

(b) Test specimens from not less than 10 per cent of the coils of the wires shall be subjected to a torsion test in which the distance between the jaws of the testing machine is 8 inches. The number of complete successive turns of 360 degrees in one direction through which an 8 inch length of wire can be twisted around its longitudinal axis without breaking or showing signs of splitting or other defects shall not be less than the following, in terms of the wire diameter "d" in inches:

Diam. Wires	Minimum Torsions in 8 inch lengths
.032-.060″	$\frac{2.3}{d}$
.061-100″	$\frac{2.2}{d}$
.101-.140″	$\frac{2.1}{d}$
.141-.190″	$\frac{2.0}{d}$

(c) The total ultimate elongation of the wires measured on a 10 inch gauge length, at the breaking load of the wire, shall not be less than the following:

Diam. Wires, Inches	Elongation, Per Cent
.032-.060	1½
.061-.100	1¾
.101-.140	2
.141-.190	2¼

The test specimens shall be at least 15 inches long, and free from bends and kinks.

(d) The tolerance limits of like positioned wires in the strands of the wire rope shall not exceed the following values:

Diam. Wires, Inches	Total Variation, Inches
.032-.060	.002
.061-.100	.0025
.101-.140	.003
.141-.190	.0035

The minimum breaking strengths of bright (uncoated) wire ropes shall be in accordance with the following values:

Diam. Wire Rope, (Inches)	Minimum Breaking Strength—Lbs.
1/2	21,000
5/8	33,000
3/4	46,000
7/8	63,000
1	81,000

Diam. Wire Rope, (Inches)	Minimum Breaking Strength—Lbs.
1-1/8	103,000
1-1/4	126,000
1-3/8	151,000
1-1/2	179,000
1-5/8	209,000
1-3/4	242,000
1-7/8	275,000
2	312,000
2-1/8	349,000
2-1/4	390,000
2-3/8	432,000
2-1/2	476,000

Should the breaking strength of the wire rope fall below the above values, the entire length from which the test pieces were taken, shall be replaced by the manufacturer with a new length, the strength and mechanical properties of which shall meet the specifications.

No splicing of the wire rope or its component strands will be permitted. All wires in the wire rope shall be of continuous length. When wire joints are necessary, they shall be electrically butt-welded and in the stranding operation no 2 joints in any one strand shall be made closer than 25 feet apart, except for filler wires.

Unless otherwise specified, all wire ropes shall be shipped on reels, the minimum diameter of which shall be not less than 25 times the nominal diameter of the wire rope; if shipped in coils, the inside diameter of the coils shall be not less than 25 times the nominal diameter of the wire rope.

Section 910
Fence and Guard Rail

910.01 BARBED WIRE. Barbed wire may be either steel or aluminum alloy.

Steel barbed wire shall conform to the requirements of ASTM Designation: A 121. The coating weight shall be Class 1 unless otherwise specified.

Aluminum alloy barbed wire shall be manufactured of aluminum alloy conforming to ASTM Designation: B 211, alloy 5052-0 for the line wire and alloy 5052-H 38 for the barbs.

General Requirements. The gage of the wire shall be as shown on the plans. The average spacing of the barbs shall not exceed the specified nominal spacing and no individual spacing shall vary from the nominal spacing by more than 1/2 inch.

910.02 WOVEN WIRE. Woven wire shall conform to the requirements of ASTM Designation: A 116. The size of the woven wire shall be as shown on the plans and the spelter coating shall be Class 1 unless otherwise specified.

910.03 CHAIN LINK FENCE AND GATES.

(a) Unless otherwise specified, chain link fence may be fabricated of either one of the following at the option of the contractor:

1. Zinc coated steel.
2. Aluminum coated steel.
3. Aluminum alloy.

(b) Height of fence, gage and mesh of fabric, gage of tension wire, type and gage of barb wire, type and dimensions of line post, corner post, pull post, top rail, gate post, gate framing, gate opening and all other miscellaneous items required to make up the fence shall be shown on the plans.

(c) All material furnished except as specified herein

shall meet the applicable requirements of AASHO Designation: M 181.

(d) Barbed wire used with chain link fence shall conform to the requirements of Subsection 910.01.

(e) Padlocks supplied by the contractor shall be solid jacket extruded brass metal with interchangeable cores and 1¾ inch cases. All padlocks furnished shall be keyed alike. Two keys shall be furnished for each padlock.

910.04 METAL BEAM FOR HIGHWAY GUARD RAIL. The rail elements shall be corrugated sheet metal beams conforming to plan details. The class and gage of the metal shall be as specified on the plans. All guard rail elements, terminal sections and fittings shall be interchangeable with similar parts, regardless of source or manufacturer.

(a) Steel Guard Rail: The guard rail and terminal sections shall be fabricated from corrugated sheet steel prepared for use as beams in highway guard rails meeting the material and test requirements of AASHO Designation: M 180.

In lieu of galvanizing requirements as specified in said specification, the contractor will be permitted, at his option, to either paint the rail or galvanize after fabrication, both in accordance with the following requirements.

If the contractor elects to paint the guard rail, the shop finish shall consist of one coat of red lead paint conforming to AASHO Designation: M 72, Type II.

If the contractor elects to furnish galvanized guard rail, galvanizing shall be performed in accordance with the requirements of ASTM Designation: A 123.

(b) Aluminum Guard Rail:

Rail Elements: The rail element shall be formed from aluminum alloy conforming to ASTM Designation: B 209, Alclad 2024, Temper T3. The rail elements shall be of such thickness as required to provide the strength and deflection re-

quirements as given in AASHO Designation: M 180, except that the thickness shall be not less than that shown in AASHO M 180.

Terminal Sections: The terminal sections shall be formed from aluminum alloy conforming to ASTM Designation: B 209, Alclad 2024, Temper T42. The terminal sections shall be of such thickness as required to provide the elongation requirements as given in AASHO M 180 but not less than that required in AASHO M 180.

910.05 TIMBER RAIL. The timber rail shall be cut from the specified grade of dry, well seasoned and dressed timber stock of the species specified, which shall meet the applicable requirements of Subsection 914.01.

Where preservative treatment is specified this shall conform to the requirements of Subsection 914.04.

910.06 POSTS. Line posts may be either treated timber posts or steel posts, except as may be provided elsewhere herein, however, the same type of posts furnished for line posts shall be used throughout any particular section of fence. Bracing posts, end posts and corner posts may be either treated timber posts or steel posts as the contractor elects.

(a) Treated Timber Posts: All treated posts shall be Southern Pine of the dimension shown on the plans. Any of the following treatments will be permitted.

1. Seasoning: Posts to be treated with creosote or pentachlorophenol-petroleum solution shall be air or artificially seasoned prior to treatment. Posts to be treated with Osmosalts shall be of green or unseasoned wood only, prior to treatment.

2. Preservative Treatment with Creosote or With Pentachlorophenol-Petroleum Solution: Treatment of posts with either creosote or pentachlorophenol-petroleum solution shall have a minimum net retention of preservative per cubic foot of wood as specified in Subsection 914.04(b).

3. Preservative Treatment with Osmosalts: Posts to be treated by this process shall be green or unseasoned wood manufactured from live, standing trees and in no case shall timber be accepted for treatment that has end checking greater than one inch or that has any surface checking whatsoever.

The salts treatment shall be as specified in Subsection 914.05.

The method of treatment shall be as follows: Posts to be treated shall be delivered to the treating site with bark intact, and shall be treated within a period not greater than 20 days after the trees are felled. The trees from which the posts are to be produced shall be branch-trimmed and cut in the woods to desired length as soon as possible after the tree has been felled. Posts shall not be peeled more than 24 hours before application of treatment.

The preservative shall be mixed with water to such a consistency that, when applied to the entire surface area of the freshly peeled post, a sufficient quantity of the Osmosalts (dry) to insure a minimum of 0.3 pound per cubic foot of material shall remain uniformly distributed over the surfaces. The treatment shall be applied either by dipping, spraying or brushing.

After application, the posts shall be dead-stacked in solid piles (no stripping). The stacks shall be stacked on timbers, or other approved material separating the posts from the ground. At the end of each day's treatment, the stack or stacks shall be completely covered on all sides and ends with an approved water proof paper, or other suitable material, which shall be securely fastened down. Earth or other satisfactory material shall be piled around the base of the stack, so as to eliminate as much as possible any free circulation of air from under the stacks. The purpose of all such covering shall be to prevent subsequent rainfall from washing off the preservative mixture, to retard seasoning, and in order to permit the pre-

servative to diffuse into the wood by natural osmotic pressure and capillary attraction.

The post shall remain under the protective covering until such time as the Osmosalts have penetrated into the timber to a minimum depth of 3/8 inch as determined by the standard Zirconium-Alizarine color reagent, however, the minimum time under cover shall be not less than 10 days for the first inch plus 5 days for each additional inch of diameter.

After the proper penetration has been secured, the stacks shall be uncovered and the posts shall be air-seasoned for at least 30 days before using.

(b) Steel Posts: Steel posts furnished for line, end, corner and bracing posts may be one of the suggested types shown on the plans or such other type the contractor elects to use, provided that the type furnished shall meet the requirements of these specifications.

All steel posts shall be equipped with corrugations, knobs, notches, holes, or studs so placed and constructed as to engage a substantial number of fence line wires in proper position. Posts may be punched with holes in such position and of such size as will not impair the strength of the posts. Posts with punched tabs used for fastening wires are not acceptable because of the risk of injury to fence wires when such tabs are crimped around the wires, and of the tendency of tabs to fracture upon removal and refastening of fence. In addition, corner, end and bracing posts shall be supplied with necessary holes and with galvanized bolts of standard commercial quality or other satisfactory substitute such as castings, for fastening braces to the posts.

Line posts shall have a nominal weight of 1.33 pounds per foot, exclusive of anchor plate. Corner, end bracing posts shall have a nominal weight of 4.10 pounds per linear foot. Permissible variation in total weight of posts in any one shipment shall be a maximum of 3½ per cent over or under the nominal weights.

Steel posts shall be furnished in the lengths shown on the plans. Permissible variation shall be a minimum of one inch under and 2 inches over the designated lengths.

Posts shall be fabricated of hot-rolled steel sections meeting either of the requirements given in the following tables:

Grade	Tensile Properties: Yield Strength Lb/Sq In (Min)	Tensile Properties: Ultimate Strength Lb/Sq In (Min)
Hot-rolled carbon steel-minimum carbon content 0.35 per cent	40,000	70,000
Hot-rolled rail steel	50,000	80,000

Methods of Tests:

Chemical requirements—ASTM E 30
Physical requirements—ASTM A 370

Note: Rail steel products shall be rolled from standard tee-section steel rails. No other materials, such as those known by the terms "rerolled," "rail steel equivalent," and "rail steel quality," shall be substituted.

Line posts shall be furnished with anchor plates of the approximate shape and dimensions shown on the plans and so tapered as to facilitate driving. The anchor plates shall weigh a minimum of 0.67 pound each. The plates shall be clamped, welded, or riveted to the posts in a substantial manner to prevent displacement of the plates when the posts are driven.

Steel posts, including anchor plates on line posts, may be either painted or galvanized, however, all steel posts furnished for the project shall have the same finish. Painted posts shall be cleaned of loose scale prior to finishing, and one or more coats of high-grade weather-resistant, special steel paint or enamel shall be applied and baked. The color shall be satisfactory to the engineer. Galvanizing of steel posts shall conform to the requirements of ASTM Designation: A 123.

Excessive bow, camber, twist, or other injurious defects in posts shall be considered cause for rejection of such posts.

910.07 BRACES.

(a) Timber Braces: All timber braces shall be of the dimensions shown on the plans and shall be treated timber meeting the applicable requirements of Section 914.

(b) Steel Braces: Steel braces shall be of the approximate type and dimensions shown on the plans. Bracing members shall have nominal weight of 3.19 pounds per linear foot. Braces shall be furnished with holes placed in proper position and of proper size for fastening braces to the posts. Fabrication and grade of steel, finish, permissible tolerances, and cause for rejection shall be the same as provided for steel posts.

910.08 STAPLES. Staples shall be made of galvanized steel wire and shall be of the size shown on the plans. The minimum spelter coating when tested by ASTM Designation: A 90 shall be 0.2 ounce per square foot.

910.09 METAL FASTENERS FOR STEEL POSTS. Metal fasteners for steel posts shall be galvanized steel wire fasteners or clamps and shall be satisfactory for use with the type of steel post furnished. Wire shall not be less than 0.120 inch in diameter. The spelter coating, when tested in accordance with ASTM Designation A 90, shall not be less than 0.2 ounce per square foot.

910.10 GUARD RAIL POSTS AND SPACER BLOCKS. Railing posts shall be of either wood, steel or concrete as may be specified. When the choice of post is at the option of the contractor, there shall be only one kind furnished on the project. Spacer blocks shall be of wood.

(a) Wood posts shall be fabricated from an approved or specified timber species and shall be of the quality, diameter or section, and length as specified or as shown on the plans. When treated posts are specified, they shall be fabricated or framed before

treatment. Timber, preservatives and preservative treatment shall conform to the requirements of Section 914.

(b) Steel posts shall be of the section and length as specified or as shown on the plans. They shall be of copper bearing steel when so specified. Steel shall conform to the requirements of ASTM Designation: A 36.

The post shall be galvanized in accordance with ASTM Designation: A 123 or, if painted, shall be given one coat of red lead paint conforming to AASHO Designation: M 72, Type II.

(c) Precast reinforced concrete posts shall be of a section and length as specified or as shown on the plans. Concrete shall be of the class specified. Reinforcement shall be deformed bars of intermediate or hard grades meeting the requirements of Subsection 909.01.

(d) Concrete deadmen for end anchorages shall be as specified or as shown on the plans. Concrete and reinforcement shall conform to the requirements as stated herein for precast reinforced concrete posts.

(e) Spacer blocks shall be of the dimensions shown on plans. The spacer blocks shall be of the same material and treated with the same type preservatives as provided for guard rail posts.

910.11 GATES (Roadside Fence).

Gates: Design of metal gates shown on standard plans is a type acceptable to the Department.

If the contractor proposes to furnish gates of a design other than that shown on the standard plan, he shall submit to the Department, for approval, specifications covering the design and fabrication of the type gates he contemplates furnishing.

Gates shall be of the dimension and weight as specified on the plan.

Steel sheets used in fabricating gates shall have a galvanized coating of 1.25 ounces (commercial) per

square foot when coated in accordance with ASTM Designation: A 446.

Posts:

(a) Treated Timber Posts: Treated timber posts shall conform to the requirements of Subsection 910.06.

(b) Metal Posts: Metal posts shall be made of galvanized steel pipe, standard weight, conforming to the applicable requirements of ASTM Designation: A 120.

Hardware:

Hinges, washers, nails, staples, well chain, and latches shall be of standard quality satisfactory for use with the type of gate and posts selected for use and acceptable to the engineer.

Gate Stops:

(a) Treated Timber Posts: The gate stop of the dimensions shown on the plans shall be treated timber conforming to the applicable requirements of Subsection 910.06. Gate stops shall be treated in the same manner as specified for treated timber posts.

(b) Metal Posts: The gate stop shall be galvanized steel, suitable for welding to the post and acceptable to the engineer.

Stop Posts:

Stop posts furnished for double swinging driveway gates shall be of the dimensions shown on the plans and shall be treated timber conforming to the applicable requirements of Subsection 910.06.

910.12 GUARD RAIL HARDWARE. Offset brackets of the resilient and non-resilient types shall be of the type specified or as shown on the plans, and shall meet the strength requirements specified.

Splices and end connections shall be of the type and design specified or shown on the plans, and shall

be of such strength as to develop the full design strength of the rail elements.

End spring assemblies, when specified, shall be positive and of a type and design coinciding with the intent, design and strength of the railing structure, and shall be as specified or as shown on the plans.

End anchor rods and accessories shall be as specified or as shown on the plans and shall be of such size and strength as to develop the full design strength of the rail elements.

Unless otherwise specified all fittings, bolts, washers, and other accessories for steel guard rail shall be galvanized in accordance with the requirements of AASHO Designation: M 111 or ASTM Designation: A 153, whichever may apply. All galvanizing shall be done after fabrication.

Hardware for aluminum guard rail shall be of aluminum alloy conforming to ASTM Designation: B 211. Bolts shall be of alloy 2024, Temper T 4 and nuts of alloy 6061, Temper T 6. Washers shall conform to ASTM Designation: B 209, Alloy 2024, Temper T 4.

Section 911

Concrete Curing Materials and Admixtures

911.01 CURING MATERIALS. Curing Materials shall conform to the following requirements as specified:

(a) Cotton Mats for Curing Concrete: AASHO M 73.

(b) Burlap Cloth made from Jute or Kenaf: AASHO M 182.

(c) Waterproof Paper for Curing Concrete: AASHO M 139.

(d) White Polyethylene Sheeting (Film) for Curing Concrete: AASHO M 171.

(e) Combined Burlap and White Polyethylene Plastic Materials. This material shall be a combination of 10 ounce burlap and 4 mil white opaque polyethylene plastic film fused together in such a way as to remain one integral unit throughout the curing period. Moisture loss and reflectivity shall be the same as for the white polyethylene sheeting (film) above.

(f) Liquid Membrane-Forming compounds for Curing Concrete. This material shall conform to the requirements of AASHO Designation: M 148, with the exception that the specimens tested for drying time shall be maintained at a temperature of 100° F ±2° F and a relative humidity of 32 ±2 per cent. When so tested, the membrane forming compound shall dry to touch in not more than 2 hours.

911.02 SUBGRADE PAPER. The subgrade paper shall conform to the requirements of AASHO Designation: M 74.

911.03 ADMIXTURES. Admixtures, air-entraining and water-reducing (normal set or set retarding) shall meet the requirements of these specifications.

(a) Water-Reducing Admixtures:

Water-reducing admixtures, either normal set or set retarding may be either of the following types:

1. A calcium, sodium, potassium or ammonium salt of lignosulfonic acid.

2. A hydroxylated carboxylic acid or its salt.

The water-reducing admixture shall be a product of a company with not less than 5 years experience in the manufacture and successful field use of this type admixture. The manufacturer shall process and package the material in its own factory.

All water-reducing admixtures (normal set or set retarding) submitted for preliminary approval when tested in accordance with LDH Designation: TR 224 shall conform to the applicable requirements given in Table VIII—Physical Requirements.

(b) Air-Entraining Admixtures: All air-entraining admixtures submitted for preliminary approval, when tested in accordance with LDS Designation: TR 224 shall conform to the applicable requirements given in Table VIII—Physical Requirements.

(c) Approved List: A list of approved water-reducing admixtures, either normal set or set retarding, and air-entraining admixtures is maintained by the Louisiana Department of Highways, Materials and Testing Section, Baton Rouge, Louisiana. Companies desiring to have admixtures placed on this list will be required to submit samples for testing at least 60 days prior to anticipated use.

(d) Requirements for Job Control Samples: Samples of admixtures shall be submitted to the Testing Laboratory, from each lot or shipment made to a job, for testing purposes. These samples must be submitted by the Project Engineer at least 10 days prior to use of the material. Furthermore, tests to determine the rate of hardening and compressive strength or other properties, may be made at any time during the progress of the work to insure continued compliance with the requirements of these specifications.

Samples submitted from the job shall be tested in accordance with LDH Designation: TR 224 and shall conform to the applicable requirements given in Table VIII—Physical Requirements.

TABLE VIII

PHYSICAL REQUIREMENTS FOR ADMIXTURES

	Air Entraining Admixture	Water Reducing Admixtures	
		Normal Set	Set Retarding
Unit Water Content, Max. per cent of control	90	95	95
Air Content, per cent	5 ± 2	0 to 3	0 to 3
Time of setting, deviation from control in hours (Note 1)			
Initial Set—Max.		±1	+3
Min.		.....	+1
Final Set—Max.		±1	+3
Min.		.....	.....
Compressive strength, min. per cent of control			
7 days	85	105	105
28 days	85	105	105

NOTE 1—The time of setting requirements in the table provide that concrete containing:

1. A water reducing, normal set admixture must reach both initial set and final set not more than 1 hour sooner or 1 hour later than the reference concrete.
2. A water reducing, set retarding admixture must reach initial set at least 1 hour later but not more than 3 hours later than the reference concrete and must reach final set not more than 3 hours later than the reference concrete.

(e) Infrared Spectrographic Analysis: In lieu of the physical testing requirements for job control samples, samples may be approved for use by means of infrared spectrographic analysis in accordance with LDH Designation: TR 224.

911.04 EPOXY RESIN SYSTEMS. The epoxy resin system shall be of the type specified on the plans or in the special provisions and shall conform to the applicable requirements of AASHO Designation: M 200 modified as follows. Bond strength tests on hardened to hardened concrete and plastic to hardened concrete shall be performed by the beam break method only.

Section 912

Railings

912.01 GENERAL. Unless otherwise specified this specification covers all of the material used in the construction of any of the types of railings as specified on the plans or in the special provisions.

912.02 CONCRETE. All concrete used in railings and railing posts shall be Class A conforming to the applicable requirements of Section 805.

912.03 REINFORCING STEEL. Reinforcing steel shall consist of deformed bars conforming to the applicable requirements of Subsection 909.01.

912.04 STRUCTURAL STEEL. Structural steel for railings and railing posts shall consist of A36 steel conforming to the requirements of Subsection 913.01.

912.05 ALUMINUM PIPE RAILINGS. Aluminum pipe, castings, fittings, and hardware shall be of the type, size and detail shown on the plans.

Aluminum Alloy Pipe (6063-T6 or 6061-T6): Aluminum alloy pipe shall be standard pipe, ASA schedule 40, and shall conform to ASTM Designation: B 241, Alloy GS10A, Condition T 6.

Cast Aluminum Railing Posts: Material for cast aluminum bridge railing posts shall conform to the following specifications.

Scope: This specification covers permanent mold types of cast aluminum alloy roadway railing posts as designated in the material section of this specification.

Material: The chemical composition of the castings shall conform to the limits listed in the following table:

TABLE IX

COMPOSITION LIMITS*

Cu	Fe	Si	Mn	Mg	Zn	Ti	Oth. (each)	Oth. (Total)
0.10	0.20	6.5-7.5	0.10	0.05	0.10	0.20	0.05	0.15

*All values maximum, unless shown as a range.

Minimum mechanical properties of test bars machined either vertically or horizontally from the high stressed area of the post tension flange (lower 14 inches), but not at the junction of the rib and tension flange, shall be as shown in the following table:

TABLE X

MECHANICAL PROPERTIES—CASTING

TENSION FLANGE

Ultimate Tensile Strength (psi)	20,000
Elongation (% in 2 inches or 4D)	20

Test Specimens: The tension test specimens shall be machined from integrally cast test coupons extending from one side of the base of the posts sufficiently large to permit obtaining a 0.350 inch diameter test specimen as defined in ASTM Designation: E 8.

Number of Tests: A minimum of one per cent of the posts in any lot, but not less than one, shall be sampled for tensile testing. For the purpose of sampling, a lot shall consist of not more than 1,000 pounds of clean castings when produced from a batch-type furnace charged with one heat of ingot of known analysis or not more than 2,000 pounds of clean castings when produced from one continuous furnace in not more than 8 consecutive hours.

Aluminum Alloy Swedge Bolts and Nuts (6061-T6 or 2024-T4): Aluminum alloy swedge bolts and nuts shall be made from rods conforming to ASTM Designation: B 211, Alloy GS11A or Alloy CG42A. Nuts shall conform to American Standard finished hexagon, ASA Designation: B18.2. Threads shall conform to the standard of Class 2, 2A or 2B. The finished bolts and nuts shall be supplied in either the T6 or T4 temper and shall be given an anodic coating at least 0.0002 inch in thickness and chromate sealed.

Aluminum Alloy Washer (2024-T4): Aluminum alloy washers shall be made of sheet conforming to ASTM Designation: B 209, Alloy clad CG42A, Condition T4.

Aluminum Alloy Shim Material (1100-0): Aluminum alloy shims shall be made of sheet or plate conforming to ASTM Designation: B 209, Alloy 990A, Condition 0.

Access door cover and rail caps shall conform to either ASTM Designation: B 221, Alloy 6061-T6 or permanent mold castings (A344-T4) conforming to the chemical and physical requirements of Tables IX and X herein.

Set Screws: Machine screws for fastening access door covers to railing posts; socket head cup point set screws for fastening pipe rail to railing posts; and pipe caps to railing shall be stainless steel and shall be furnished by the supplier.

912.06 GALVANIZED STEEL PIPE RAILINGS. The standard weight galvanized steel pipe, castings, fittings, and hardware shall be of the type, size and detail shown on the plans. Galvanized surfaces to be placed in contact with concrete shall be given a heavy coat of an approved alkali-resistant bituminous paint and allowed to dry before placing on the concrete. However, a pad of clear opaque poleyethylene film of not less than 6 mils thickness may be placed between the galvanized and concrete surfaces in lieu of the paint and trimmed to the perimeter of the casting base after casting has been bolted down.

The galvanized steel pipe shall be of standard weight, conforming to the requirements of ASTM Designation: A 120. From each 1,000 feet or less of galvanized pipe, a sample not less than one foot in length shall be submitted direct to the Material and Testing Engineer for examination and approval as to wall thickness and zinc spelter thickness before shipment.

Fittings and castings for steel pipe shall be of malleable iron or cast steel and shall comply with ASTM Designation: A 47 or ASTM Designation: A 27, Grade 70-36. All fittings and castings shall be galvanized and the galvanizing shall comply with ASTM Designation: A 153.

The castings shall be produced under radiographic

control. This shall consist of radiographic examination of castings until proper foundry techniques are established for each mold which will produce castings of a satisfactory quality free from harmful internal defects. Seven copies of certified chemical and physical test reports shall be forwarded for approval to the Materials and Testing Engineer for each heat or foundry pour of iron or steel post castings with a certification as to ounces per square foot of the zinc spelter coating applied to these castings.

All bolts, nuts, washers and screws required in handrail construction shall be of the type, size and detail shown on the plans.

Unless otherwise specified all bolts, nuts and washers shall conform to the ASTM Designation: A 307, Grade A.

When high tensile bolts are required, such bolts shall conform to ASTM Designation: A 325. All bolts, nuts and washers shall be galvanized and the galvanizing shall comply with ASTM Designation: A 153.

Machine screws for fastening access door covers to railing posts; socket head cup point set screws for fastening pipe rail to railing posts and pipe caps to railing shall be stainless steel and shall be furnished by the supplier.

Section 913

Structural Steel and Structural Metals

913.01 STRUCTURAL STEEL. Unless otherwise specified, the contractor will be required to obtain all applicable physical and chemical tests and furnish the Department's Materials and Testing Engineer, in Baton Rouge, with the required number of copies of the certified test reports.

The type of structural steel to be used shall be as specified and shall meet the following requirements:

(a) Manganese Vanadium Steel (A 441): Manganese vanadium steel shall conform to the requirements of ASTM Designation: A 441.

(b) Manganese Steel (A 440): Manganese steel shall conform to the requirements of ASTM Designation: A 440.

(c) Structural Carbon Steel (A 36): Structural Carbon steel shall conform to the requirements of ASTM Designation: A 36.

913.02 RIVET STEEL.

(a) Structural rivet steel shall conform to the requirements of ASTM Designation: A 141.

(b) High strength rivet steel shall conform to the requirements of ASTM Designation: A 195.

913.03 COPPER BEARING STEEL. When copper bearing steel is specified, the steel shall contain not less than 0.2 per cent copper.

913.04 STEEL FORGINGS.

(a) Carbon steel Forgings: Carbon steel forgings shall conform to the requirements of ASTM Designation: A 235, Class C-1.

(b) Heat-Treated Forgings: Heat-treated forgings, where specified, shall conform to the requirements of ASTM Designation: A 235, Class G.

(c) Alloy Steel Forgings: Alloy steel forgings shall conform to the requirements of ASTM Designation: A 237, Class A.

913.05 WROUGHT IRON.

(a) Wrought Iron Plates: Wrought iron plates shall conform to the requirements of ASTM Designation: A 42.

(b) Rolled Wrought Iron Shapes and Bars: Rolled wrought iron shapes and bars shall conform to the requirements of ASTM Designation: A 207.

(c) Welded Wrought Iron Pipe: Welded wrought iron pipe shall conform to the requirements of ASTM Designation: A 72. The pipe shall be standard galvanized unless otherwise shown on the plans.

913.06 STEEL CASTINGS.

(a) Carbon Steel Castings: Carbon steel castings shall conform to the requirements of ASTM Designation: A 27. Grade to be as specified.

(b) Chromium Alloy Steel Castings: Chromium alloy steel castings shall conform to the requirements of ASTM Designation: A 296, Grade CA-15.

913.07 GRAY IRON CASTINGS. Gray iron castings shall conform to the requirements of ASTM Designation: A 48, Class No. 30, unless otherwise specified.

Iron castings shall be true to pattern in form and dimensions, free from pouring faults, sponginess, cracks, blow holes, and other defects in positions affecting their strength and value for the service intended. The castings shall be boldly filleted at angles.

All castings must be sandblasted or otherwise effectively cleaned of scale and sand so as to present a smooth, clean and uniform surface.

913.08 MALLEABLE CASTINGS. Malleable castings shall conform to the requirements of ASTM Designation: A 47, Grade No. 35018.

Malleable castings shall be true to pattern in form and dimensions, free from pouring faults, sponginess,

cracks, blow holes, and other defects in positions affecting their strength and value for the service intended.

The castings shall be boldly filleted at angles. The surfaces shall have a workmanlike finish.

All castings must be sandblasted or otherwise effectively cleaned of scale and sand so as to present a smooth, clean and uniform surface.

913.09 BRONZE OR COPPER ALLOY BEARING AND EXPANSION PLATES.

(a) Bronze Bearing and Expansion Plates: Bronze bearing and expansion plates shall conform to the requirements of ASTM Designation: B 22, Alloy B.

(b) Rolled Copper-Alloy Bearing and Expansion Plates: Rolled copper-alloy bearing and expansion plates shall conform to the requirements of ASTM Designation: B 100, Alloy No. 1.

913.10 BOLTS, NUTS AND WASHERS.

(a) All bolts and nuts except high tensile bolts, unless otherwise specified, shall conform to ASTM Designation: A 307, Grade A.

(b) High tensile bolts, nuts and washers shall conform to ASTM Designation: A 325.

913.11 STEEL BEARING PILES. Steel bearing piles shall be as specified on the plans and in the special provisions, the steel shall conform to Subsection 913.01 (c).

913.12 STEEL SHEET PILES. Steel sheet piling shall be of the type and weight as specified on the plans and in the special provisions, and conforming to the requirements of ASTM Designation: A 328.

913.13 CORRUGATED METAL UNITS. Corrugated metal units shall conform to plan dimensions and the metal to AASHO Designation: M 36. Bituminous coating, when specified, shall conform to AASHO Designation: M 190, Type A.

913.14 SHEET COPPER. Sheet copper shall be of the

type and dimensions as specified and shall conform to the applicable requirements of AASHO Designation: M 138.

913.15 COLD ROLLED STEEL. Cold rolled steel shall conform to the requirements of ASTM Designation: A 108.

913.16 BRONZE.

(a) Bronze for center discs (for movable bridges) shall conform to the requirements of ASTM Designation: B 22, Alloy A.

(b) Bronze for trunnion and similar bearings (for movable bridges) shall conform to the requirements of ASTM Designation: B 22, Alloy B.

(c) Bronze for shafts and ordinary bearings shall conform to the requirements of ASTM Designation: B 22, Alloy C.

(d) Bronze for gears, nuts transmitting motion, and other parts involving stresses other than compression shall conform to the requirements of ASTM Designation: B 22, Alloy D.

913.17 BABBITT METAL. Babbitt metal shall conform to the requirements of ASTM Designation: B 23, Grade 3.

913.18 STEEL FOR CENTER DISCS (Movable Bridges). Steel for center discs shall conform to the requirements of ASTM Designation: A 235, Class G.

913.19 STEEL FOR KEYS (Movable Bridges). Steel for keys shall conform to the requirements of ASTM Designation: A 235, Class E.

913.20 SEAMLESS CARBON-STEEL PIPE FOR HYDRAULIC LINES. Pipe for hydraulic lines shall conform to the requirements of ASTM Designation: A 106, Grade B.

913.21 STEEL FOR OPEN GRID BRIDGE FLOORING. All steel, except rivet steel, shall conform to the requirements of Subsection 913.01 (c), except that copper bearing steel, meeting the requirements of Subsection 913.03, will be permitted.

Rivet steel shall meet the requirements of Subsection 913.02 (a).

Unless otherwise specified, the contractor or his fabricator will be required to perform all applicable ASTM tests and submit 7 copies of the certified tests to the Materials and Testing Engineer of the Department of Highways, Baton Rouge, Louisiana.

913.22 NODULAR CAST IRON BEARINGS. Nodular cast iron bearings shall conform to the requirements of ASTM Designation: A 339. The grade shall be as specified on the plans or in the special provisions.

913.23 SHEAR CONNECTORS.

1. General:

(a) Shear connector studs shall be of a design suitable for end-welding to steel beams and girders with automatically timed stud welding equipment. The type, size or diameter, and length of stud shall be as specified by the plans, specifications, or special provisions and approved by the engineer. (See Figure 1 for allowable tolerances on dimensions.)

(b) An arc shield (ferrule) of heat-resistant ceramic or other suitable material shall be furnished with each stud. The material shall not be detrimental to the welds or cause excessive slag and shall have sufficient strength so as not to crumble or break due to thermal or structural shock before the weld is completed.

(c) Flux for welding shall be furnished with each stud, either attached to the end of the stud or combined with the arc shield for automatic application in the welding operation.

(d) Studs shall not be painted or galvanized.

(e) Only qualified studs shall be used. A stud, to be qualified, shall have passed the tests prescribed in LDH Designation: TR 601. The arc shield used in production shall be the same as used in the qualification tests.

(f) Before placing orders for studs, the contractor

shall submit to the engineer for approval the following information on the studs to be purchased:

(1) The name of the manufacturer.

(2) A detailed description of the stud and arc shield to be furnished.

(3) A certification from the manufacturer that the stud is qualified as specified herein.

(4) A copy of the qualification test report as certified by the testing laboratory.

(g) The studs, after welding, shall be free from any defect or substance which would interfere with their function as shear connectors.

2. Material Requirements:

(a) Shear connector studs shall conform to the requirements of ASTM Designation: A 108, cold-drawn bar, Grades 1015, 1017, or 1020, either semi- or fully-killed. If flux-retaining caps are used, the steel for the caps shall be of a low carbon grade suitable for welding and shall comply with ASTM Designation: A 109.

(b) Tensile properties as determined by tests of bar stock after drawing or of finished studs shall conform to the following requirements:

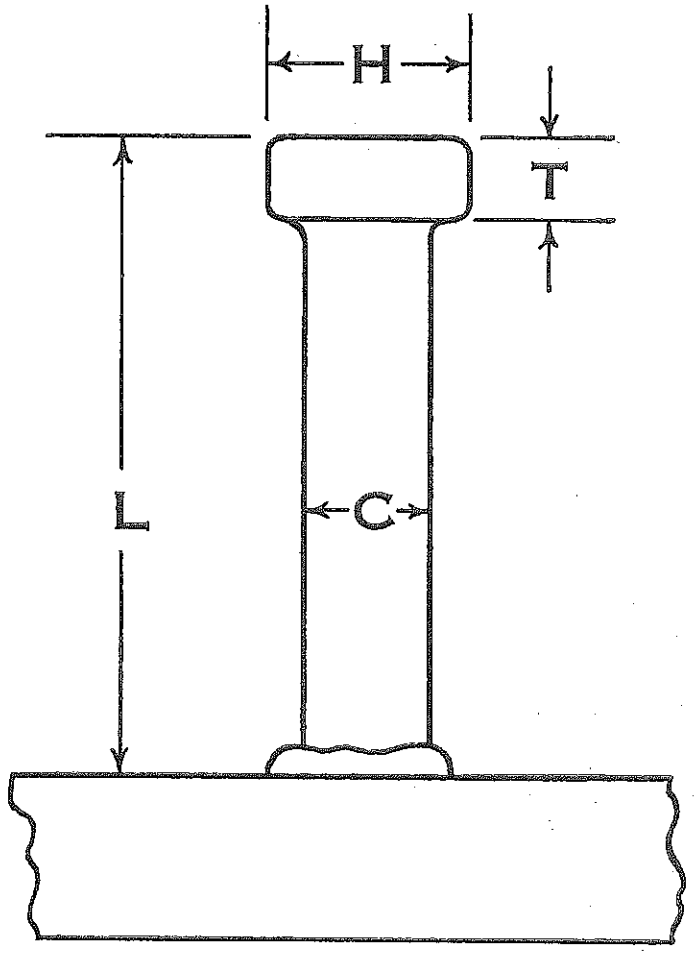
Tensile Strength (Min.)	60,000 psi
Yield Strength* (Min.)	50,000 psi
Elongation (Min.)	20 per cent in 2 inches
Reduction of area (Min.)	50 per cent

*As determined by a 0.2 per cent offset method.

(c) Tensile properties shall be determined in accordance with the applicable sections of ASTM Designation: A 370. Tensile tests of finished studs shall be made on studs welded to test plates using a test fixture similar to that given in LDH Designation: TR 601. If fracture occurs outside of the middle half of the gage length, the test shall be repeated.

(d) Finished studs shall be of uniform quality and condition, free from injurious laps, fins, seams,

FIGURE 1
DIMENSIONS AND TOLERANCES



STANDARD DIMENSIONS—INCHES			
C	L*	H	T
3/4 - .015	4 $^{+\ .062}_{-\ .125}$	1 1/4 ± 1/64	3/8 min.
7/8 - .015	4 $^{+\ .062}_{-\ .125}$	1 3/8 + 1/64	3/8 min.

*4" length is standard. Other lengths may be obtained by special order.

cracks, twists, bends, or other injurious defects. Finish shall be as produced by cold drawing, cold rolling, or machining.

(e) The manufacturer shall certify that the studs as delivered are in accordance with the material requirements of this section. Certified copies of in-plant quality control test reports shall be furnished to the engineer upon request.

Section 914

Timber and Timber Preservatives

914.01 STRUCTURAL TIMBER AND LUMBER. The specie, grade and treating requirements of structural timber and lumber shall be as specified and shall conform to the applicable requirements of AASHO Designation: M 168, and the following requirements.

Southern Pine Timber: Referring to Standard Grading Rules for Southern Pine lumber, as published by Southern Pipe Inspection Bureau of the Southern Pine Association, effective February 1, 1963, Southern Pine lumber shall be furnished in grades, with definite unit working stresses assigned, as indicated, for grade of lumber required.

For caps, stringers and decking the material shall conform to the following:

Grade: Dense Structural, 58 Timbers; Paragraph 257, also Paragraph 6 and 213 thru 232.

Stress Rating: 1600 f to 1750 f; Paragraph 230.

For items other than caps, stringers and decking, with the exception of sheet piling, the material shall conform to the following:

Grade: No. 1 SR Timbers; Paragraph 231, also Paragraphs 236, 86 and 249.

Stress Rating: 1400 f and 1500 f; Paragraph 230.

For sheet piling; the material shall conform to the following:

Grade: No. 1 Utility Timbers; Paragraph 236.

Douglas Fir Timber: Referring to West Coast Bureau of Lumber Grades and Inspection Standards-Grading and Dressing Number 15, effective March 15, 1956, revised May 1, 1962, Douglas Fir lumber shall be furnished in grades with definite unit working stresses assigned as indicated for the kind of lumber required.

For caps, stringers and decking, material shall conform to the following:

Grade: Dense Construction, 1750 f; Paragraph 124-bb. The material shall conform to all the grade provisions of paragraph 124-b with the additional requirement of density as defined in Paragraph 504.

For items other than caps, stringers and decking, the material shall conform to the following:

Grade: Construction, 1500 f; Paragraph 124-b.

914.02 TIMBER PILING. The specie, grade and treating requirements of timber piling shall be as specified and shall conform to the applicable requirements of AASHO Designation: M 168.

914.03 TIMBER PRESERVATIVES. Unless otherwise specified, the type preservatives to be used are as follows:

Creosote Oil
Creosote Coal-Tar Solution
Pentachlorophenol-Petroleum Solution
Tanalith Wolman Salts
Chromated Zinc Chloride

The kind of preservative treatment required shall be as specified on the plans or in the special provisions and shall conform to the applicable requirements of AASHO Designation: M 133.

914.04 TREATMENT.

(a) General: Unless otherwise provided on the plans or in the special provisions, all materials shall be treated according to current AWPA Standard Specifications for Preservative Treatment by Pressure Processes, except as modified or supplemented by these specifications, as follows:

Timber and Lumber	C1 and C2
Piles	C1 and C3
Poles	C1 and C4
Posts	C1 and C5

(b) Amount of Preservative: The net retention in any charge shall be not less than 90 per cent of the quantity of preservative that may be specified; but the average retention by the material treated under the contract and the average retention of any 5 consecutive charges shall be at least 100 per cent of the quantity specified. Unless otherwise specifically provided on the plans or in the special provisions, the minimum amount of preservative retained shall be as follows:

When the preservative treatment specified is Creosote Coal-Tar Solution, unless otherwise specified, the ratio shall be 80 per cent creosote oil and 20 per cent coal-tar.

(1) Creosote, Creosote Coal-Tar Solution or Pentachlorophenol-Petroleum Solution Treatment:

Material	Min. Net Retention of Preservative per cu. ft. of Wood
Southern Pine Timber	16 lbs. full cell
Douglas Fir Timber	12 lbs. full cell
Douglas Fir Piles	12 lbs. full cell
Southern Yellow Pine Piles	16 lbs. full cell
Southern Yellow Pine Piles for use in coastal water (to be specified on plans or in special provisions)	20 lbs. full cell
Fence and Gate Posts	5 lbs. full cell

Note: Creosote and Creosote Coal-Tar Solution shall not be used for treatment of materials which the plans require to be painted. Pentachlorophenol-petroleum solution may be used where painting is required, when permitted on the plans, however, the minimum net retention of preservative per cubic foot of wood shall be reduced to 8 pounds full cell.

(2) Salts Treatment:

	Pounds Dry Salts per cu. ft.	
	Unpainted Timbers	Painted Timbers
Tanalith Wolman Salts	3/8	1/4
Chromated Zinc Chloride	3/4	1/2

Note: After treatment and before shipment, timber which is to be painted shall be kiln-dried or air-seasoned for a minimum of 30 days.

914.05 OSMOSALTS TREATMENT FOR FENCE POSTS. The chemical composition of the salts treatment shall meet the following requirements:

	Per Cent by Weight	
	Min.	Max.
Sodium Fluoride	30	38
Dinitrophenol	5	10
Potassium Bichromate	30	38
Sodium Arsenate	22	28

Section 915

Miscellaneous

915.01 WATER FOR USE WITH CONCRETE, MORTAR AND SOIL CEMENT. Water for use with cement in mortar, concrete or soil cement shall meet the following requirements with the exception that the salt (NaCl) requirements may be waived when used for soil cement.

Sugar	None
Oil	None
Acid	None
Alkali Not over	0.1%
Solids (Organic) Not over	0.1%
Solids (Inorganic) Not over	0.4%
Salt (NaCl) Not over	0.5%

Water of questionable quality shall be subjected to the soundness test as specified in AASHO Designation: T 26.

The sample being tested shall show a strength of 90 per cent of the comparative at 7 or 28 days of age.

915.02 CALCIUM CHLORIDE. Calcium chloride shall conform to the requirements of AASHO Designation: M 144.

915.03 HYDRATED LIME. Hydrated lime for use in soil stabilization and conditioning shall conform to the requirements of ASTM Designation: C 207, Type N, except the Calcium Oxide and Magnesium Oxide shall be a minimum of 90 per cent on non-volatile basis, and the Hydrated Lime shall have a maximum free moisture content of 1½ per cent.

Sampling and Testing: All sampling and testing is to be done in accordance with LDH Designations: S 613 and ASTM Designations: C 25 and C 110 of the Testing Research Manual.

915.04 FRAMES, GRATES AND COVERS, AND LADDER RUNGS. Metal units shall conform to the plan

dimensions and to the following specification requirements for the designated materials:

(a) Gray Iron casting shall conform to the requirements of Subsection 913.07.

(b) Carbon-steel castings shall conform to the requirements of Subsection 913.06.

(c) Wrought iron items shall conform to the requirements of ASTM Designation: A 42 for plates, ASTM Designation: A 207 for shapes and bars and ASTM Designation: A 152 for rivets.

(d) Malleable iron castings shall conform to the requirements of ASTM Designation: A 47. The grade shall be as specified on the plans or in the special provisions.

(e) Galvanizing, where specified for these units, shall conform to the requirements of AASHO Designation: M 111. The weight of the spelter coat shall be as specified on the plans or in the special provisions.

915.05 COTTON DUCK (Canvas). Cotton duck (canvas) shall be the weight specified and shall conform to the applicable requirements of AASHO Designation: M 166.

915.06 PREFABRICATED MASONRY PADS. Prefabricated masonry pads shall be composed of an approved type of fiber or of multiple layers of 8 ounce cotton duck impregnated and bound with high quality natural rubber, or the pads may be composed of equivalent and equally suitable materials compressed into resilient pads of uniform thickness. The furnished pads shall withstand compression loads of not less than 10,000 psi without detrimental reduction in thickness or extrusion.

915.07 SIGNS AND BARRICADES. Material for use in signs and barricades shall conform to the requirements of the plans.

915.08 COMMERCIAL FERTILIZER. All fertilizers shall be commercial type, granulated or pelletized and furnished in suitable containers. All fertilizers shall

conform to the conditions of the commercial fertilizer law of 1948 (Act Number 93) issued by the Louisiana Department of Agriculture.

Fertilizers shall be analyzed for the minimum percentage by weight of Nitrogen (N), available Phosphoric Acid (P_2O_5) and Soluble Potash (K_20). Fertilizer sample sent to laboratory shall be clearly marked to identify the analysis type.

8-8-8 Fertilizer shall contain the following:

8% Nitrogen (N); 8% available Phosphoric Acid (P_2O_5); 8% Soluble Potash (K_2O).

9-9-9 Fertilizer shall contain the following:

9% Nitrogen (N); 9% available Phosphoric Acid (P_2O_5); 9% Soluble Potash (K_2O).

10-10-10 Fertilizer shall contain the following:

10% Nitrogen (N); 10% available Phosphoric Acid (P_2O_5); 10% Soluble Potash (K_2O).

12-12-12 Fertilizer shall contain the following:

12% Nitrogen (N); 12% available Phosphoric Acid (P_2O_5); 12% Soluble Potash (K_2O).

13-13-13 Fertilizer shall contain the following:

13% Nitrogen (N); 13% available Phosphoric Acid (P_2O_5); 13% Soluble Potash (K_2O).

14-14-14 Fertilizer shall contain the following:

14% Nitrogen (N); 14% available Phosphoric Acid (P_2O_5); 14% Soluble Potash (K_2O).

15-15-15 Fertilizer shall contain the following:

15% Nitrogen (N); 15% available Phosphoric Acid (P_2O_5); 15 Soluble Potash (K_2O).

16-16-16 Fertilizer shall contain the following:

16% Nitrogen (N); 16% available Phosphoric Acid (P_2O_5); 16% Soluble Potash (K_2O).

915.09 SEEDING. All seed furnished shall conform to all requirements, rules and regulations of Chapter

11 Title 3 of Louisiana Revised Statutes of 1950. The minimum percentage of pure live seed and the maximum percentage of weed seed permitted shall be in accordance with Table XI, herein.

Each variety of seed shall be furnished and delivered in separate bags or other containers. Each bag or container shall bear an analysis tag which shall conform to the applicable requirements of the Rules and Regulations as promulgated by the Louisiana Seed Commission for the enforcement of the Louisiana Seed Law (Acts 372 of 1946 and 1952).

The analysis tag shall be a No. 6 standard shipping tag, minimum size, and shall carry the information required by the Louisiana Seed Law, arranged as follows and in addition, shall carry the Laboratory number of the Louisiana Department of Agriculture for that particular lot number shown on tag:

All seed furnished shall be of the previous season's crop and the date of analysis shown on each tag shall be within 6 months of the time of delivery to the project.

TABLE XI

Variety of Seed	Minimum Percentage of Pure Live Seed (Purity Times Germination Including Hard Seed)	Maximum percentage of weed seed permitted
Hulled Bermuda	86	1
Carpet Grass	76	2
Pensacola Bahia	81	2
Louisiana White Dutch Clover	86	1
Dixie Crimson Clover	82	1
Common Lespedeza	76	2.5
Kobe Lespedeza	80	2.5
Alta Fescue	82	1
Kentucky 31 Fescue	82	1

Noxious Weeds: Noxious weeds shall be interpreted to mean that list of weeds, except bermuda, which has been approved and adopted by the Louisiana Seed Commission as being noxious in Louisiana. The sum

La. Dept. of Agriculture

Kind & Variety_____ Laboratory No._____

Where Grown_____ Net Wt._____ Lot No._____

Pure Seed_____% Germination _____%

Inert Matter_____% Hard Seed_____%

Crop Seed_____% Total Germ. & Hard Seed_____%

Weed Seed_____% Date of Test_____%

Name & No. of Noxious Weed Seed per Lb._____

_____

Name_____

Address_____

total of all noxious weed seeds shall not exceed 500 per pound.

Analysis tags shall be removed from each bag or container only by the Project Engineer or his authorized representative. After removal, the tags shall be filed with other test reports and forwarded by the engineer to the Construction Section upon completion of the project.

Test Report: A copy of the laboratory test report as prepared by the State Seed Analyst of the Louisiana Department of Agriculture and Industry for each lot of seed furnished shall be submitted to the Project Engineer.

915.10 TIMBER CONNECTORS. Connectors for treated timber structures, except those of malleable iron, shall be galvanized in accordance with the requirements of ASTM Designation: A 123, and shall be one of the following types as specified on the plans:

(a) Split Ring Connectors: Split rings of 2½ inch inside diameter, 4 inch inside diameter and 6 inch inside diameter shall be manufactured from hot rolled, low-carbon steel conforming to the requirements of ASTM Designation: A 273, Grade No. 1015. Each ring shall form a closed true circle with an outside cylindrical surface parallel to the axis of the ring. The inside surface, except for the 6 inch ring shall be beveled from the median line toward the edges. It shall be cut through in one place in its circumference to form a tongue and slot.

Connector grooves in timber shall be cut concentric with the bolt hole and shall be of the following dimensions:

For 2½ inch split rings—inside diameter, 2.56 inches; width of groove, 0.18 inch; depth of groove, 0.37 inch.

For 4 inch split rings—inside diameter 4.08 inches; width of groove, 0.21 inch; depth of groove 0.50 inch.

For 6 inch split rings—inside diameter, 6.12 inches; width of groove, 0.27 inch; depth of groove, 0.62 inch.

(b) Toothed-ring connectors: Toothed-ring connectors shall be stamped cold from U. S. Standard 16 gage hot rolled sheet steel conforming to the requirements of ASTM Designation: A 273, Grade No. 1015, and shall be bent cold to form a circular, corrugated, sharp-toothed band and circle and shall be paralled to the axis of the ring. The central band shall be welded to fully develop the strength of the band. All sizes; 2 inch, 2 5/8 inch, 3 3/8 inch and 4 inch diameters; shall have an over-all depth of 0.94 inch and a depth of fillet of 0.25 inch.

(c) Shear Plate Connectors: Shear plate connectors shall be of the following types:

(1) Pressed Steel Type: Pressed steel shearplates of 2 5/8 inch diameter shall be manufactured from mild steel conforming to the requirements of ASTM Designation: A 273, Grade No. 1015. Each plate shall be a true circle with a flange around the edge, extending at right angles to the face of the plate and extending from one face only, the plate portion having a central bolt hole and 2 small perforations on opposite sides of the hole and midway from the center and circumference.

(2) Malleable Iron Type: Malleable iron shear plates of 4 inch diameter shall be manufactured according to the requirements of ASTM Designation: A 47, Grade No. 35018. Each casting shall consist of a perforated round plate with a flange around the edge extending at right angles to the face of the plate and projecting from one face only, the plate portion having a central bolt hole reamed to size with an integral hub concentric to the bolt hole and extending from the same face as the flange.

(d) Claw-Plate Connectors: Claw-plate connectors of 2 5/8 inch, 3 1/8 inch and 4 inch diameter shall be of malleable iron, manufactured according to the requirements of ASTM Designation: A 47, Grade No. 35018. Each claw-plate shall consist of a perforated circular flanged plate with 3 sided teeth arranged about the perimeter of one face. The male plate shall have integral cylindrical hubs on both faces

concentric to a bolt hole through the center of the plate. The female plate shall be flat on the side opposite the teeth but shall have an integral cylindrical hub concentric to the central bolt hole and on the face with the teeth.

(e) Spike-Grid Connectors: Spike-grid connectors shall be manufactured according to the requirements of ASTM Designation: A 47, Grade No. 35018. They shall consist of 4 rows of opposing spikes forming a 4 1/8 inch square grid with 16 teeth which are held in place by fillets. Fillets for the flat grid in cross section shall be diamond shaped. Fillets for the single and double curve grids shall be increased in depth to allow for curvature and shall maintain a thickness between the sloping faces of the fillets equal to the width of the fillet.

915.11 HARDWARE AND STRUCTURAL SHAPES.

(a) Hardware: Machine bolts, drift bolts and dowels may be either wrought iron or medium steel. Washers shall be cast ogee gray iron or malleable castings, unless washers cut from medium steel or wrought iron plate are called for on the plans. A standard circular washer shall be used under the heads of all lag screws.

Machine bolts shall have square heads and nuts unless otherwise called for. Nails shall be cut or round wire of standard form. Spikes shall be cut, wire or boat spikes. All bridge hardware shall be galvanized in accordance with ASTM Designation: A 153.

(b) Structural shapes: All structural shapes, rods and plates shall be of structural steel or wrought iron, as specified or called for on the plans, meeting the respective requirements prescribed under "Structural Steel", Section 913. All castings shall conform to the requirements therefore prescribed under the aforementioned section for "Structural Steel."

915.12 RIGID METAL CONDUIT (Electrical). Rigid metal conduit shall be of the type and size specified on the plans or in the special provisions, and shall

conform to the applicable requirements of American Standard Association C 80.1.

915.13 ELECTRICAL CONDUCTORS. Electrical conductors shall be of the type and size as specified on the plans and in the special provisions and shall conform to the latest applicable requirements of IPCEA Pub. No. S-19-81.

915.14 ALUMINUM PLATE. Aluminum plate for use in construction of such items as junction boxes shall conform to the requirements of ASTM Designation: B 209, Alloy 6061-T6.

915.15 JUTE MATTING. Jute matting shall be of uniform open weave, new, unbleached, single jute yarn. Yarn shall be of loosely twisted construction and shall not vary in thickness by more than one half its normal diameter. Jute matting shall be furnished in roll strips and shall conform to the following specifications:

Length—approximately 75 yards
Width—48" plus or minus one inch.
78 warp ends per width.
41 weft ends per linear yard.
Weight to average 1.22 pounds per linear yard, plus or minus 5%

915.16 STAPLES USED WITH JUTE MATTING. Staples shall be "U" shaped number 11 gauge or heavier wire. They shall be 6 inches long and 1 to 1 1/4 inches wide.

Handmade staples shall be made from 12 inch long number 8 gauge or heavier wire.

915.17 FLASHING WARNING LIGHTS (Battery Operated). Battery operated flashing lights shall conform to the following:

Each unit shall be furnished with double lens directly opposed for viewing from each direction of travel. Each lens shall be constructed of amber colored plastic of not less than 7 inches in diameter. The bulb shall be of a suitable size and type.

The electrical circuit shall be so enclosed and protected that it will be weather and tamper proof. The

flash rate shall be regulated from 70 to 120 flashes per minute and the "on" time shall be at least 25 per cent of the cycle.

The flash shall be clearly visible, during the hours between sunset and sunrise, for a distance of 800 feet and any deviation from this requirement as a minimum standard will be grounds for immediate replacement of the unit.

915.18 VEGETABLE MATERIAL FOR MULCH. Vegetable material for mulch shall be applied as indicated on the plans for erosion prevention and shall meet the following requirements:

Mulch shall be vegetative in character and shall consist of either stems or stalks of oats, rye, rice, wheat or other approved straws. The contractor may also use hay obtained from various legumes and grasses such as lespedezas, clover, vetches, soybeans, bermuda, dallas, carpet sedge, fescue or other approved legumes of grasses or any combination thereof. Straw or hay shall be dry and reasonably free from mold, Johnson grass or other noxious weeds.

915.19 ROOFING PITCH. Roofing pitch shall conform to the requirements of AASHO Designation: M 118.

Section 916

Qualification of Procedures, Welders and Welding Operators

916.01 GENERAL.

1. The Material and Testing Section of the Department shall be the sole qualifying agency.

2. Qualifying tests, may be made at locations selected by the contractor, but advance notice of not less than one week shall be given to the Department's Materials and Testing Engineer so that the Department can arrange for the presence of the inspector.

3. Seven copies of the required reports will be furnished to the Materials and Testing Engineer. If requested, the Department will furnish the necessary forms.

4. Each welder and welding operator's work shall be identified with a steel stencil.

5. The fabricator will be required to furnish the engineer with 10 copies of photographs of each qualifying welder and welding operator for identification purposes. The photographs shall be 2" x 2" in size.

6. All costs incidental to welding qualifications shall be the responsibility of the contractor.

916.02 STEEL.

1. Welding procedures conforming to the requirements of Section 5, Article 501 (a) of the American Welding Society D2.0-63, shall be deemed prequalified and are exempt from tests or qualifications. Other procedures shall conform to the requirements of Section 5, Article 502 (a).

2. Welders and welding operators shall be qualified in accordance with the requirements of Section 5, Article 503 of the American Welding Society D2.0-63,

except that welders and welding operators previously qualified by the Department need not be requalified subject to the requirements of Section 6, Article 604.

3. Above referenced to American Welding Society D2.0-63.

916.03 ALUMINUM. Welding qualifications for aluminum shall conform to the requirements of the American Society of Mechanical Engineers (ASME) Code Section IX.

916.04 PIPE. Welding qualifications for aluminum pipe and for steel pipe shall conform to the requirements of the American Society of Mechanical Engineers (ASME) Code Section IX.

916.05 ELECTRODES. All electrodes shall be qualified in accordance with AWS D2.0-63.

The contractor may at his option, perform the required usability tests, or he may furnish the Department's Materials and Tests Section with certified test reports from the manufacturer covering these requirements. If certified test reports are furnished, the contractor shall also furnish a certification from the manufacturer that the process and material requirements were the same for manufacturing the tested electrodes and the furnished electrodes.

PART X

DESIGN OF STRUCTURES

(Current AASHO Standard Specifications for Highway Bridges unless otherwise indicated on plans).

PART XI

DESIGN OF MOVABLE BRIDGES

(Current AASHO Standard Specifications for Movable Highway Bridges unless otherwise indicated on plans.)

PART XII

CONTRACT DOCUMENTARY FORMS

Notice to Contractors

(ALL CONSTRUCTION PROJECTS EXCEPT INTERSTATE)

Sealed proposals for the construction of the following project will be received by the Louisiana Department of Highways, Room 426, Headquarters Administration Building, Baton Rouge, Louisiana, until 8:00 A.M. on . After 8:00 A.M., proposals will be received in the Auditorium until 10:00 A.M. No proposals will be received after 10:00 A.M. At 10:00 A.M. of the same day and date, they will be publicly opened and publicly read in said Auditorium.

(Description of Project and other pertinent information to be placed here.)

Proposal forms will be issued to "contractors" lic-

ensed by the State Licensing Board for Contractors in accordance with Act 233 of 1956 or to an authorized representative of a licensed contractor. Where Federal-aid funds are involved in the construction work, contractors may receive proposal forms and submit bids on any Federal-aid project without having secured a license. However, the successful bidder not having a license will be required to secure same before actual construction work is started.

The rules and regulations of the State Licensing Board for Contractors will apply.

Proposal forms will be issued to non-licensed contractors when the estimated cost of the improvement is less than $30,000.00.

Proposal forms will not be issued later than twenty-four hours prior to the hour and date set for receiving proposals, except where Federal-aid funds are involved (or where the estimated cost of the improvement is less than $30,000.00); in which event, proposal forms may be secured at any time prior to the time set for receiving proposals.

Additional information relative to licensing may be obtained from the State Licensing Board for Contractors, Baton Rouge, Louisiana.

Every bid submitted shall be accompanied by a certified check or a bid bond in the amount of $ and shall be made payable to the Louisiana Department of Highways.

Full information and proposal forms are available at the offices of the Department of Highways at Baton Rouge. Plans and specifications may be inspected at said office or at the Project Engineer's Office

_____,

Louisiana, or plans will be furnished upon payment

of_____

upon request of the bidder, the Project Engineer,

_____,

or his qualified representative, will show the work.

Bids must be submitted on proposal forms provided by the Department.

The Department of Highways reserves the right to reject any or all proposals.

The Following Paragraph Shall Apply Only To Federal-Aid Highway Projects

The Louisiana Department of Highways, in accordance with the provisions of Title VI of the Civil Rights Act of 1964 (78 Stat. 252) and the Regulations of the Department of Commerce (15 C.F.R., Part 8), issued pursuant to such Act, hereby notifies all bidders that it will affirmatively insure that the contract entered into pursuant to this advertisement will be awarded to the lowest responsible bidder without discrimination on the ground of race, color, or national origin.

DEPARTMENT OF HIGHWAYS
_____, DIRECTOR

(INTERSTATE PROJECTS ONLY)

Sealed proposals for the construction of the following project will be received by the Louisiana Department of Highways, Room 426, Headquarters Administration Building, Baton Rouge, Louisiana, until 8:00 A.M. on _____. After 8:00 A.M., bids will be received in the Auditorium until 10:00 A.M. No bids will be received after 10:00 A.M. At 10:00 A.M. of the same day and date, they will be publicly opened and publicly read in said Auditorium.

(Description of Project and other pertinent information to be placed here.)

Proposal forms will be issued to "contractors" licensed by the State Licensing Board for Contractors in accordance with Act 233 of 1956 or to an authorized representative of a licensed contractor. Where Federal-aid funds are involved in the construction work, contractors may receive proposal forms and submit bids on any Federal-aid project, without having secured a license. However, the successful bidder not having a license will be required to secure same before actual construction work is started.

The rules and regulations of the State Licensing Board for Contractors will apply.

Proposal forms will be issued to non-licensed contractors when the estimated cost of the improvement is less than $30,000.00.

Proposal forms will not be issued later than twenty-four hours prior to the hour and date set for receiving proposals, except where Federal-aid funds are involved (or where the estimated cost of the improvement is less than $30,000.00); in which event proposal forms may be secured at any time prior to the time set for receiving proposals.

Additional information relative to licensing may be obtained from the State Licensing Board for Contractors, Baton Rouge, Louisiana.

The attention of bidders is directed to Special Provisions governing the selection and employment of labor.

Minimum rates for this project have been predetermined by the Secretary of Labor and are set forth in the advertised specifications.

The Louisiana Department of Highways, in accordance with the provisions of Title VI of the Civil Rights Act of 1964 (78 Stat. 252) and the Regulations of the Department of Commerce (15 C.F.R., Part 8), issued pursuant to such Act, hereby notifies all bidders that it will affirmatively insure that the contract entered into pursuant to this advertisement will be awarded to the lowest responsible bidder without discrimination on the ground of race, color, or national origin.

Every bid submitted shall be accompanied by a certified check or bid bond in the amount of $_____ and shall be made payable to the Louisiana Department of Highways.

Full information and proposal forms are available at the offices of the Department of Highways at Baton Rouge. Plans and specifications may be inspected at said office or at the Project Engineer's Office

_____,

Louisiana, or plans will be furnished upon payment of

_____

upon request of the bidder, the Project Engineer,

_____,
or his qualified representative, will show the work.

Bids must be submitted on proposal forms provided by the Department.

The Department of Highways reserves the right to reject any and all proposals.

DEPARTMENT OF HIGHWAYS
_____, DIRECTOR

STATE OF LOUISIANA
DEPARTMENT OF HIGHWAYS
Contruction Proposal

STATE PROJECT NO._____

Proposals will be received up to 8:00 A.M. on_____ by the Department of Highways, Room 426, Headquarters Administration Building, Baton Rouge, Louisiana. After 8:00 A.M., proposals will be received in the Auditorium until 10:00 A.M. No proposals will be received after 10:00 A.M. At 10:00 A.M. of the same day and date, they will be publicly opened and publicly read in said Auditorium.

BID OF_____

ADDRESS_____

DATE_____, 19___

To the Department of Highways,
Baton Rouge, Louisiana.

Gentlemen:

I (We) hereby agree to perform all the work known and described by you as:

State Project No._____
entitled _____
Route No._____, Parish_____
consisting of_____miles of_____
_____
_____, located as follows:

(Description of location to be placed here.)

The specifications, contract and bonds, governing the construction of the work contemplated are those known and designated as Louisiana Standard Specifications for Roads and Bridges dated_____, approved by the Board of Highways, _____, together with the "Special Provisions," if any, attached to this proposal.

The plans herein referred to are the plans approved

by the Chief Engineer and marked with the project number, route and Parish, set out above, together with all standard or special designs that may be designated in such plans.

The undersigned, as bidder, declares that the only persons or parties interested in this proposal as principals are those named herein; that this proposal is made without collusion or combination of any kind or character with any other person, firm, association, or corporation, or any member or officer thereof; that he has (or they have) carefully examined the site of the proposed work, the plans, Standard Specifications and special provisions above-mentioned, and the form of contract and contract bond; that he (or they) proposes, and agrees, if this proposal is accepted, to provide all necessary machinery, tools, apparatus, and other means of construction, and will do all the work and furnish all the materials specified in the contract, in the manner and time therein prescribed and in accordance with the requirements of the engineer as therein set forth; and that he (or they) hereby proposes to accept as full compensation therefor, the amount of the summation of the products of the quantities of work and material actually incorporated in the completed project, as determined by the engineer, multiplied by the respective unit prices herein bid.

It is understood by the undersigned that the quantities given in the following itemized proposal are a fair approximation of the amount of work to be done, and that the sum of the products of the approximate quantities multiplied by the unit price bid shall constitute gross sum bid, which sum shall be used in the comparison of bids, and the awarding of the contract.

The undersigned further proposes to perform all extra and force account work that may be required on the basis provided in the specifications, to give such work his personal attention and to secure economical performance.

The undersigned further agrees that within ten days after notice of the award of the contract to undersigned, he (or they) will execute the contract and furnish to the Department of Highways a satisfactory surety bond in a sum equal to the contract price as provided in the Standard Specifications.

The undersigned further agrees that work will begin not later than ten calendar days after the date of the Work Order, and shall be diligently prosecuted at such rate and in such manner, as in the opinion of the Chief Engineer, is necessary for the completion of the work within the time specified in the contract, it being understood that time is the essence of the contract.

Accompanying this proposal is a proposal guaranty payable to the Louisiana Department of Highways as follows:

Certified check in amount of_____Dollars ($____)

or

Bid bond in the amount of_____Dollars ($____).

If this proposal shall be accepted and the undersigned shall fail to execute the contract and furnish bond as above provided, then the proposal guaranty shall become the property of the State; otherwise, the said proposal guaranty shall be returned to the undersigned. All proposal guaranties, except those of the two lowest bidders, will be returned immediately following the opening and checking of the proposals. The retained proposal guaranty of the unsuccessful of the two lowest bidders will be returned within ten days following the award of contract and that of the successful bidder will be returned after a satisfactory bond has been furnished and the contract has been executed.

Respectfully submitted,

(If a Firm or Individual)

SIGNATURE OF BIDDER_____(Seal)

By: _____

_____

ADDRESS OF BIDDER _____

_____

(_____

(

Names and Addresses of Members of the Firm (_____

(

(_____

(

(_____

(If a Corporation)

SIGNATURE OF BIDDER_____(Seal)

By: _____

_____

(President _____

(

(_____

(Secretary _____

Names and Business Address of Officers

(

(_____

(

(Treasurer _____

(

(_____

Legal Domicile _____

Return Proposal Guaranty to:_____

_____

STATE OF LOUISIANA

DEPARTMENT OF HIGHWAYS

Contract

This Agreement, made and executed in_____(__) original copies, on this_____day of the month of _____in the year of our Lord, one thousand, nine hundred and _____, by and through_____, Director of Highways, the Party of the First Part, and hereinafter designated as "Department," and_____ Contractor, domiciled and doing business in_____, Party of the Second Part, and hereinafter designated as "Contractor."

WITNESSETH, That, in consideration of the covenants and agreements herein contained, to be performed by the parties hereto and of the payments hereinafter agreed to be made, it is mutually agreed as follows:

The Contractor shall and will provide and furnish all materials, equipment and labor and perform the work required to build, construct and complete in a thorough and workmanlike manner, to the satisfaction of the Chief Engineer of the Department of Highways. _____Project No._____

_____

entitled _____,
Route No._____, Parish_____
consisting of_____miles of_____

_____

_____, located as follows:

(Description of location to be placed here.)

in accordance with the plans on file in the Office of the Department at Baton Rouge, Louisiana, dated _____, and with the Standard Specifications for Roads and Bridges dated_____, approved by the Board of Highways, _____, and with the proposal filed with the Department dated_____, and with the special provisions accompanying said

proposal; copy of said plans, specifications and proposal, which are made a part hereof as fully as if set out herein and hereby become a part of this contract.

It is agreed and understood between the parties hereto that the contractor agrees to accept and the Department agrees to pay for the work at the prices stipulated in said Proposal, such payment to be in lawful money of the United States, and the payment shall be made at the time and in the manner set forth in the Specifications.

Performance will begin within ten calendar days after date of the work order and shall be completed within_____from that date subject to such extensions as may be authorized by the terms of Subsection 108.06 of the Specifications.

STATE OF LOUISIANA
DEPARTMENT OF HIGHWAYS
Contractor's Bond

KNOW ALL MEN BY THIS INSTRUMENT, That we _____, as principal, and the _____, a surety company authorized to do business in the State of Louisiana, as Surety, are held and firmly bound, in solido, unto the Department of Highways, and unto all sub-contractors, workmen, laborers, mechanics, and furnishers of materials and equipment, jointly, in the full sum of _____ Dollars ($_____), payable in lawful money of the United States, and to this bond we obligate our heirs, successors and assigns.

Now, the consideration of this bond is such, that if the said _____, Contractor, shall well and truly perform _____ contract, made and entered into on this _____ day of _____, 19__, to construct _____ Project No. _____ entitled _____ Route No. _____, Parish _____ consisting of _____ miles of _____ according to the stipulations recited in said contract, attached hereto and made a part thereof; and shall pay all sums due on materials and supplies used and for wages earned by laborers and workmen employed upon the work to be done; and if the above bonded _____ shall in all things stand to and abide by and well and truly observe, to keep and perform, all and singular, the terms, covenants, conditions, guarantees and agreements in said contract to be observed, kept, done and performed, and each of them, at the time and in the manner and form therein specified; and shall do and perform all the labor and work; and shall furnish all the materials as specified in said contract, in strict accordance with all the terms of said contract and the plans and specifications thereto attached and made a part thereof; and shall indemnify and save harmless said Depart-

ment of Highways against any loss or damage of whatever kind and character arising or occasioned by deeds of negligence of said principal, his agents, servants and employees, in the prosecution of the work, or by reason of improper safeguards or incomplete protection to the work; and shall pay all bills for materials and labor entered into the construction of said work, or used in the course of the performance of the work; then this obligation shall be null and void; otherwise to remain in full force and effect.

In faith whereof, we have subscribed this obligation at Baton Rouge, Louisiana.

WITNESS OUR HANDS AND SEALS, This_____ day of_____, 19____.

WITNESSES
As to Principal

_____ _____
Principal

By: _____

_____ _____

WITNESSES
As to Surety:

_____ _____
Surety

By: (Seal)

_____ _____
Attorney-in-Fact

Countersigned
By: (Seal)

_____
Resident Agent

Request for Permission to Sublet

In the event a contractor desires to sublet certain items, in accordance with the specifications and provisions relating to "Subletting," the contractor shall address a letter in the following form to the Chief Engineer of the Department of Highways requesting permission to sublet the items which it is desired to sublet and attach thereto the required list of equipment.

FORM OF REQUEST TO SUBLET

Date_____

State Project No._____
Name of Highway_____
Parish _____

Chief Engineer
Department of Highways
Baton Rouge, Louisiana

Dear Sir:

I desire to sublet the following items of work included in the above captioned project:

_____

_____

_____

_____

to _____

whose address is_____

The proposed subcontractor is a contractor of recognized standing with a satisfactory performance record and with an organization particularly experienced and equipped to perform the proposed work.

All work to be performed by the said proposed subcontractor shall be done in full compliance with all applicable terms of the Department's contract and assurance is hereby given that the minimum wage

for labor as stated in my proposal shall apply to labor performed on all work sublet.

Very truly yours,

_____

(Name of firm, individual or Corporation)

By:_____

Title

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