City of Lowell

Public Works Construction Standards

February 2003 Edition

Consisting of

Vol. I City of Lowell Technical Specification for Public Works Construction.

Vol. II City of Lowell Standard Details

City of Lowell

Technical Specifications

For Public Works Construction

February 2003

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101 DEFINITIONS

101.1.00 Definitions

Unless otherwise defined in the contract documents, the following definitions, abbreviations and references shall apply wherever used.

ACCEPTANCE TESTING - Testing of in-place materials and products in their finished state to determine acceptability for payment.

ADDENDUM - A modification to the bid document issued by the owner prior to the opening of the proposal.

ADJUSTED CONTRACT TIME - The contract time which has been changed for cause during the progress of the work.

ADVERTISEMENT - Publishing of the Notice to Contractors in newspapers or other periodicals in accordance with ORS 279.

AGGREGATE - Sound, tough, durable gravel or fragments of rock of uniform quality crushed to size with or without sand or other inert mineral matter.

AWARD OF CONTRACT - Written notification to the bidder that the bidder's proposal has been accepted by the owner and the bidder has been awarded the project subject to the execution of the contract.

BID SCHEDULE - The list of bid items, units of measurement, quantities, and prices included with the proposal or contract.

BIDDER - Any individual or legal entity submitting a proposal.

CALENDAR DAY - Any day shown on the calendar beginning and ending at midnight.

CHANGE ORDER - A written order, approved by the owner, and issued by the engineer to the contractor, covering changes in either the plans, specifications, or quantities within the scope of the contract.

CITY - The City of Lowell acting through its legally constituted officials, officers, employees or designated agents.

CLOSE CONFORMANCE - Where working tolerances are not given on the plans or in the specifications, close conformance means compliance, in the engineer's judgment, with reasonable and customary manufacturing and construction tolerances. Where working tolerances are given, close conformance means compliance with those tolerances.

CONTRACT - The agreement between the owner and the contractor describing the work to be done and defining the obligations of the owner and the contractor. The contents of a contract may include but not be limited to standard specifications, special provisions, standard drawings, plans, proposals, method of payment, and performance and payment bond.

CONTRACT REVIEW BOARD - The governing body that has rule-making authority to carry out the powers and duties in accordance with ORS 279.

CONTRACT TIME - The amount of time allowed to perform the work under the contract.

CONTRACTOR - Any individual or legal entity which has entered into a contract with the owner.

ENGINEER - The individual who represents the owner and who is designated by the contracting entity to administer the contract.

EQUIPMENT - All machinery, tools, and apparatus necessary for the completion of the contract.

ESTABLISHMENT PERIOD - The period of time specified to assure satisfactory establishment and growth of planted material.

EXTRA WORK - Work not provided for in the contract but determined by the engineer as essential to the completion of the contract. Extra work may be paid for as a price agreement, force account, or change order.

GRAVEL - Naturally occurring rounded or sub-rounded particles of rock that will pass a 3-inch and be retained on a No. 4 U.S. standard sieve.

INCIDENTAL WORK - Work necessary for fulfillment of the contract but which is not listed as a pay item in the contract and for which no separate payment will be made.

INSPECTOR - The authorized representative of the engineer assigned to inspect and report on contract performance and work.

LEGAL HOLIDAY - The following days are legal holidays: Sunday, New Years, Memorial Day, Independence Day, Labor Day, Veteran's Day, Thanksgiving, Christmas, and those days declared as holidays by authorized public proclamation. When a legal holiday,

other than Sunday, falls on a Sunday, the following Monday is a legal holiday. When a legal holiday falls on a Saturday, the preceding Friday is a legal holiday.

MATERIALS - Any substances specified for use in the construction of the project.

NOTICE TO CONTRACTORS - Written public announcement inviting proposals for work to be performed.

NOTICE TO PROCEED - A written notice from the engineer or owner to the contractor designating the date the contract time is to begin.

OR APPROVED - A product, component or process whose use in or on a particular project has been approved by the Engineer, pursuant to Section 106 as a substitute for the specified product, component or process.

OSHD STANDARD SPECIFICATIONS - The latest edition of the specification document published by the State of Oregon entitled *Standard Specifications for Highway Construction*, including supplements and standard drawings, Oregon State Highway Division; available from the Oregon Department of Transportation, State Highway Division, Salem, Oregon.

OWNER - The City of Lowell acting through its legally constituted officials, officers, employees or designee in the case of a public contract. In the case of a private contract for infrastructure construction, a private individual, partnership or corporate entity engaged in installation of improvements required for .

PAVEMENT - Asphaltic concrete or portland cement concrete placed for vehicular use on highway, road, and street travel ways; shoulders, auxiliary lanes, and parking areas.

PERFORMANCE AND PAYMENT BOND - The form of security approved by the owner, furnished by the contractor and contractor's surety, guaranteeing the complete and faithful performance of all the work and payment of all obligations of the contract.

PLANS - The drawings which show the location, type, dimensions, and details of the work to be done under the contract.

PROCESS CONTROL TESTING - Testing of materials and products during fabrication and construction to insure the materials and products comply with the specifications.

PROJECT - The work to be performed under the contract.

PROPOSAL - A written offer by a bidder on forms furnished by the owner to perform the work at the quoted prices.

PROPOSAL GUARANTY - The security furnished with a proposal to assure that the bidder will enter into the contract if the proposal is accepted by the owner.

RAILROAD - The word railroad applies to railroad or railway companies, their tenants, licensees, and utility companies which jointly own or use facilities with a railroad or railway company.

RENTAL RATE BLUE BOOK - *Rental Rate Blue Book for Construction Equipment*, latest edition, published by Dataquest Inc., 1290 Ridder Park Drive, San Jose CA 95131, Phone No. (800) 227-8444.

REFERENCE SPECIFICATIONS - The bulletins, standards, rules, methods of analysis or test, codes and specifications of other agencies, engineering societies, or industrial associations referred to in the contract documents. All such references specified refer to the latest edition, including any amendments which are in effect and published at the time of advertising for bids.

RIGHT OF WAY - A general term denoting land or property, or interest therein, designated for public use.

ROAD - Every bikeway, street, alley, road, roadway, thoroughfare, bridge, viaduct, or other structure used or intended for use by vehicles.

ROCK - Natural deposit of solid material composed of one or more minerals occurring in large masses or fragments.

SAND - Crushed or naturally occurring particles of rock that will pass the No. 4 U.S. Standard sieve and be retained on the No. 200 U.S. Standard Sieve.

SPECIAL PROVISIONS - The special directions or requirements identified as special provisions or special specifications, peculiar to the project and modifying the standard specifications.

STANDARD DRAWINGS - The typical details of structures or devices, or other information shown in the standard drawings included with these specifications, as supplemented and modified by the owner or engineer and referred to in the contract documents.

STANDARD SPECIFICATIONS - The terms, directions, provisions, and requirements of this document, together with all subsequent addenda and supplements.

SUBCONTRACTOR - An individual or legal entity with whom the contractor, with the consent of the owner, contracts to perform a portion of the work.

SUPERINTENDENT - The superintendent is the person at the construction site in charge of the project, for the contractor or subcontractor at any given time. The term superintendent does not refer to skill or wage level.

SUPPLEMENTAL AGREEMENT - A written agreement between the contractor and the owner to supplement, clarify or alter the plans, specifications or contract, or to provide for unforeseen work, alterations in plans or other circumstances not anticipated by or provided for in the plans and specifications.

SURETY - The corporate body which is bound with and for the contractor for the acceptable performance of the work and the payment of all obligations of the contract. When applied to the proposal guaranty, surety refers to the corporate body which engages to be responsible for the bidder's execution of a satisfactory contract when and if the bid is accepted by the owner.

TRAFFIC LANE - That portion of the traveled way marked for the movement of a single line of vehicles.

UTILITY - The tracks, overhead or underground wires, pipelines, conduits, ducts, or other structures owned, operated, or maintained in or across a public right of way or easement.

WETLANDS - The areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, under normal circumstances, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas.

WORK - The furnishing of labor, materials, equipment, and other incidentals required for the fulfillment of all of the contractor's duties and obligations under the contract.

WORK DAY - Every calendar day excluding Saturdays and legal holidays.

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.

101.2.00 Abbreviations

AASHTO American Association of State Highway and Transportation Officials
ACI American Concrete Institute
ADA American with Disablilities Act
AGC Associated General Contractors of America
AIA American Institute of Architects
AISC American Institute of Steel Construction
ANSI American National Standards Institute
APA American Plywood Association
APWA American Public Works Association
ASCE American Society of Civil Engineers
ASME American Society of Mechanical Engineers
ASTM American Society for Testing and Materials
AWG American Wire Gauge
AWPA American Wood Preservers Association
AWS American Welding Society
AWWA American Water Works Association
CRSI Concrete Reinforcing Steel Institute
DEQ Oregon Department of Environmental Quality
EPA United States Environmental Protection Agency
FEMA Federal Emergency Management Agency
FHWA Federal Highway Administration
ITE Institute of Transportation Engineers
MUTCD Manual on Uniform Traffic Control Devices For Streets and Highways (as adopted and supplemented by Oregon)
NEC National Electrical Code (as adopted by Oregon)
OAR Oregon Administrative Rules
ODOT Oregon Department of Transportation
ORS Oregon Revised Statutes
OSHA Occupational Safety and Health Administration
OSHD Oregon State Highway Division
PCA Portland Cement Association
PCI Prestressed Concrete Institute
UBC Uniform Building Code (as adopted by Oregon)
UL Underwriter's Laboratories, Inc.

101.3.00 Avoidance of Repetitious References

Throughout these specifications, the words acceptable, approved, authorized, considered necessary, deemed necessary, designated, determined, directed, disapproved, established, given, indicated, instructed, insufficient, ordered, permitted, prescribed, rejected, requested, required, satisfactory, specified, sufficient, suitable, suspended, unacceptable, unauthorized, unsatisfactory, or words of like import, refer to actions, expressions, and prerogatives of the engineer.

Command type sentences are used throughout the contract documents. In all cases the command, expressed or implied, is directed to the contractor.

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102 Proposal Requirements

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102.1.00 Pre-qualification of Bidders

A public contracting agency may require pre-qualification of bidders in accordance with ORS 279.

102.2.00 Contents of Proposal Form

The proposal form for bidding purposes will be furnished to prospective bidders. The proposal form may include, but not be limited to, the location and description of the work, and the time, date, and place of opening and reading the proposals. The proposal form will show the approximate quantities of work to be performed and materials to be furnished and will state the time in which the work is to be completed. The form will identify supplemental standard specifications, special provisions, and other documents which will govern the work.

All papers bound with or attached to the proposal form are considered a part of the proposal and must not be altered in an unauthorized manner when the proposal is delivered.

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

102.3.00 Interpretation of Quantities in Bid Schedule

The quantities appearing in the bid schedule are approximate and are prepared for the comparison of bids. The Owner does not represent or warrant that the individual items or total quantities of the actual of work will correspond. 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 be increased, decreased or omitted as provided in Section 104.

102.4.00 Examination of Proposal Documents and the Work Site

The bidder is expected to examine the site of the proposed work and the proposal form 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 proposal documents.

The Owner will in no case be responsible for any loss or for any unanticipated costs that may be suffered by the contractor as a result of the contractor's failure to be fully informed regarding all conditions pertaining to the work.

The Owner may or may not conduct sub-surface investigations in aid of design of the project. The Owner is under no obligation or requirement to conduct sub-surface investigations prior to bidding the project and the lack thereof in the bidding documents shall not constitute a basis of claim for changed conditions..

Where the Owner has conducted subsurface explorations, records of these investigations will be made known and available for the bidder's inspection and evaluation at the offices of the Owner. Upon request, the bidder may obtain a copy of these records.

While subsurface investigations may have been performed with reasonable care, there is no warranty or guaranty, either expressed or implied, that the subsurface investigation will disclose the actual conditions which will be encountered during the progress of the work. The sole purpose of these investigations is to furnish planning and design information for the project. When such data is shown in the plans as foundation data, the data shall not constitute a part of the contract.

102.5.00 Explanation or Interpretation of Proposal Documents

Any explanation desired by a bidder regarding the meaning or interpretation of proposal documents shall be requested in writing and in sufficient time to allow for a reply before the submission of the bid. Oral explanations or instructions given before receiving bids on the project will not be binding. Any interpretation made will be in the form of an addendum to the specifications or drawings and will be furnished to all bidders. Bidders shall acknowledge addenda in their proposals.

102.6.00 Changes in Proposal Documents Prior to Opening Bids

The Owner reserves the right, at any time prior to the time of opening proposals, to make changes or corrections in proposal documents. Bidders will be notified of such changes or corrections by letter or telegram sent to the bidder's address as it

appears in the files of the Owner, or an announcement of such changes or corrections will be made immediately prior to the opening of proposals. When such changes are made, bidders will be allowed to withdraw their proposals or to modify the proposals to account for the changes.

The Owner will not be responsible for failure of bidders to receive notifications sent out as above stated or for failure of bidders to withdraw their proposals after announcement of changes or corrections in proposal documents. All proposals opened will be understood to be based upon the changed or corrected proposal documents. Proposals will be subject to corrections as to changed quantities, extensions, and amounts for comparison of bids.

102.7.00 Preparation of Proposals

The bidder shall submit the proposal upon the forms furnished by the Owner. The filling in of the blank spaces shall be done in accordance with the apparent intent. The bidder shall specify a unit price, in figures and words, for each pay item for which a quantity is given and shall show the products, in figures, of the respective unit prices and quantities in the column provided for that purpose and the total amount of the proposal obtained by adding the amounts of the several items. When an item in the proposal contains a choice to be made by the bidder, the bidder shall indicate a choice. All figures shall be in ink or typed. Erasures, changes, and corrections shall be initialed by the bidder.

The bidder's proposal must be signed in ink by the bidder or by an agent of the bidder. The contractor shall include the name and address of all parties and persons who have an interest in the submitted bid. The contractor shall sign all other statements which may be required in the proposal form.

102.8.00 Proposal Guaranty

Each proposal shall be accompanied by a cashier's check, a certified check, or a proposal bond, payable to the Owner in the amount of FIVE percent (5%) of the total amount bid including additive alternates but not deductive alternates, as applicable.

If the successful bidder fails to execute the contract and deliver the executed contract with the performance and payment bond to the Owner within ten work days from the date on which the contract is received by the bidder, the cashier's check, certified check, or proposal bond may be forfeited to the Owner.

102.9.00 Delivery of Proposals

Each proposal must be presented or delivered under sealed cover to the Owner at the specified place prior to the time scheduled for opening and reading of proposals. The proposal should be identified by a notation, on the outside of the cover, identifying it as a proposal and the name of the project. Proposals presented or delivered after the scheduled time will not be opened or considered.

102.10.00 Withdrawal or Modification of Proposals

Upon written request of the bidder, a proposal may be withdrawn prior to the time scheduled for opening and reading of proposals. Negligence on the part of the bidder in preparing the proposal confers no right to withdraw the proposal after said scheduled time.

Change in a delivered proposal will be permitted only if a request for making such modification is submitted in writing, signed by the bidder, and the specific modification is received prior to the time scheduled for the opening of proposals.

102.11.00 Opening and Comparison of Proposals

Proposals will be opened and read publicly at the time and place indicated in the advertisement.

The proposals for each project will be compared on the basis of total cost including alternates. Adjustments shall be made for alternate items and for any specified or authorized reductions, additions, or changes after award of the project and prior to execution of the "Agreement Between Owner and Contractor". In the event of a conflict between the unit price in words and the unit price in numbers, the price in words shall control. In case of conflict between a unit price and the corresponding extended amount, the unit price shall govern.

The results of the comparisons and considerations will be made available to the public within a reasonable time after opening of the proposals.

102.12.00 Consideration of Proposals

The Owner reserves the right to reject any or all proposals and waive irregularities not affecting substantial rights in accordance with ORS 279.

Proposals will be considered irregular and may be rejected for any of the following reasons.

a) If the proposal is not submitted on the standard proposal form or is not completed;

b) If the proposal contains or is accompanied by conditions, offers, reservations, or statements concerning limitations, qualifications, contingencies, combination of bids, alternate bids, or deductions other than authorized;

c) If the proposal contains any unauthorized alteration;

d) If the proposal contains any erasure or correction of a bidder's entry which is not initialed by the bidder;

e) If the proposal is not in conformity with law; or

f) If the proposal is not accompanied by a proposal guaranty.

102.13.00 Return of Proposal Guaranties

All proposal guaranties, except those of the two low bidders, will be released within ten calendar days after the date of proposal opening. The proposal guaranties of the two low bidders will be released within ten calendar days after the contract has been entered into and signed by the Owner.

103 Award and Execution of Contract

103 Award and Execution of Contract

103.1.00 Contents of Contract

The contents of the contract shall be stated in the AAgreement Between Owner and Contractor@ and may include, but are not be limited to, the standard specifications and drawings, special provisions, plans, bid schedule, the method of payment, the signed proposal, the performance and payment bond, and the executed agreement.

103.2.00 Award of Contract

The award will be made by the Owner to the responsible bidder submitting an acceptable proposal with the lowest total bid. In determining the lowest acceptable bid, the Owner may take into account, among other factors:

a) The prices bid including discounts;

b) The time of completion or delivery proposed between equal bids;

c) The relative merits and performance of any item specifically proposed by the bidder;

d) Any variation in maintenance and warranty period specially proposed by the bidder in excess of minimums specified;

e) The realistic balance of prices in the proposals for various units of work; and,

f) The experience and ability of the bidder to perform the work.

The Owner reserves the right to waive informalities or irregularities in the proposals. Determination of the lowest acceptable bidder and award may be subject to review and determination by the Owner as to the legal sufficiency of any proposal submitted.

The award of contract, or the rejection of all bids, will be made by the Owner within 45 calendar days after the date of opening of the proposals.

103.3.00 Performance and Payment Bond

The performance and payment bond to be furnished by the successful bidder shall be the bond of a surety company authorized to transact business in the State of Oregon. The bond must be acceptable to the Owner. The amount of the performance and payment bond shall be the same as the amount of the contract.

The performance and payment bond must be signed by the surety company's Attorney-in-Fact. The surety's seal must also be affixed to the performance and payment bond. Power of Attorney for the Attorney-in-Fact must be attached to the bond.

103.4.00 Execution of the Contract

The bidder to whom the contract is awarded shall, within ten work days from the date of receipt, deliver to the Owner the fully executed contract along with required insurance certificates and performance and payment bonds. The Owner will execute the contract within ten work days and forward a copy to the contractor.

103.5.00 Failure to Execute Contract

Failure on the part of the bidder to execute the contract in accordance with subsection 103.4.00 will be just cause for cancellation of the award and forfeiture of the proposal guaranty. The forfeited proposal guaranty shall become the property of the Owner as liquidation of damages sustained by the breach of contract by the bidder. The Owner may then award the contract to the next lowest acceptable bidder, re-advertise the work, or take such other course the Owner deems expedient.

103.6.00 Notice to Proceed

After the contract has been executed and the performance and payment bond and all required insurance certificates have been received and approved by the Owner, the engineer will issue a written notice to proceed.

104 Scope of Work

104 Scope of Work

104.1.00 Intent of Contract

The intent of the contract is to provide for the construction and completion of the work described. The contractor shall furnish all labor, materials, equipment, tools, transportation, supplies, and incidentals required to complete the work in accordance with the contract.

The contractor shall perform all work in accordance with the lines, grades, typical cross sections, dimensions and other data shown on the plans or as modified by written orders from the engineer, and all other work determined by the engineer as necessary for the proper prosecution and completion of the work.

104.2.00 Plans and Specifications

The standard specifications, supplemental specifications, plans, special provisions, and all supplementary documents are essential to the contract. A requirement occurring in one is as binding as though occurring in all. All are intended to be complementary and to describe and provide for the complete work.

In case of discrepancy or conflict in the plans, standard specifications, supplemental standard specifications, and special provisions, they shall govern in the following order.

a) Standard Specifications

b) Standard or general plans

c) Plans specifically applicable to the project

d) Special Provisions

e) Supplemental Standard Specifications

Dimensions written on the plans shall govern over scaled dimensions.

The intent of the plans and specifications is to prescribe the details for the construction of the work which the contractor is to perform. Where the specifications or plans describe portions of the work in general terms, but not in complete detail, the best general practice is to prevail and only materials and workmanship of the first quality may be used.

If a conflict, error, omission, or lack of detailed description is discovered in the contract documents, the contractor shall immediately notify the engineer and request clarification. The engineer will resolve the conflict and make any corrections and interpretations necessary to fulfill the intent of the plans and specifications.

104.3.00 Working Drawings

The contractor will supplement the Owner's prepared plans with working drawings as necessary and as specified. When working drawings or other drawings are required, the drawings shall be prepared in accordance with current modern engineering practice. Drawings shall be of a size and scale that will clearly show all necessary details and shall be transmitted to the engineer for review before commencing the work. A minimum of five copies shall be furnished. Materials shall not be furnished or fabricated nor any work done before the drawings are approved.

The engineer will review the working drawings and note any comments on the drawings. Working drawings submitted as specified will be processed and returned within 21 calendar days of receipt by the engineer. If the drawings are not returned within 21 calendar days, the engineer may grant an extension of the contract time equal to any delay in work caused by the excess review time.

The engineer's review will not relieve the contractor of any responsibilities under the contract. The contractor shall be responsible for correcting errors or omissions in the drawings and deviations from the specified work unless such errors, omissions, or deviations were specifically called to the attention of, and approved by, the engineer. The contractor is responsible for the correctness of the drawings, shop fits, and field connections, and the results obtained by use of such drawings.

104.4.00 Changes in Work

The Owner may change the plans, specifications, character of the work, or quantity of work, provided the total value of all such changes, both additive and deductive, does not exceed the following.

a) An increase or decrease of more than 25 percent of the total cost of the work calculated from the original proposal quantities and the unit contract prices; or,
b) An increase or decrease of more than 25 percent in the quantity of any one major contract item.

For condition b) above, a major item is defined as any item that amounts to 10 percent or more of the total contract price. If it is necessary to exceed this limitation, the change shall be by written supplemental agreement between the contractor and Owner.

Any change shall be in writing and state the dollar value, method of payment, and any adjustments in contract time, and shall provide for the signatures of the contractor and Owner.

Changes in the plans and specifications, requested in writing by the contractor, which do not materially affect the work, may be granted by the engineer. Payment will be made in accordance with Section 109.

104.5.00 Changed Conditions

The contractor shall notify the engineer of changed work site conditions upon their discovery and before they are disturbed. Changed conditions are as follows.

a) Subsurface or latent physical conditions differing materially from those represented in the contract; or,
b) Unknown physical conditions of an unusual nature differing materially from those ordinarily encountered and generally recognized as inherent in the work.

The engineer will promptly investigate all changed conditions. If the engineer determines that the changed conditions will materially increase or decrease the costs of any portion of the work, the engineer will make an equitable adjustment in the amount of compensation to be paid for the performance of that part of the work involved, the time required, or both. If the engineer determines that the changed conditions do not justify an adjustment in compensation, and the contractor disagrees with the engineer's determination, the contractor may submit a written notice of dispute to the engineer.

104.6.00 Disputed Work

If the contractor considers that a part of the required work is outside the scope of the contract or considers any ruling of the engineer to be unfair, the contractor shall:

a) immediately give oral notice to the engineer;

b) before performing the work, obtain a written order from the engineer;

c) within 24 hours of receiving the written order, confirm the notice of dispute in writing; and

d) within ten calendar days after receipt of the written order, file a written protest with the engineer stating clearly and in detail the basis of objection, and include an itemized statement of any extra costs which have resulted from the disputed work.

If the contractor fails to comply with the above procedure, the engineer's ruling shall be final and conclusive and the contractor shall have no claim for additional compensation or time.

Although not to be construed as proceeding under extra work provisions, the contractor shall keep and furnish records of all disputed work.

104.7.00 Extra Work

Upon the written order of the engineer, the contractor shall perform extra work. If extra work is of a kind for which specifications are given in the contract, the extra work shall be performed in accordance with the contract. If extra work is of a kind not covered by the contract, the extra work shall be performed as ordered by the engineer in writing.

Payment for extra work will be as set forth in Section 109.

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105 Control of Work

105 Control of Work

105.1.00 Authority of the Engineer

The contractor shall perform all work to the satisfaction of the engineer. The contract and specifications give the engineer authority over the work. For the purpose of determining the contractor's duties, liabilities or entitlement to compensation or liability for damages, the decision of the engineer will be final on all questions including, but not limited to, the following.

a) Quality and acceptability of materials and work;

b) Classification and measurement of unit price work;

c) Acceptability of rates of progress on the work;

d) Interpretation of plans and specifications;

e) Fulfillment of the contract by the contractor; and,

f) Payments under the contract.

The contractor shall at all times carry out and fulfill the instructions and directions of the engineer relative to the work.

The work will not be considered complete until it has passed final inspection by the engineer and is accepted by the Owner and, in the case of private construction of public infrastructure, by the City. Interim approval of the work by the engineer during progress of the work signifies favorable opinion and qualified consent; it does not carry with it certification, assurance of completeness, assurance of quality, or assurance of accuracy concerning details, dimensions, and quantities. Such approval will not relieve the contractor from responsibility for errors, for improper fabrication, for failure to conform with requirements, or for other deficiencies.

105.2.00 Authority of Inspectors

Inspectors have the authority to:

a) Inspect all work done and materials furnished including preparation, fabrication, or manufacture of materials to be used;

b) Report to the engineer about the progress of the work and the manner it is performed;

c) Report to the engineer and notify the contractor when materials furnished or work performed by the contractor fail to meet the requirements of the plans and specifications.

d) Orally reject defective work;

e) Temporarily suspend work being done improperly until the engineer can render a decision; and,

f) Additional authority that may be delegated by the engineer or Owner.

Inspectors are not authorized to:

a) Accept work; or,

b) Alter or waive the provisions of the contract.

105.3.00 Inspection

The contractor shall allow the engineer every reasonable facility necessary to obtain information about type and quality of materials used in the work, methods used to complete the work, and progress of the work. The engineer and the inspector shall be allowed access to all parts of the work to ascertain whether or not the work is performed in accordance with the requirements and intent of the contract.

The contractor shall furnish, at no expense to the Owner, samples required for testing purposes. The contractor shall, at any time before final acceptance of the work, remove or uncover portions of the work as directed by the engineer. The

contractor shall restore the portions of the work to the standard required by the contract. If the exposed work is acceptable, the uncovering and restoring of the work will be paid for as extra work. If the exposed work is unacceptable, the uncovering and restoring of the work shall be at the expense of the contractor. Any work done or materials used without approval of the engineer may be ordered removed and replaced at no expense to the Owner.

When the work affects or may affect property of any other unit of government than the City of Lowell or any political subdivision, utility, or railroad corporation, representatives of that organization shall have the right to inspect the work. Such inspection shall not make any other unit of government, political subdivision, utility, or any railroad corporation a party to the contract and shall not interfere with the rights of the parties of the contract.

105.4.00 Responsibilities of the Contractor

The contractor shall be responsible for any process control sampling, testing, measurement, and inspection needed to insure that the finished work complies with specifications. When density testing is required for assurance and/or acceptance testing, the contractor shall furnish and operate the nuclear gauge or shall retain an independent testing firm to perform the compaction testing. The testing shall be conducted under the observation of the engineer and performed on all surfaces regardless of density requirements unless otherwise directed by the engineer. All test results shall be provided in written report form to the engineer.

The contractor shall give the attention necessary to keep the work progressing at a rate satisfactory to the engineer. The contractor shall provide, at all times, a competent superintendent for all work on the project. The superintendent shall be readily accessible on a daily basis, have a set of plans, specifications, special provisions, and addenda, and be experienced in the type of work being performed. The superintendent shall have the authority to receive and carry out, without delay, the engineer's instructions and orders and to make arrangements for necessary materials, equipment, and labor.

The contractor shall allow the engineer access at all times, during normal office hours, to books and records of the contractor and the contractor's subcontractors which pertain to the contract, and furnish the engineer facts necessary to determine actual cost of any part or all of the work. The engineer will consider a request for confidentiality to protect trade secrets.

If the engineer is not provided proper facilities by the contractor for keeping strict accounting of costs, then the contractor agrees to waive any claim for extra compensation.

105.5.00 Correspondence

The engineer's written correspondence to the contractor shall be delivered to the contractor or the contractor's representative by personal delivery or by mailing or delivering to the address given in the contract.

The contractor's written correspondence to the engineer shall be delivered to the engineer or the engineer's representative by personal delivery or by mailing or delivering to the office of the engineer.

When available, electronic mail services may be used.

105.6.00 Notifications Relative to Contractor's Activities

The contractor shall obtain prior approval from the City of Lowell for the closing or partial closing of any road, street, alley or other public thoroughfare. The contractor shall give two work days' advance notice of such closure to all affected agencies and individuals including, but not limited to, the sheriff, police, fire, ambulance, public or private transportation services, public or private school systems, solid waste services, postal and parcel delivery services, and affected businesses and residents.

The contractor shall notify the Utility Notification Center. (800.332.2344) at least two work days prior to commencing work in order to give the utilities reasonable opportunity to mark the location of their facilities.

The contractor shall notify all agencies affected by the operations so as to coordinate the work with other agencies.

Notification shall include, but not be limited to, the time of commencement and completion of the work, the names of streets or location of alleys to be closed, the schedule of operations, and routes of detours where possible. The engineer shall have the right of review of such notices.

The contractor shall be responsible for renotifying the affected agencies when the schedule of work is changed. Damages or claims resulting from improper or insufficient notification to the affected agencies shall be the responsibility of the contractor.

105.7.00 Utilities and Existing Improvements

105.7.01 General

Information shown on the plans as to the location of existing water courses and utilities has been compiled from available sources and may not be accurate. The contractor shall determine the location and nature of affected water courses, utilities or underground structures prior to commencing the work.

The contractor shall provide for the flow of water courses and other essential utilities that may be interrupted during the progress of the work and shall restore such water courses or utilities after completion of the work.

The adjustment of utilities or the altering or shifting of existing utility lines, facilities, or systems in any manner may be temporary or permanent. This includes but is not limited to improvement, connection, disconnection, relocation, or removal.

Existing utilities requiring adjustment may be adjusted by the utility owner before, during, or after project construction. The plans will not normally show the new location of utilities that have been or will be adjusted.

105.7.02 Owner's Responsibilities

Before proposals are received, the Owner will make preliminary arrangements for planned adjustment of utilities.

105.7.03 Contractor's Responsibilities

After the contract is awarded, the contractor shall contact utility Owners and verify all utility involvement within the work.

The contractor will coordinate project construction with the adjustment of utilities, take all necessary precautions to prevent disturbing the utilities, and perform work so that utility Owners and users are caused a minimum of inconvenience.

The contractor shall protect from damage or disturbance any utility which is to remain within the right of way. When an existing utility requires adjustment, the contractor shall protect it from damage or disturbance and promptly notify the engineer.

The contractor shall report to the engineer any utility Owner who fails to cooperate or fails to follow the planned utility adjustment.

To ease or streamline the work, the contractor may desire to adjust the utilities by asking the utility owners to move, remove, or alter their equipment in ways other than those shown on the plans or in the contract documents. The contractor shall conduct the negotiations, make the arrangements, and pay all costs that arise from such changes.

105.8.00 Cooperation Between Contractors

The Owner reserves the right to contract for and perform other or additional work on or near the work covered by this contract.

When separate contracts are let within the work area, each contractor involved will submit a realistic progress schedule for the Owner's approval. Each party shall have the right to review all schedules. After consultations with the contractors, the Owner will determine acceptable schedules.

Each contractor involved shall assume all liability in connection with the contract and shall protect and save harmless the Owner from any and all damages or claims that may arise because of inconvenience, delay, or loss experienced by the contractor due to the presence and operations of other contractors working on or near the same project.

The contractor shall arrange the work and shall place and dispose of the materials being used so as not to interfere with the operations of other contractors on or near the same project.

When a dispute arises between two or more contractors engaged on work in the same or adjacent areas as to the respective rights of each, the engineer will determine the matters at issue and define the respective rights of the various interests involved. The engineer's decision shall be final and binding on all parties concerned.

If the contract gives notice of other work that may affect the work of this contract, the coordination of the work shall be taken into account by the contractor, and any resulting costs shall be considered incidental work.

In an emergency, the contractor that is immediately accessible may make repairs to a facility or utility of another contractor.

105.9.00 Construction Stakes, Lines, and Grades

105.9.01 General

No work shall be done until the engineer establishes field controls. Work performed without field controls will be subject to removal.

105.9.02 Owner's Responsibilities

The engineer shall:

a) Lay out and set construction stakes and marks needed to establish the lines, grades, slopes, cross sections, and curve superelevations for road work;

b) Provide one set of control stakes for line and grade for each additional phase of work; and,

c) Deduct from payments due or to become due to the contractor all costs to replace stakes and marks carelessly or willfully damaged or destroyed by the contractor's operation.

105.9.03 Contractor's Responsibilities

The contractor shall:

a) Keep the engineer informed of staking requirements to provide the engineer with enough time to set stakes. Requests for stakes shall be made at least three work days before stakes are required;

b) Coordinate construction activity so as to provide an area for the engineer to perform surveying work efficiently and safely;

c) Take full responsibility for detailed dimensions, elevations, and slopes measured from engineer's stakes and marks;

d) Perform the work in a manner to preserve stakes and marks; and,

e) Set any reference lines for automatic control from the control stakes provided.

105.10.00 Protection of Permanent Survey Markers

The contractor shall notify the engineer not less than seven work days prior to starting work so that the engineer may take necessary measures to insure the preservation of survey monuments, property corners, stakes, and bench marks. The contractor shall not disturb permanent survey monuments, stakes, or bench marks without the consent of the engineer, and shall notify the engineer and bear the expense of replacing any that are disturbed without permission. Replacement shall be done by a registered land surveyor.

When a change is made in the finished elevation of the pavement of any roadway in which a permanent survey monument is located, the monument cover shall be adjusted to the new grade without disturbing the underlying monument.

105.11.00 Protection of Property

The contractor shall protect all public and private property that may be endangered by operations and take every precaution to avoid damage to such property.

The contractor shall restore any public or private improvement, facility, or structure located within the right of way that is damaged in the execution of the work. The contractor shall restore such facilities to as good or better condition than that existing before the damage occurred, or make a suitable settlement with the Owner of the damaged property.

The contractor shall give at least ten work days' notice to occupants of buildings on property adjacent to the work to permit the occupants to remove vehicles, trailers, other possessions, and salvage or relocate plants, trees, fences, sprinkler systems, or other improvements designated for removal or that might be destroyed or damaged by work operations. Mailboxes removed during the course of construction shall be relocated as specified or directed by the engineer and in accordance with the Postal Service requirements. Signs which must be removed in the course of construction shall be relocated or stored as directed by the engineer. Signs damaged or lost as a result of carelessness on the part of the contractor shall be replaced by the contractor at no expense to the Owner.

The contractor shall protect all designated trees and planted areas within the right of way and shall exercise care and conduct operations so as to minimize damage.

The contractor shall review with the engineer the location, limits and methods to be used prior to clearing work. Clearing and grubbing shall be performed in strict compliance with all local, state and federal laws and requirements pertaining to clearing, disposal, and burning, and particularly in conformity with the provisions of ORS 477.

105.12.00 Preservation of Historic Objects

If historic objects of archeological or paleontological nature, including ruins, sites, buildings, artifacts, fossils, and other objects of antiquity are encountered within the area in which the contractor's operations are performed, the contractor shall postpone operations in the area, preserve the objects from disturbance or damage, and notify the engineer of their existence and location.

Upon receipt of notification, the engineer will arrange for the disposition of the objects or for the recording of relative data, and will notify the contractor when it is appropriate to proceed with the work in the affected area. If the contractor is directed by the engineer to perform any work in salvaging historic objects, the work will be paid as extra work.

105.13.00 Temporary Traffic Control

Temporary traffic control shall conform to Section 202.

105.14.00 Protection of Work

The contractor shall protect and maintain the work during construction and until the final inspection has been completed. This maintenance shall constitute continuous and effective work prosecuted day by day, with adequate equipment and forces so the work is kept in satisfactory condition at all times.

When the contract is for the placing of a course upon a grade or sub-grade previously constructed, the contractor shall protect and maintain the previous grade or sub-grade during the work.

The cost of maintenance work during construction shall be considered incidental work.

If the contractor fails to protect or maintain the work, the engineer will immediately notify the contractor. If the contractor fails to correct the deficiency within 24 hours after receipt of such notice, the engineer may correct the deficiency. The cost of this maintenance shall be borne by the contractor and may be deducted from payments due or to become due to the contractor.

If the contractor delays in completing shoulders, drainage structures, or other features of the work, the engineer may order all or a portion of the project opened to traffic. In such event, the contractor will not be relieved of the liability and responsibility, including maintenance and traffic control, during the period the work is opened to traffic prior to final acceptance. The contractor shall conduct the remainder of the work in a manner that will cause the least obstruction to traffic and shall bear any additional expense attributable to the presence of traffic.

105.15.00 Maintenance of Work After Acceptance

At the request of the contractor and with the approval of the engineer, the contractor will be relieved of the duty of maintaining and protecting certain portions of the work that are approved to be placed in service and which have been completed in accordance with the contract.

Such approval by the engineer will relieve the contractor of responsibility for injury or damage to completed portions of the work resulting from use by the public or from the action of the elements or from any other cause, excepting injury or damage resulting from the contractor's operations or negligence. The contractor will not be required to clean up such portions of the improvement prior to field acceptance, excepting for such items of work as result from the contractor's operations.

Nothing in this section shall be construed as relieving the contractor from full responsibility for correcting defective work found prior to end of the warranty period.

105.16.00 Use of Light, Power and Water

The contractor shall furnish temporary light, power and water complete with connecting piping, wiring, lamps and equipment necessary for the work. The contractor shall obtain all authorizations and permits and bear all costs in connection with temporary services and facilities. The contractor shall remove temporary facilities upon completion of work.

105.17.00 Subsurface Conditions

Information that may be available from the engineer regarding subsurface conditions and groundwater elevations is offered as supplementary information only. Neither the engineer nor the Owner assumes any responsibility for the accuracy, completeness, or interpretation of such supplementary information. Determination of the actual subsurface conditions is the responsibility of the contractor.

Logs of test holes, test pits, soils reports, groundwater levels, and other supplementary subsurface information are offered as available information of underlying materials and conditions at the locations actually tested.

105.18.00 Verbal Agreements

No verbal agreement or conversation with any officer, agent or employee of the Owner or the City of Lowell, either before or after execution of the contract, shall affect or modify any of the terms or obligations contained in the contract.

105.19.00 Environmental Pollution Control

105.19.01 General

The contractor shall conduct the work in accordance with local laws and ordinances, with the applicable sections of ORS 449, with all regulations of the Department of Environmental Quality and other agencies of the state, and with all laws and regulations of the Federal government. All practicable means shall be exercised to prevent, control and abate the pollution of waters and to maintain reasonable purity of the air.

105.19.02 Dust Control

The contractor shall abate dust nuisance by cleaning up, sweeping, sprinkling with water, or other means as necessary to accomplish the suppression of dust.

105.19.03 Erosion, Sedimentation and Water Pollution Control

The contractor shall conduct the work in conformity to all applicable laws and regulations and permits governing erosion, sedimentation and water pollution control.

Where required by City Ordinance, State or Federal Laws, the contractor shall submit a written plan to the engineer that will include design, materials, method of installation, maintenance schedule, and removal. Erosion control manuals are available from Unified Sewerage Agency, Clackamas County, City of Eugene, City of Springfield and City of Portland.

105.20.00 Removal of Unacceptable or Unauthorized Work

If the engineer finds the work performed is not in conformance with the contract, the engineer will:

a) Reject the work and have it replaced or otherwise corrected by the contractor at no expense to the Owner, or;

b) Accept the work as suitable for the intended purpose, document the basis of acceptance, and adjust the amount paid to the contractor.

The engineer's judgment concerning acceptability of work will be final. Unacceptable work found before final acceptance of the work shall be corrected or removed as directed by the engineer and replaced by work and materials conforming to the requirements of the contract.

Unauthorized work will not be paid for and may be ordered removed at the contractor's expense.

Unauthorized work is:

a) Work done beyond lines shown on the plans or established by the engineer;

b) Work done contrary to the engineer's instructions; or,

c) Work done without the engineer's written authorization.

If, when ordered by the engineer, the contractor fails to correct or remove unacceptable work or to remove unauthorized work, the engineer may have the correction or removal and replacement done by others. The cost shall be borne by the contractor and may be deducted from payments due or to become due to the contractor.

105.21.00 Cleanup

As the work progresses and immediately after completion of the work, the contractor shall clean up and remove all refuse and unused materials of any kind resulting from the work. If the contractor fails to commence the cleanup within 24 hours after directed by the engineer, the engineer may have the work performed by others. The cost shall be borne by the contractor and may be deducted from payments due or to become due to the contractor.

After the work is completed and before final acceptance of the work, all areas affected by the work shall be neatly finished and all equipment, temporary structures, rubbish and waste shall be removed from the work area.

105.22.00 Final Inspection

When all on site construction work on the project is completed, the contractor shall notify the engineer in writing that the project is ready for final inspection. The engineer will make an inspection within 15 calendar days of receiving notification. The engineer will notify the contractor, in writing, within ten calendar days thereafter. If all construction work required by the contract is found complete and satisfactory, this inspection will constitute the final inspection.

If any work is found incomplete or unsatisfactory, the engineer will give written instructions as to what shall be done to satisfactorily complete the work. After complying with the engineer's instructions, the contractor shall follow the above procedures of notification, requesting a final inspection.

The engineer will issue a notice to the contractor when all the following work is satisfactorily completed.

a) All work required under the contract;

b) All change order work;

c) The final trimming and cleanup work; and,

d) All required test results, certifications, bills, forms, and other documents are received from the contractor.

105.23.00 Final Acceptance

See Section 108.

106 Control of Materials

106 Control of Materials

106.1.00 Preference for Use of Oregon Products

Preference may be given to materials produced or manufactured in Oregon is so indicated in the Special Conditions. This provision does not apply to contracts on projects financed wholly or in part by federal funds.

106.2.00 Quality of Materials

The contractor shall use only new materials, parts, products, and equipment which conform to the specifications. The contractor shall determine the kind of work, amount of work, and other factors that may be necessary or involved in furnishing the products and materials. Materials and products that are unsuitable for the work will be rejected by the engineer.

106.3.00 Sampling and Testing

The contractor shall be responsible for process control testing necessary to insure that materials and performance comply with the specifications. The engineer reserves the right to require samples and to test products for compliance regardless of prior certification. Testing of materials will be made in accordance with the methods described or designated in the specifications, or as required, and may be conducted at any time during the production, fabrication, preparation and use of the materials.

Testing to be provided by independent organizations and paid for by the Contractor shall include, but is not necessarily limited to, water line pressure testing, sewer line pressure or vacuum testing, manhole pressure or vacuum tests, compaction testing, material gradation testing, concrete compressive strength, asphalt temperature, asphalt extraction, asphaltic concrete aggregate testing. Frequency of compaction, asphalt and concrete testing shall be as called for in the respective technical specifications sections.

When the engineer determines that tests are necessary, the tests will be ordered by and at the expense of the Contractor unless otherwise specified. The contractor shall furnish the required samples without charge and shall provide suitable facilities for collecting samples and withhold from use the materials represented by the samples until tests have been made and the materials found to comply with the specifications. The contractor shall provide safety measures and devices to protect those who take samples and perform tests. Samples shall be made available in ample time to permit testing of the materials prior to use. The contractor shall have no claim for any delay caused by awaiting test results.

ODOT (or OSHD) test methods have been called out in many cases. Where ODOT has changed the test method called out, or has given the test method a new number, or where ODOT has deleted a tested method and replaced it with a callout to an AASHTO or ASTM (or other) test method, the test method to be used shall be the most current method used by ODOT for the test specified. In the absence of any reference specification, materials shall meet the specifications and requirements of the ASTM, AASHTO, or AWWA. When there is no coverage under ASTM, AASHTO, or AWWA, materials shall meet the commercial standards of the Commodity Standards Division of the U.S. Department of Commerce. Lacking such coverage, the materials shall meet requirements established by reputable industry for high quality products of the kind involved.

All required testing, including that required of the Contractor, shall be performed by or handled through a testing laboratory approved by the engineer. Test results shall be provided in English units for projects designed in English units and in metric units for projects designed in metric units. If tests are conducted at the expense of the Owner, and the materials are found out of compliance with the specifications, the contractor shall bear all costs for testing of replacement materials.

106.4.00 Certification of Commercial Products

For commercial products, the engineer may accept from the contractor the manufacturer's certification of the product involved under the following conditions.

a) The certification shall state that the named product conforms to the Owner's requirements and that representative samples have been tested as specified.

b) The certification shall include a certified copy of the test results or a certification that such test results are on file with the manufacturer and will be furnished to the engineer upon request.

c) The certification shall give the name and address of the manufacturer, the testing agency, the dates of tests, and the means of identification that will permit field determination of the product delivered.

d) The certification shall be in duplicate. One copy shall be sent with the shipment, the other sent directly to the engineer.

e) The Owner will not be responsible for any costs involved in the certification.

106.5.00 Inspection Requirements

The contractor shall allow access for the engineer to all parts of the work and to the plants of producers and fabricators and will furnish the engineer with every reasonable facility for ascertaining that the materials are in accordance with the contract.

106.6.00 Storage and Protection of Materials

Materials shall be stored 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 use in the work. Stored materials shall be located to facilitate prompt inspection.

When shown on the plans or approved by the engineer, portions of the right of way may be used for storage purposes and for the placing of the contractor=s plant and equipment. Any additional space required shall be provided by the contractor at the contractor=s expense.

The contractor shall not use private property for storage purposes without written permission of the property Owner or lessee. The contractor shall furnish copies of such written permission to the engineer.

106.7.00 Rejected Materials

Materials rejected by the engineer shall be removed from the site of the work. Rejected material on which defects have been corrected shall not be used until written approval has been given by the engineer. Failure of the contractor to comply with the engineer's directions shall be cause for the engineer to have the defective material removed from the work site and to deduct the cost of removal from payments due or to become due to the contractor.

106.8.00 Trade Names, Approved Substitutions

To establish a basis of quality, certain processes, types of machinery and equipment, or kinds of materials may be specified either by description or process, by designating a manufacturer by name and referring to specific brands or products, or by specifying a kind of material. It is not the intent of the specifications to exclude other processes, equipment or materials of equal value, utility or merit.

Whenever a process, manufacturer's name, brand, item, patented process or patented material is designated or described, it shall be implied that the words "or approved" follow such name, designation, or description. The determination of acceptable substitutes shall be the sole province of the engineer and substitutes shall not be ordered or furnished unless approved.

If the proposal includes a list of equipment, materials, or articles for which the contractor must name the manufacturer at the time of submission of the bid, no substitutions will be permitted without the approval of the engineer.

106.9.00 Mineral Deposits

When materials sources are shown or described in the contract, the Owner will acquire and make available to the contractor the right to take materials from the sources and the right to use the property for plant site, stockpiles and hauling roads.

The quality of the material in the mineral deposits may be acceptable, but the contractor shall determine the work required to produce finished products meeting the specifications. Because it is not feasible to ascertain from samples the quality of an entire deposit, variations will be considered usual and expected. The engineer may order use of material from any portion of a deposit and may reject portions of a deposit as unacceptable.

If the contractor elects to use material from sources other than those shown or described, the contractor shall acquire the necessary rights to take materials from the sources and shall bear all costs including those for development and exploration and costs which may result from an increase in length of haul. The use of material from such sources will not be permitted until the engineer determines, from representative samples obtained and tested at the expense of the contractor, that satisfactory materials are available from the source.

Gravel pits, other than commercially operated borrow pits, shall meet all local, state, and federal regulations.

106.10.00 Owner Furnished Equipment and Materials

Equipment and materials furnished by the Owner will be delivered or made available to the contractor at the locations specified. An inspection of the Owner-furnished equipment and materials shall be made at the time of delivery to the contractor to satisfy the Owner and the contractor that the quantity and quality of the equipment and material is satisfactory for use in the work. Thereafter, the contractor will be responsible for the equipment and material. Deductions will be made from payments due or to become due to the contractor for any shortages, deficiencies, or damages which may occur after such delivery, and for any demurrage charges.

107 Legal Relations and Responsibilities

107 Legal Relations and Responsibilities

107.1.00 Laws and Regulations

107.1.01 General

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 affects the conduct of the work. Where these specifications are in conflict with regulations of other agencies having jurisdiction over the work or over the area in which the work is performed, the more restrictive standards or regulations shall apply. The contractor shall at all times observe and comply with all laws, ordinances, regulations, orders, and decrees. The contractor shall protect and indemnify the Owner and the Owner's representatives against any claim or liability arising from or based on the violation of any law, ordinance, regulation, order or decree, by the contractor, subcontractors, suppliers of materials or services, or others engaged by the contractor or contractor's employees.

107.1.02 Protection of the Environment

The contractor's attention is directed to ORS 279 dealing with the prevention of environmental pollution and the preservation of natural resources that affect the performance of the work. Any unforeseen work relating to the prevention of environmental pollution or the preservation of natural resources shall be considered extra work.

The contractor shall conduct operations in conformity to the applicable sections of ORS Chapter 449, laws amendatory thereto, and all pertinent regulations of the Department of Environmental Quality and other agencies of the state and the federal government, as well as ordinances or resolutions enacted or adopted by local authorities. It is public policy that all practicable means be exercised to prevent, control, and abate the pollution of waters of the state, and to maintain reasonable purity of the air by the control or abatement of air pollution.

The contractor shall exercise every reasonable precaution throughout the life of the contract to safeguard the air resources of the state by controlling or abating air pollution, as defined in ORS 468.275, in accord with the policy and purpose set forth in ORS 468.280 and 468.285.

Federal, state, and local agencies having a responsibilities and/or jurisdiction relating to the environment include, but are not limited to, the following agencies:

U.S. Department of Agriculture
U.S. Department of Health and Human Services
U.S. Environmental Protection Agency
U.S. Corps of Engineers
U.S. Coast Guard
U.S. Department of Interior
U.S. Department of Labor
U.S. Department of Transportation
U.S. Forest Service
Heritage Conservation and Recreation Services
Oregon Department of Environmental Quality
Oregon Department of Geology and Mineral Industries
Oregon Department of Agriculture
Oregon Department of Energy
Oregon Department of Fish and Wildlife
Oregon Department of Forestry
Oregon Department of Human Resources
Oregon Department of Water Resources
Oregon Division of State Lands
Oregon Land Conservation and Development Commission
Oregon Soil and Water Conservation Commission
Local County Courts and Boards of Commissioners
Local City Councils and Commissions
Local Planning Commissions

107.2.00 Assignment of Contract and Subletting

The contractor agrees not to assign, transfer, convey or otherwise dispose of the contract or the right, title or interest therein either in whole or in part, or the power to execute such contract, to any person, firm or corporation without the written consent of the Owner.

No portion of the contract shall be sublet, subcontracted or performed by other than the contractor's own organization except with the written consent of the Owner. Requests for permission to sublet or subcontract any portion of the contract or to have any of the work performed by another organization shall be in writing and accompanied by a demonstration that the organization which will perform the work is experienced and equipped for such work.

Written consent to assign, transfer, convey, sublet, subcontract or otherwise dispose of any portion of the contract or to have portions of the work performed by other than the contractor's own organization shall not relieve the contractor of any responsibility under the contract or for the fulfillment of the contract.

The contractor shall perform with the contractor's own organization contract work amounting to not less than 50 percent of the amount of the contract as awarded, except that any items designated in the contract as specialty items may be performed by subcontract. The cost of any such specialty items may be deducted from the amount of the contract before computing the amount of work required to be performed by the contractor's own organization. The term "own organization" refers only to workers employed and paid directly by the contractor and equipment owned or rented by the contractor.

The contractor shall make payment for subcontract work, performance of specialty items and other contract work performed by others in the same units and on the same basis of measurement as apply under the contract.

In making payment to subcontractors and to others by whom work under the contract is performed, the contractor shall protect against the possibility of overpayment, and shall assume losses that result from overpayment. While the engineer may estimate the quantities of work performed and of materials on hand for inclusion in progress payments, there is no guarantee of the correctness of such estimates. No incorrect estimate, regardless of by whom or when given, will be binding upon the Owner in final settlement.

The contractor shall direct and coordinate the operations of subcontractors and others performing the work and shall insure that the orders of the engineer are promptly carried out. Failure of the contractor to control the work of subcontractors and other employees may result in the issuance of orders requiring the cancellation of the subcontracts and the removal of the subcontractors and other employees from the work site.

107.3.00 No Waiver of Legal Rights

The Owner shall not be precluded or estopped by any measurement, estimate, or certificate made either before or after the completion and acceptance of the work from showing the true amount and character of the work performed. The Owner shall not be precluded or estopped from recovering from the contractor and/or the contractor's sureties damages the Owner may sustain by reason of contractor's failure to comply with the terms of the contract. The acceptance, payment, or possession of the work by the Owner shall not constitute a waiver of any portion of the contract. A waiver of any breach of the contract shall not be held to be a waiver of any other subsequent breach.

107.4.00 Insurance

Neither the Owner nor their officers, employees and agents will not in any manner be answerable or accountable for any loss or damage from any cause whatsoever resulting to the work, or any part thereof, or to any of the equipment, materials or other things used or employed in prosecuting or completing the work.

The contractor shall carry, at a minimum, comprehensive or commercial general liability personal injury and property damage insurance in the amount of $1,000,000 aggregate total for all claims arising out of a single accident or occurrence. The contractor shall include the Owner, its officers, agents and employees as named insured on insurance policies issued for this project, or shall furnish an additional insured endorsement naming the same as additional insured to the contractor's existing public liability and property damage insurance.

The contractor shall carry, at a minimum, automobile liability in the amount of $1,000,000 aggregate total for all claims arising out of a single accident or occurrence. The automobile liability insurance may be written in combination with comprehensive or commercial general liability insurance.

In addition, the contractor shall insure the work for 100 percent of replacement value for the life of the contract against all loss or damage by fire, theft, vandalism and malicious mischief. The amount of the insurance may vary with the extent of the work completed but shall be at least equal to the replacement value of the work completed. The insurance policy or policies shall be in the names of the contractor and the Owner. Any loss shall be payable to the Owner, as trustee. Any payments made shall inure to the benefit of the Owner to the extent of the loss suffered by the Owner and the remaining balance for the loss suffered by the contractor.

Before the contract is executed, the contractor shall furnish to the Owner a certificate of insurance for the limits set out above which is to be in force and applicable to the project. The insurance coverage shall not be amended, altered, modified or cancelled without at least 30 days' notice mailed by registered mail to the engineer.

107.5.00 Industrial Accident Protection

The contractor, subcontractors, and all employers working under the contract are subject employers under the Oregon Workers' Compensation Law and shall comply with ORS 656.017, which requires workers' compensation coverage for all subject workers.

The industrial accident protection to be provided shall be in full compliance with ORS Chapters 656 and 864.

The contractor shall certify in the contract that the contractor is qualified either as a direct responsibility employer or a contributing employer; or is an independent contractor who will perform the work on this project without the assistance of others. If the contractor is going to perform the work on this project without the assistance of others, the contractor and Owner will jointly sign and file with the State Accident Insurance Fund Corporation a declaration that the services rendered under the contract will be rendered as those of an independent contractor.

If Workers' Compensation coverage is required, the contractor will not be permitted to begin work on the project until verification has been made of the coverage indicated on the contract form entitled "Certification of Workers Compensation Coverage." If coverage is provided by a carrier other than the state, verification cannot be made until the insurance carrier files the guarantee contract with the Workers' Compensation Board. Under Oregon law the carrier may delay 30 days after providing binding coverage before filing the guarantee contract. It is the contractor's responsibility to see that the insurance carrier has filed the guarantee contract with the Workers' Compensation Board.

107.6.00 Minimum Wage Rates

Projects which are financed wholly or in part by federal funds require compliance with the Davis-Bacon Act. On these projects wage rates set forth in the *Wage Determination Decision of the Secretary of Labor* bound with the contract documents will apply.

On projects which are not financed wholly or in part by federal funds the following will apply.

a) The contractor shall comply fully with ORS 279.348 through 279.361. The hourly rate of wage to be paid by any contractor or subcontractor to workers upon all public works shall be not less than the prevailing rate of wage for an hour's work in the same trade or occupation in the locality where such labor is performed. The obligation of a contractor or subcontractor to pay the prevailing rate of wage may be discharged by making the payments in cash, by the making of contributions of a type referred to in ORS 279.348, or by the assumption of an enforceable commitment to bear the costs of a plan or program of a type referred to in ORS 279.348, or any combination, where the aggregate of any such payments, contributions and costs is not less than the prevailing rate of wage.

b) After a contract is executed with any contractor or work is commenced, the amount of the prevailing rate of wage shall not be subject to attack in any legal proceeding by any contractor or subcontractor in connection with that contract.

c) It shall not be a defense in any legal proceeding that the prevailing rate of wage or overtime pay is less than the amount required to be in the specifications of a contract, or that there was an agreement between the employee and the employer to work at less than the wage rates required to be paid under this subsection.

d) Every contractor or subcontractor engaged on a project for which there is a contract shall keep the prevailing wage rates for that project posted in a conspicuous and accessible place in or about the project. Contractors and subcontractors can obtain copies of these wage rates from the Labor and Industries Commissioner without charge.

e) The minimum hourly rate of wage, not less than the prevailing rate of wage, which may be paid to workers in each trade or occupation employed in the performance of the contract either by the contractor or subcontractor or by other person doing or contracting to do the whole or part of the work contemplated by the contract shall be as set forth in the *Schedule of Minimum Hourly Wage Rates* bound with the contract documents.

f) The term "prevailing rate of wage" shall mean the rate of hourly wage including fringe benefits as determined by the Commissioner of the Bureau of Labor and Industries.

g) The contractor or contractor's surety and every subcontractor or subcontractor's surety shall submit to the engineer written statements, in a form prescribed by the Commissioner of the Bureau of Labor and Industries, certifying under oath the hourly rate of wage paid each worker employed upon the work, and further certifying that no worker employed upon the work has been paid less than the prevailing rate of wage or less than the minimum hourly rate of wage specified in the contract. Certified statements shall be submitted as follows.

For any project 90 days or less from the date of award of the contract to the date of completion of the work, the statements shall be submitted once before the first payment and once before final payment is made of any sum due under the contract.

For any project exceeding 90 days from the date of award of the contract to the date of completion of the work, the statements shall be submitted once before the first payment is made, at 90-day intervals thereafter, and once before final payment is made of any sum due under the contract.

h) The contractor is required to pay a fee to the Bureau of Labor and Industries pursuant to the provisions of ORS 279.352 (2) and Section 5 (1), Ch 594, 1995 Oregon Laws. The fee is one-tenth of one percent of the price of this contract, but not less than $100.00 nor more than $5,000.00, regardless of the contract price.

i) There is no representation on the part of the Owner that labor can be obtained at the hourly rates bound with the contract documents. It is the responsibility of bidders to inform themselves as to local labor conditions and prospective changes or adjustments of wage rates. No increase in the contract price shall be allowed or authorized as a result of the payment of wage rates in excess of those listed.

j) Workers engaged in the production and delivery of aggregates to be stockpiled and subsequently used in connection with the construction and maintenance of a public road are not required to be paid the prevailing rate of wage provided for in ORS 279.348 to 279.352.

107.7.00 Hours of Work and Rates of Pay

Pursuant to ORS 279.316, the contractor shall comply fully with ORS 279.334. On Federal Aid projects where provisions of ORS 279.334 are in conflict with federal requirements, the federal requirements will apply.

107.8.00 Certification of Contractor's Payroll

A certified copy of the contractor's or any subcontractor's current weekly payroll shall be submitted to the engineer. The certification shall be by the authorized officer or employee of the contractor or subcontractor who is responsible for payroll records, or payment of wages.

The certification shall affirm that the payroll covers only those laborers and mechanics employed and paid directly by the contractor or subcontractor, and that said payroll covers and includes all laborers and mechanics employed by the contractor or subcontractor in the performance of the work under the contract.

107.9.00 Labor

Any person employed on the project, by the contractor or a subcontractor, who, in the opinion of the engineer, does not perform in a proper and skillful manner or whose conduct interferes with the progress of the work shall, at the written request of the engineer, be removed from the project. That employee shall not be again employed on the project without the approval of the engineer.

The contractor's attention is directed to ORS Chapter 659, particularly Section 659.030, which sets forth unlawful employment practices including that of discrimination because of race, religion, color, sex, or national origin.

107.10.00 Payment of Obligations

The contractor shall promptly make payment to all persons supplying labor, equipment, supplies, or materials for the work. The contractor shall be responsible for any lien or claim filed against the Owner.

Failure to make payment of any claim when due may necessitate the Owner paying such claim to the person furnishing the work and charging the amount against payments due or to become due to the contractor. Such payment shall not relieve the contractor or contractor's surety from the contractor's obligation for any unpaid claims.

107.11.00 Permits, Licenses, and Taxes

The Owner shall obtain and pay for the following.

a) All permits required by the Coast Guard for crossing navigable streams;

b) All permits required by the Corps of Engineers for encroachments on navigable streams;

c) All permits required by the Division of State Lands for removal of materials from or depositing materials in waterways or wetlands;

d) All permits required by the state Department of Geology and Mineral Industries for operations in materials source or disposal areas; and,

e) All permits required from local agencies for construction of buildings or facilities.

The contractor shall:

a) License all vehicles that are subject to Oregon vehicle registration requirements;

b) Procure all other permits and licenses;

c) Pay all fees and taxes required for the work;

d) Comply with ORS 274.530 relating to lease of stream beds; and,

e) Comply with ORS 477.685 relating to clearing and fire hazards on forest lands.

107.12.00 Royalties and Patents

If the contractor employs any design, device, material or process covered by letters of patent or copyright, the contractor 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 Owner, 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 Owner 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.

107.13.00 Indemnification

The contractor shall indemnify and save harmless the Owner, and the Owner's 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 or property on account of the operations of the contractor, subcontractors or the employees of either; or on account of or in consequence of any neglect in safeguarding the work; or because of any act or omission, neglect or misconduct of the 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 any workman's compensation law or any other law, ordinance, order or decree; and so much of the money due the contractor under and by virtue of the contract as may be considered necessary by the Owner may be retained for the use of the Owner; or, in case no money is due, the contractor's surety may be held until such suit or suits, action or actions, claim or claims for injuries or damages have been settled and suitable evidence to that effect furnished to the Owner; except that money due the contractor will not be withheld when the contractor produces satisfactory evidence that the contractor is adequately protected by public liability and property damage insurance.

107.14.00 Public Safety and Convenience

The contractor shall be responsible for all damages to property, injury to persons, and loss, expense, inconvenience, and delay that may be caused by or that may result from any act, omission or neglect of the contractor, subcontractors, or the employees of either in the performance of the work.

The contractor shall at all times conduct the work in a manner that will insure the least possible obstruction or hazard to traffic. The convenience of the general public and the residents and the protection of persons and property is of prime importance and shall be provided for by the contractor in an adequate and satisfactory manner.

The contractor shall observe all safety instructions received from governmental authorities, but following of such instructions shall not relieve the contractor from the responsibility or liability for accidents to workers or damage or injury to persons or property. Emergency traffic such as police, fire, and disaster units shall be provided access to the work area at all times.

107.15.00 Sanitary, Health, and Safety Provisions

107.15.01 General

The contractor shall observe all rules and regulations of the federal, state, and local health officials concerning construction safety and health standards. The contractor shall not require any worker to work in surroundings or under conditions which are unsanitary, hazardous or dangerous to health or safety.

107.15.02 Safety Regulations - Compliance and Inspection

All workers shall comply with OSHA safety regulations regardless of whether the worker performing the work is covered by Worker's Compensation or not. Any work performed in violation of OSHA safety regulations shall be considered unauthorized work not in compliance with the contract and unacceptable.

The contractor shall admit, without delay and without the presentation of an inspection warrant, any inspector of the Occupational Safety and Health Administration or the Accident Prevention Division of the Workers' Compensation Department upon presentation of proper credentials.

107.15.03 Sanitary Accommodations

The contractor shall provide and maintain in a neat and sanitary condition such accommodations for the use of his employees as may be necessary to comply with requirements and regulations of the State Department of Health and of other bodies or officers having jurisdiction thereover. Contractor shall permit no public nuisance.

107.15.04 First Aid and Accident Reporting

The contractor shall maintain, at the work site, all articles necessary for giving first aid to the injured and establish procedures for the immediate removal to a hospital or a doctor's care of employees and other persons injured on the job site.

All accidents causing death or serious injuries or damages shall be reported immediately to the engineer. The contractor shall promptly report, in writing, to the appropriate authorities all accidents arising out of, or in connection with, the performance of the work. If any claim is made against the contractor or any subcontractor on account of any accident, the contractor shall promptly report the facts, in writing, to the engineer.

107.15.05 Noise Restrictions

The contractor shall conduct operations in conformity to all laws, regulations, and ordinances or resolutions enacted or adopted by local authorities for the purpose of governing construction noise and noise nuisance. In addition, the following restrictions apply:

a) General time restrictions.

1) No construction operations shall be performed within 1,000 feet of any occupied dwelling unit on legal holidays or between the hours of 10 p.m. and 6 a.m. without the approval of the engineer.
2) No pile driving or blasting operations shall be performed within 3,000 feet of any occupied dwelling unit on legal holidays or between the hours of 8 p.m. and 8 a.m., without the approval of the engineer.

b) Requirements for equipment used on the project.

1) Noise control devices shall be no less effective than those provided on original equipment.
2) Exhausts shall be muffled.
3) Equipment shall comply with pertinent equipment noise standards of the DEQ.

c) If a specific noise complaint occurs during construction, the contractor, at the contractor's own expense, may be required to implement one or more of the following, as directed by the engineer.

1) Locate stationary construction equipment as far from nearby noise sensitive properties as possible.
2) Shut off idling equipment.
3) Reschedule construction operations to avoid periods of noise annoyance.
4) Notify nearby residents whenever extremely noisy work will be occurring.
5) Install temporary or portable acoustic barriers around stationary construction noise sources.
6) Place material stockpiles between crushing or screening operations and the affected dwelling.

107.15.06 Confined Space

The contractor is cautioned that the work may involve entry into a permit-required confined space, as defined in Oregon Administrative Rules, which has one or more of the following characteristics:

1) Contains or has a potential to contain a hazardous atmoshere;

2) Contains a material that has the potential for engulfing an entrant;

3) Has an internal configuration such that an entrant could be trapped or asphyxiated by inwardly converging walls or by a floor which slopes downward and tapers to a smaller cross-section; or,

4) Contains other recognized serious safety or health hazards.

Entry into a permit-required confined space is allowed only through compliance with an Oregon-OSHA approved permit space program.

The contractor shall determine the presence of permit-required spaces, and the need to enter these spaces to perform the work.

107.16.00 Use of Explosives

When the use of explosives is necessary for the prosecution of the work, the contractor shall exercise the utmost care not to endanger life or property, including new work. The contractor shall be responsible for all damage resulting from the use of explosives.

The transport, storage, and use of all explosives shall be in compliance with all laws and ordinances. 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 any road or from any building or camping area or place of human occupancy.

The contractor shall notify each public utility company having facilities in proximity to the site of the work of the intent to use explosives. Such notice shall be given sufficiently in advance to enable the companies to take steps necessary to protect the facilities.

107.17.00 Railroad Crossings or Rights of Way

Whenever the work involves the crossing of any railroad line or encroachment on any railroad right of way, the contractor shall submit to the engineer a schedule of proposed operations within the railroad right of way which has been approved by the appropriate railroad officials. The contractor shall comply with all requirements of the railroad company at no cost to the Owner.

The contractor shall be responsible to the Owners and operators of railroad properties for any damage, injury, expense, loss, inconvenience or delay which may result from the work. When indicated in the contract documents, the contractor shall give bond or insurance of the kind and in the amount specified to each corporation, company, partnership or individual owning or operating any of the properties affected. Any extension of time granted the contractor to complete the work shall not relieve the contractor or the contractor's surety from this responsibility.

107.18.00 Rights of Way and Easements

The contractor shall confine construction activities within rights of way, easements, or limits of construction permits. Prior to the use of any property outside these specified boundaries, the contractor shall file, with the engineer, the written permission of the property Owner. Upon terminating such usage, the contractor shall file, with the engineer, a release from all damages signed by the property Owner.

The contractor shall be responsible for any trespass upon or injury to other property resulting from or in connection with the work. The contractor shall be liable for any claims that may be made due to encroachment of any kind upon private property.

107.19.00 Waste Sites

Excavated materials not suitable for or required in the work shall be deposited on waste sites specified in the contract, or waste sites provided by the contractor.

The Owner will provide permits for waste sites specified in the contract. The contractor will be responsible for obtaining permits for waste sites provided by the contractor. The contractor shall operate waste sites in conformance with safety and health requirements of state and local agencies.

Disposal of unsuitable or excess material shall be considered incidental work.

108 Prosecution and Progress of Work

108 Prosecution and Progress of Work

108.1.00 Contractor's Construction Schedule

Prior to beginning the work the contractor shall submit a proposed schedule to the engineer showing the beginning time, the order of work, and the time required for completion of the major items of work. The construction schedule shall show the orderly, timely, and efficient prosecution of the work. The construction schedule will be used as an indication of the progress of the work, but does not become a part of the contract.

The engineer shall approve or disapprove the proposed construction schedule within ten work days after receipt. Disapproved construction schedules shall be revised and resubmitted for approval. The work shall not commence until the construction schedule is approved. The engineer's review of the contractor's schedule shall not relieve the contractor of the requirements of the contract.

When the progress of the work does not correspond to the approved construction schedule, the engineer may require the contractor to submit a revised construction schedule. The revised schedule shall be subject to the engineer's approval or disapproval.

If requested by the engineer, the contractor shall provide weekly progress schedules of expected project activities. The progress schedules will be used as an indication of the sequence of the major construction operations and as a check on the progress of the work. The progress schedules shall indicate the contractor's plan of prosecution of the work in sufficient detail to enable both the contractor and the engineer to plan, coordinate, appraise, document, and control their respective contract responsibilities. Any work done without notification to the engineer is subject to rejection.

108.2.00 Preconstruction Conference

At the request of either the contractor or engineer, the contractor shall meet with the engineer for a preconstruction conference at a time mutually agreed upon. The meeting may include representatives of the Owner, engineer, contractor, subcontractor, affected utility companies, and other affected agencies.

The purpose of the conference will be to discuss the construction schedule, items of the work which require special coordination or documentation and any other appropriate review of the plans and specification pertaining to the work.

108.3.00 Commencement of Work

The contractor shall commence work promptly after the engineer issues the notice to proceed. The contractor shall notify the Owner at least two work days prior to the beginning of work or occupation of the project site.

108.5.00 Contract Time

108.5.01 General

It is essential and in the public interest that the work be prosecuted vigorously to completion. Delays in the performance of the work will inconvenience the public, obstruct traffic, interfere with business and commerce, may be expensive to the public and may increase cost to the Owner.

The period of time allowed for completion of the work under the contract will be set forth in the proposal and contract and will be known as the contract time, as defined in Section 101.

The contract time will be expressed in workdays, calendar days, or fixed completion date. The contract time may be subject to adjustment during the progress of the work.

The contractor shall complete the work called for under the contract within the contract time or adjusted contract time.

108.5.02 Recording of Contract Time

When the contract time is expressed on the basis of workdays or calendar days, the recording of the elapse of such days will begin on the date of the notice to proceed, or on the 15th work day following the date upon which the contract and performance bond forms are mailed to the contractor for execution, whichever is earlier.

108.5.03 Adjustment of Contract Time

The contractor shall notify the engineer in writing of any delay encountered which may be the basis for an adjustment of contract time. Such written notification shall be submitted to the engineer within two work days of the beginning of the delay and shall set forth the facts upon which the delay is based. Any period of delay occurring more than two work

days before the written notification will not be considered for adjustment of contract time unless otherwise determined by the engineer.

Extensions of time may be granted for causes beyond the control of the contractor and subcontractors and without any fault or negligence or participation by them. The contractor's request for adjustment of contract time shall be in writing with the written consent of the surety.

The request shall be submitted prior to the contract completion date and shall include the cause of each delay and the amount of time adjustment requested for each cause.

Extensions will be granted only when the engineer determines the delays actually affect the time necessary for completion of the work. Any adjustment of contract time shall be that which the engineer determines to be justified and the engineer's decision in the matter shall be final.

The contractor will be advised of the engineer's decision within 60 days of receipt of the contractor's request submitted in accordance with these specifications.

Causes which will be given consideration for an extension of contract time include, but are not limited to, the following.

a) Errors, changes or omissions in the plans, or errors or changes in the specifications;
b) Failure of the Owner or the engineer to act promptly in carrying out obligations and duties;
c) Failure of the Owner to submit the contract and bond to the contractor for execution;
d) Performance of extra work; or,
e) Court orders enjoining the prosecution of the work or an act of the Owner not authorized by the contract or permitted by law.

The engineer will not consider an extension of contract time based on shortage or inadequacy of labor and equipment, negligence or fault of the contractor, and other deficiencies which are within the province of the contractor's control or responsibility. The engineer may consider an extension of contract time due to unseasonable weather.

The engineer may instruct the contractor in writing to increase labor or equipment, or adopt improved methods to expedite the work if progress is not satisfactory. Conformity to the engineer's instructions shall not relieve the contractor of responsibilities under the contract.

When work under a contract is suspended pursuant to ORS 279, is not the result of a labor dispute, and the contract is not terminated, the contractor may be entitled to an extension of the contract time and compensation for costs resulting from the suspension.

108.5.04 Exclusions

The engineer may grant exclusions from elapse of contract time when the contractor is prevented from performing the work for the following causes or reasons.

a) Epidemics, quarantine restrictions, strikes, labor disputes, freight embargoes and acts of the public enemy; or,
b) Periods when the work is temporarily suspended upon written order of the engineer.

The exclusions will be to the nearest one half day.

108.6.00 Liquidated Damages

When the work is not completed within the contract time or within the final adjusted contract time, damage may be sustained by the Owner. When it will be impractical or difficult to determine the actual damage which the Owner will sustain, it is agreed that the contractor shall pay to the Owner, not as a penalty but as liquidated damages, the per diem amount listed in the following Schedule of Liquidated Damages for each and every such day elapsed in excess of the contract time or the final adjusted contract time.

SCHEDULE OF LIQUIDATED DAMAGES

Original Amount of Contract		Amount of Liquidated Damages	
For More Than	To and Including	Calendar Day*	Workday
$ 0	$ 25,000	$ 45	$ 60
25,000	50,000	75	105
50,000	100,000	120	165
100,000	500,000	220	310
500,000	1,000,000	380	530
1,000,000	2,000,000	500	700
2,000,000	-	600	840

* Calendar day amounts are applicable when the contract time is expressed on the calendar day, or fixed date basis.

Permitting the contractor to continue and finish the work after the contract time or adjusted contract time has expired shall not be a waiver of any of the Owner's contract rights.

Payment of liquidated damages shall not release the contractor from any obligations to complete the work, nor constitute a waiver of the Owner's right to collect any additional damages which the Owner may sustain by failure of the contractor to carry out the terms of the contract. The liquidated damages shall be full and complete payment only for failure of the contractor to complete the work on time. The amount of liquidated damages accrued may be deducted from payments due or to become due to the contractor.

108.7.00 Suspension of Work

The engineer may, for good and sufficient cause, temporarily suspend the contractor's operations on all or part of the work. Where appropriate, the engineer shall give the contractor three days' notice of such suspension. The work shall be resumed within five days after notice to resume has been given the contractor by the engineer. The engineer may allow the contractor an extension of time for completion of the work corresponding to the total period of the temporary suspension.

When a temporary suspension is ordered by the engineer, and is not the result of the contractor's fault or failure, the contractor shall be reimbursed for the rental of unused equipment and other unavoidable expenses accruing by reason of the suspension. The contractor will not be entitled to damages, intangible or overhead costs, or anticipated profits arising from the temporary suspension.

The engineer shall have authority to suspend the work wholly or in part for cause due to the contractor's failure to carry out the provisions of the contract or to carry out orders. The engineer shall determine the length of any suspension due to conditions considered unsuitable for the performance of the work or for any reason in the public interest.

If the contractor voluntarily suspends the work because of seasonal conditions or other unsuitable conditions, an order to suspend the work may not be required or issued. In all cases of suspension, the work shall not be resumed until ordered by the engineer.

During any suspension of the work, the contractor shall be responsible for the work and take every precaution to prevent damage to or deterioration of the work including temporary traffic control. The contractor shall be responsible for damage to the work that may occur during suspensions of work the same as though the damage had occurred while the work was in progress. If the contractor fails to provide for temporary traffic control and to maintain the work, the engineer may immediately proceed to maintain the work. The cost of such maintenance will be deducted from payments due or to become due to the contractor.

The contractor's voluntary or involuntary suspension or slow down, with or without the approval of the engineer, will not be grounds for claims by the contractor for damages, idle equipment or labor, or extra compensation. No allowance or compensation will be made on account of such suspensions of the work.

108.8.00 Owner's Right to Do Work

If the contractor neglects to prosecute the work properly, or fails to perform any of the terms or conditions of the contract, the Owner may, without prejudice to any other remedy, supply or correct any deficiency or defect. Such action by the Owner shall be taken after five work days' notice by the engineer to the contractor and the contractor's surety. If, in the judgment of the engineer, an emergency or danger to the work or to the public exists, the Owner may take action without notice. The cost of such action by the Owner shall be deducted from payments due or to become due to the contractor. The contractor or the contractor's surety shall pay to the Owner any excess of cost over payments due.

108.9.00 Termination of Contract

The contract may be canceled by the Owner for any willful failure or refusal on the part of the contractor to faithfully perform the work according to all of the terms and conditions of the contract. If the Owner cancels the contract, neither the contractor nor the contractor's surety shall be relieved from responsibility for damages or losses suffered by the Owner on account of the contractor.

The Owner may, at the written request from the contractor, terminate the contract or a portion of the contract if the contractor is prevented from completing construction of the project for reasons beyond control of the contractor. These reasons may include non-availability of materials, phenomenon of nature of catastrophic proportions or intensity, executive orders of the President of the United States related to national defense, acts of Congress, or acts of state, county or municipal governments.

When any part of the contract is terminated before completion of all of the work, payment will be made at the contract unit price for the actual number of units or items of work completed, or as mutually agreed to for items of work partially completed. No claim for loss of anticipated profits will be allowed.

Reimbursement for mobilization expenses, when not included in the contract as a separate pay item, including moving equipment to and from the work, will be considered where the volume of work completed is too small to compensate the contractor for these expenses under the contract prices. When an item for mobilization appears in the contract as a separate pay item, the amount to be paid the contractor will be the mobilization amount earned in accordance with Section 201.

Acceptable materials obtained by the contractor and not incorporated in the work may be purchased from the contractor at actual cost as shown by receipted bills.

Termination of any or all of the contract shall not relieve the contractor of the responsibilities for the completed work, or relieve contractor's surety of the obligation for any just claims arising out of the work performed.

108.10.00 Default by Contractor

The Owner may, without prejudice to any other right or remedy and after giving the contractor and contractor's surety seven days' written notice, terminate the employment of the contractor if the contractor should:

a) Be adjudged bankrupt;
b) Make a general assignment for the benefit of the contractor's creditors;
c) Have a receiver appointed on account of contractor's insolvency;
d) Fail to supply enough properly skilled workers, proper materials, or adequate equipment for the efficient prosecution of the work;
e) Fail to make prompt payment to subcontractors or suppliers;
f) Disregard laws, ordinances, or the instructions of the engineer; or,
g) Be guilty of a substantial violation of any provision of the contract.

The Owner will take possession of the premises and all materials, tools, and appliances as well as all other materials on which the contractor has received partial payment. The Owner may finish the work by any method the Owner deems expedient.

The contractor shall not be entitled to receive any further payment until the work is completed. On completion of the work, determination shall be made by the engineer of the total amount the contractor would have been entitled to receive for the work had the contractor completed the work. The difference between the total amount and the amounts previously paid to the contractor shall be called the unpaid balance and if the unpaid balance exceeds the expense incurred by the Owner in completing the work, including expense for additional managerial and administrative services, the excess will be paid to the contractor, with the consent of the surety. If the expense incurred by the Owner exceeds the unpaid balance, the amount of the excess shall be paid to Owner by the contractor or the surety.

108.11.00 Completion and Acceptance

After completion of the work specified in the contract, and completion of the final inspection, the engineer will recommend to the Owner that the work be accepted and payment be made.

No payment made under the contract except the final payment shall be evidence of the performance of the contract, either wholly or in part, and no payment shall constitute an acceptance of unauthorized or defective work or improper material.

A certificate of completion or letter of acceptance of the project, submitted by the engineer or other officer of the Owner, shall constitute final acceptance of the work on the date of the certificate or letter. Such certificate or letter of acceptance shall not constitute an acceptance of any unauthorized work. The contractor shall be notified in writing within ten (10) calendar days after final acceptance of the work.

The acceptance of the work shall not prevent the Owner from making claim against the contractor for defective work.

108.12.00 Final Warranty

The work is guaranteed by the contractor for a specified period from the date of final acceptance by the Owner. If no warranty period is specified, the work shall be guaranteed for one year from the date of final acceptance by the Owner.
If, within the warranty period, repairs or changes are required in connection with the work, the contractor shall promptly, without expense to the Owner:

a) Place in satisfactory condition all guaranteed work;
b) Correct all damage to the building, site, equipment or contents which is the result of the use of materials, equipment or workmanship which are inferior, defective, or not in accordance with the terms of the contract; and,
c) Correct any work, material, equipment, or contents of building, structure or site disturbed in fulfilling the guarantee.

Repairs, replacements or changes made under the warranty requirements shall be warranted for the specified warranty period, or for one year, beginning on the date of the acceptance of the repairs, replacements or changes.

If the contractor fails within ten days to proceed to comply with the terms of this warranty, the Owner may have the defects corrected. The contractor and contractor's surety shall be liable for all expense incurred. In case of an emergency where delay would cause serious loss or damage, repairs may be made without notice to the contractor and the contractor or contractor's surety shall pay the cost.

109 Measurement and Payment

109 Measurement and Payment

109.1.00 Measurement of Quantities

109.1.01 General

Measurement will be according to the system of weights and measures recognized by the United States Bureau of Standards. Methods of measurement and computation of quantities will conform to generally recognized engineering and construction practice. Computer generated or electronic digital measuring and computing devices may be used.

109.1.02 Linear Measure

Measurement of pay lengths will be by the linear foot, measured along the line and grade of the item involved as actually placed and accepted.

109.1.03 Area

Areas will be measured on the surface of the item and may be expressed in square feet, square yards or acres as appropriate for the particular item involved.

109.1.04 Volume

Volume of earthwork, particularly excavation and embankment, will be computed by the average end area method, in place or excavated, or by other methods of equivalent accuracy.

Volumes of trench excavation or concrete and masonry in structures will be measured according to the neat lines as shown on the plans or as changed by order of the engineer.

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 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 this method of measurement of quantities is used.

109.1.05 Weight

When measurement for materials is on a weight basis, the quantities will be determined by weighing the material on certified weigh scales. The contractor shall provide the scales at no expense to the Owner and shall transport the materials so they can be weighed on the scales provided.

The scales shall be licensed by the Oregon Department of Agriculture. The contractor shall be responsible for maintaining the scales in an accurate condition at all times.

Vehicle scales shall be inspected and the accuracy tested every six months. All testing shall be by the Oregon State Department of Agriculture, the Oregon State Department of Transportation, or an approved scale service company. Testing by a scale service company shall be done by using a minimum of 10,000 pounds of test weights certified by the Department of Agriculture. Copies of scale inspection and testing results shall be furnished by the contractor.

In addition to the required six-month scale examinations, the scales shall be inspected and the accuracy tested as often as the engineer deems necessary.

Scales installed at a new site shall be inspected and the accuracy tested before use.

Material will be weighed in the hauling vehicle when loaded for delivery to the work site.

Tare weights will be determined by weighing empty vehicles at intervals as the engineer requires to ensure accuracy of pay load weights. The determination of tare weights and the weight of loaded vehicles will be to the nearest 0.01 ton.

If scale accuracy tests reveal the scales have been indicating less than the true weight, no additional payment will be allowed for previously weighed materials. If the tests reveal that scales have been indicating more than the true weight, all materials received since the last passing accuracy test, or the time at which the engineer determines the problem occurred, will be reduced by the amount of error in excess of the tolerance allowed by state law.

When approved by the engineer, measurement of bituminous materials, portland cement, lime and similar bulk materials that are shipped by rail or truck may be by use of the supplier's shipping invoice with net scale weights or volumes that are converted to weight. The weights and volumes are subject to correction when material has been lost, wasted, or otherwise not incorporated in the work.

Portland cement will be measured by the pound, hundredweight, ton, sack, bag or barrel. The term barrel of cement will mean 376 pounds, avoirdupois. The terms sack and bag of cement will each mean 94 pounds, avoirdupois.

109.1.06 Lump Sum

Lump sum means the work described is to be done, complete and accepted, without further measurement. Lump sum will be in effect without further measurement unless changes are ordered in writing by the engineer. The estimated quantities of the work to be performed may be listed in the contract documents to provide a basis for adjustment of payment in the event changes in the work are ordered by the engineer. These estimated quantities are to be considered as approximate and no guarantee is made that computations based on the details and dimensions shown on the plans will equal the estimated quantities. If no changes are made in the work, no allowance will be made in the event the quantities based on the contractor's computations overrun or under-run the estimated quantities.

109.1.07 Haul Distance

When the hauling of materials is specified to be on a "yard-mile" or "ton-mile" basis, the pay haul distances will be measured along the shortest route which the engineer determines from the point at which the specified material is produced, or from the point of unloading if the materials are rail or water shipped, to the point at which the specified material is incorporated in the work. Measurement of pay haul distances will be in half-mile units, fractional half-miles being allowed for as full half-miles.

109.2.00 Payment for Work

The contractor shall accept the compensation as full payment for furnishing all materials, labor, tools, and equipment necessary to complete the work. Compensation shall include loss or damage arising from the nature of the work or action of the elements, or any unforeseen difficulties which may be encountered during the prosecution of the work.

The quantities listed in the bid schedule do not govern final payment. Payments to the contractor will be made only for the actual quantities of the work performed and for the quantities of work performed as extra work or under supplemental agreement. When items of work are not listed in the bid schedule, the work shall be considered incidental and no separate payment shall be paid.

109.3.00 Compensation for Alteration of Contract

Unless changes and alterations in the plans, or quantities, or details of construction materially change the character of the work to be performed or the unit costs, the contractor shall accept as payment the unit prices listed in the bid schedule.

If the character of the work or the unit costs are materially changed, compensation for the work will be made on the basis of prices agreed to in advance of the performance of the work. If no prices are agreed upon, then an allowance may be made in an amount the engineer determines to be fair and equitable for the actual cost of the work.

Under no conditions will the allowance for the work be more than the amount justified by the engineer on a force account basis.

109.4.00 Eliminated Items

The engineer shall have the right to eliminate, omit or cancel any portion of the contract relating to the construction of any item or part of any item. The contractor shall be paid a fair and equitable amount covering all items of actual cost incurred directly in connection with the eliminated work and prior to the date of elimination of the work. The work completed before elimination shall be paid for at unit prices, or on a force account basis. A difference between bid quantity and final pay quantity does not constitute an eliminated item.

Acceptable materials ordered by the contractor or delivered to the work site prior to the date at elimination of the work may be purchased by the Owner at actual cost.

109.5.00 Payment for Extra Work

Upon written order by the engineer, the contractor shall carry out extra work at prices agreed upon between the contractor and the Owner. If the engineer and contractor do not agree on prices, the extra work shall be paid as force account work.

109.6.00 Payment for Force Account Work

109.6.01 General

The contractor shall perform extra work on a force account basis when directed in writing by the engineer. After receipt of written authorization, the contractor shall provide an itemized force account estimate of the cost. Progress payments will be made only when the itemized force account estimate has been approved by the Owner.

109.6.02 Labor

Wages of supervisors, equipment operators, and skilled, semiskilled and common laborers assigned to the specific operation will be reimbursed, at contract or actual payroll rate of wages per hour and actual fringe benefits paid, for each hour that the employees are actually engaged in the performance of the force account work. Reimbursement for hourly wage rates and benefits shall not exceed prevailing wage rates and benefits for the class or classes of work performed under force account.

If the engineer directs or approves overtime work, overtime hours will be reimbursed as provided by existing laws and regulations.

In addition to wages and fringe benefits, reimbursement will be allowed for indirect labor costs as follows.

a) Social Security Tax at the percentage legally required;

b) Unemployment Tax at the percentage legally required;
c) Contractor's Public Liability Insurance at the policy percentage rate; and,
d) Contractor's Property Damage Liability Insurance at the policy percentage rate, including coverage for damage due to blasting and explosions when additional coverage is secured on projects requiring blasting.

109.6.03 Materials
The cost of material used will be reimbursable at the actual cost of the material, including applicable tax and transportation charges, shown on invoices.

109.6.04 Equipment
Equipment, owned or rented, that is mutually considered necessary, will be reimbursed at equipment rental rates.

The hourly rental rate will be determined using the monthly rental rates taken from the current edition of the *Rental Rate Blue Book for Construction Equipment* and dividing by 176. The daily rental rate for equipment used on a 24-hour basis will be determined by dividing the monthly rental rate by 22.

To the above rates, add the predominant area adjustment percentage for the state as shown on the area adjustment map in the *Rental Rate Blue Book.*

An allowance will be made for operating costs for every hour the machinery or equipment is operating. If machinery or equipment is required at the work site, but is not operating, compensation will be at the hourly rental rate, exclusive of operating costs.

In the case of machinery or equipment not in the *Rental Rate Blue Book*, a monthly rate will be computed on the basis of 6 percent of the manufacturer's list price for sale of new equipment. The hourly rate in this case will be determined by dividing the monthly rate by 160, when actually operating, and by 176 when at the work site but not operating.

For equipment used on a 24-hour basis and having no rate listed in the *Rental Rate Blue Book*, the daily rate will be 6 percent of the manufacturer's list price for the sale of new equipment, divided by 22.

109.6.05 Services by Others
For any service such as temporary traffic control, engineering services, or specialized construction analysis not considered as subcontract work, the contractor will be compensated at the invoice price plus 7 percent to cover administration and other costs.

109.6.06 Insurance
When required, railroad's protective public liability insurance or railroad's protective property damage liability insurance will be paid at the policy premium rate.

109.6.07 Subcontract
For work performed by a subcontractor, payment will be as described for the contractor.

109.6.08 Overhead and Profit
To cover administration, general superintendence, other overhead, bonds, insurance, anticipated profit, and use of small tools and equipment for which no rental is allowed, an allowance of 25 percent will be added to the labor cost, the material cost, and the equipment cost.

The overhead and profit allowance for subcontract work shall be 7 percent of the total force account invoice for the subcontract work.

109.6.09 Invoices
The contractor and the engineer will review the record of extra work done on a force account basis at the end of each day.

The contractor shall submit invoices detailing labor, material, equipment costs, overhead and profit, insurance premiums and subcontractor costs, including overhead and profit. The contractor shall provide supporting documents for all invoice items. The required statements shall be filed no later than the month following that in which the work was performed.

109.7.00 Advances on Materials

Allowances may be made in the partial payments to the contractor for acceptable materials which are to become a part of the work.

Materials must be acceptably stored or stockpiled on the project or in close proximity to the project. The contractor shall furnish a written permit giving the Owner the right to enter upon and remove the materials for a period of not less than 6 months after completion of the project.

No allowances will be made in the partial payments to the contractor for living or perishable plant materials.

Advances on materials will not be made unless the following conditions are met.

a) The contractor has made a written request for allowance for materials and, if required by the engineer, the request is accompanied by written consent of the contractor's surety.
b) The total value of all materials must be at least $5,000 and the value of any single class of material must be at least $1,000.
c) If the material has been purchased, the contractor shall provide proof of payment for the purchased material. The proof of payment shall be supplied within 30 days of the date of the progress estimate on which the progress payment is made.
d) The material meets specifications and required test results or certifications are on file with the engineer.
e) The material is clearly marked and identified as being specifically fabricated, produced, and reserved for use on the project.

The allowances shall be in amounts not exceeding the net cost to the contractor of the material f.o.b. the work or approved site. As a basis for estimating materials on hand and the cost, the contractor shall provide the engineer with invoices, freight bills, and other information concerning the materials.

In the event the contract is terminated or canceled and the Owner elects to terminate the employment of the contractor, the contractor, or contractor's surety, shall provide the Owner with immediate and peaceful possession of all materials on which the contractor has received progress payments. If the contractor or contractor's surety cannot provide peaceful possession of the materials, then the contractor, or contractor's surety, shall immediately refund to the Owner the total amount of all the progress payments for the materials.

109.8.00 Allowance for Materials Left on Hand

Materials delivered to the work or acceptably stored at approved sites at the order of the engineer, but left unused due to changes in plans ordered by the engineer, will, if not practicably returnable for credit, be purchased from the contractor, at actual cost without percentage allowance or profit.

The contractor, or contractor's surety, shall provide the Owner with immediate and peaceful possession of all materials purchased by the Owner.

Responsibility for excess materials delivered to the work or stored at storage sites without authority from the engineer will rest with the contractor. Any allowance that may be made to the contractor for such excess materials will be under conditions and prices acceptable to the engineer.

109.9.00 Progress Payments and Retainage

109.9.01 General

At a regular period each month the engineer will make an estimate of the amount and value of work accomplished and an estimate of the amount and value of acceptable material to be incorporated in the completed work which has been delivered and acceptably stored. The sum of these values will be defined as the value of work accomplished.

The estimates upon which progress payments are based are not represented to be accurate estimates, and all quantities shown are subject to correction in the final estimate.

Progress payments shall not be construed as an acceptance or approval of any part of the work covered and shall in no manner relieve the contractor or contractor's sureties from obligations under the contract.

No payment shall release the contractor or contractor's sureties

109.9.02 Progress Payments

Progress payments will be equal to the value of work accomplished, less such amounts as may have been previously paid, less such other amounts as may be deductible or as may be owing and due to the Owner, and less an amount to be retained.

109.9.03 Retainage

The amount to be retained will equal 10 percent of the value of completed work except as follows.

a) When the contract work is 50 percent completed, the engineer may reduce or eliminate the retainage on the progress payments for the remaining work accomplished.

b) When the contract work is 97-1/2 percent completed, the engineer may reduce the retained amount to 100 percent of the value of the contract work remaining.
c) Retainage will not be withheld from payments for force account work.

In accordance with the provisions of ORS 279.575, upon written request of the contractor, the Owner will deposit amounts withheld as retainage in an interest bearing account in a bank, savings bank, trust company, or savings association for the benefit of the Owner. Interest shall accrue to the contractor.

If the Owner incurs additional costs as a result of the exercise of any of the options for retainage, the Owner may recover such costs from the contractor by reduction of the final payment. As the work progresses, the Owner shall, upon demand, inform the contractor of all accrued costs.

The contractor may deposit bonds or securities with the Owner or in any bank or trust company to be held in lieu of the cash retainage for the benefit of the Owner. In such event, the Owner shall reduce the retainage in an amount equal to the value of the bonds and securities and pay the amount of the reduction to the contractor in accordance with ORS 279.575. Interest on such bonds or securities shall accrue to the contractor.

Bonds and securities deposited or acquired in lieu of retainage shall be of a character approved by the Public Contract Review Board, including but not limited to:
a) Bills, certificates, notes, or bonds of the United States;
b) Other obligations of the United States or its agencies;
c) Obligations of any corporation wholly owned by the Federal Government; and,
d) Indebtedness of the Federal National Mortgage Association.

The bonds and securities deposited by the contractor shall be fully assigned to the Owner or be payable to the Owner on demand.

109.10.00 Deferment of Payments

No final payment will be made until all orders made by the engineer to the contractor in accordance with the contract are complied with, and all claims or liens filed or prosecuted against the Owner contrary to the contract are satisfied.

In the event a complaint or charge of unlawful employment practices pursuant to the provisions of ORS 659 is filed against the contractor with the Commissioner of Labor, and the Commissioner of Labor issues a cease and desist order as defined in ORS 659, no further payments will be made until all of the provisions of the cease and desist order have been complied with by the contractor.

109.11.00 Final Estimate and Payment

The contractor shall notify the engineer when work is considered complete and the engineer shall, within 15 work days after receiving the notice, either accept the work or notify the contractor of the work yet to be performed. If the work is accepted, the engineer shall notify the contractor and will make a final estimate and recommend acceptance of the work as of a certain date. Upon approval and acceptance by the Owner, the contractor will be paid a total payment equal to the amount due under the contract including all retainage.

Prior to final payment, the contractor shall deliver to the Owner a receipt for all amounts paid or payable to the contractor and a release and waiver of all claims against the Owner arising from or connected with the contract and shall furnish satisfactory evidence that all amounts due for labor, materials and all other obligations have been fully and finally settled, or are fully covered by insurance.

109.12.00 Acceptance of Final Payment

The acceptance by the contractor of the final payment shall release the Owner and the engineer from all claims and all liability to the contractor for all things done or furnished in connection with the work, and for every act of the Owner and others relating to or arising out of the work.

Division 2 - Streets and Related Work

201 Mobilization

201 Mobilization

201.1.00 Description

Mobilization consists of preparatory work and operations necessary for the movement of personnel, equipment, supplies, and incidentals to the project site; for the establishment of offices, buildings, and other facilities necessary for the work; for premiums on bond and insurance for the work; and for other operations performed or costs incurred before the beginning of the work.

201.2.00 Materials

None required.

201.3.00 Construction

None required.

201.4.00 Measurement and Payment

201.4.01 Lump Sum Basis

When listed in the bid schedule, mobilization will be paid for on a lump sum basis for all required.

The amounts to be allowed for mobilization in the partial payments will be as follows:

a) When 5 percent of the total original contract amount is earned from other bid items, the lesser of 50 percent of the amount bid for mobilization or 5 percent of the total original contract amount, less retainage, will be paid;

b) When 10 percent of the total original contract amount is earned from other bid items, the lesser of 100 percent of the amount bid for mobilization or 10 percent of the total original contract amount, less retainage, will be paid; and,

c) Upon completion of all work on the project, mobilization in excess of 10 percent of the total original contract amount will be paid.

The above schedule of partial payments for mobilization shall not be construed to limit or preclude partial payments provided by the contract.

201.4.02 Incidental Basis

When not listed in the bid schedule, mobilization will be considered incidental work.

202 Temporary Protection and Direction of Traffic

202 Temporary Protection and Traffic Direction

202.1.00 Description

This work consists of furnishing, installing, moving, operating, and maintaining signs, barricades, and other traffic control devices throughout the area affected by the project.

202.2.00 Materials

All materials used in temporary installations under this section shall be in conformance with the ODOT Standard Specifications and the ODOT Short Term Traffic Control Handbook. All signs to be used at night shall have standard ODOT reflectorized backgrounds.

202.3.00 Construction

202.3.01 General

Protective and directional devices shall be provided by the contractor as required. The devices and their placement shall conform to the requirements of the ODOT Standard Specifications and the ODOT Short Term Traffic Control Handbook.

If the contractor fails to furnish and maintain appropriate protective and directional devices, the engineer may suspend the work and/or correct the deficiency. The cost of such corrective measures will be borne by the contractor and shall be at no cost to the Owner or City.

202.3.02 Contractor's Plan and Schedule

Prior to beginning the work, the contractor shall submit a proposed plan for protective and directional measures. During the performance of the work, the contractor shall submit any proposed revisions to the plan for the engineer's approval.

No work shall be started on any stage of construction until the traffic control plan has been approved and all approved traffic control devices are in place.

During construction, the contractor shall determine if any protective and directional devices are required in addition to those in place and shall immediately notify the engineer. The contractor shall immediately make any changes approved or directed by the engineer but shall not place or remove devices without prior approval from the engineer.

202.3.03 Maintenance

The contractor shall maintain all traffic devices in proper position, clean, and legible at all times. Vegetative growth or other materials shall be trimmed or removed to permit clear vision of the devices. Lights, beacons, and flashers shall be kept clean, visible and operable. The effectiveness of the installations shall be verified at frequent intervals, both in daylight and dark, by actual travel and inspection by the contractor. Devices damaged or destroyed by any means shall be repaired, replaced, or restored by the contractor.

The contractor shall have a person on the job during working hours, and on call at all other times, who will maintain all directional and warning devices in proper position and condition. The name and phone number for that person shall be on file with the engineer and local law enforcement agencies.

Temporary devices used under these provisions remain the property of the contractor and shall be moved, removed, or made inoperative as occasion dictates during the life of the contract. Inappropriate temporary or existing signs shall be covered or turned to preclude visibility to traffic. Flags shall be removed or rolled and completely covered with an opaque, black, nonreflective sheath.

Upon completion of the work the devices shall be removed from the project and evidence of their existence obliterated.

202.3.04 Flaggers, Signal Operators, and Pilot Car Operators

Flaggers, signal operators, and pilot car operators shall have satisfactorily completed the ODOT approved training courses and shall maintain in their possession a current certification.

202.3.05 Concrete Barriers

Temporary concrete barriers shall be placed on appropriate supports to protect the pavement when directed.

202.3.06 Oiling Road Markers

Oiling road markers used in chip seals and oil mats shall be installed during the 24-hour period immediately prior to placement of the chip seals or oil mats. The covers on the markers shall be removed when the engineer orders termination of traffic control by pilot car. In the event a section of roadway is not completed when pilot car traffic control ends, another set of markers shall be installed immediately prior to the next application of oil.

The oiling road markers shall be installed so that they will remain in place at least 30 days to allow time for permanent striping. Nailing the markers to the roadway surface may be required.

202.3.07 Lane Closures

The contractor shall obtain the engineer's approval of proposed methods and timing of lane closures.

202.3.08 Temporary Illumination and Traffic Signals

Electrical power for temporary illumination and traffic signals shall be arranged for and provided by the contractor.

202.3.09 Stripe Removal

The removal of temporary striping shall be scheduled to coincide with the painting of revised temporary striping or permanent striping.

Pavement striping on pavement surfaces to remain shall be removed so that the pavement surface is not damaged. Any permanent pavement surfaces damaged in stripe removal shall be repaired by the contractor.

202.3.10 Temporary Direct Access on Access-Controlled Roads

The contractor shall not open or use any temporary direct access to a controlled access road without written approval from the engineer.

202.3.11 Obstruction of Traffic

The contractor shall conduct work to assure the least possible obstruction to traffic. Work which would restrict or interrupt traffic movement shall not be performed on opposite sides of the traveled way at the same time.

202.3.12 Temporary Pavement Markers and Striping

When existing pavement markings are destroyed, they will be replaced with temporary pavement markings in compliance with ODOT Standard Specifications and ODOT Short Term Traffic Control Handbook. Temporary pavement markings shall be reflective and be either approved flexible pavement markers or pressure sensitive traffic marking tape. Nail the markers to the roadway surface if necessary. Replace missing markers at contractor's expense.

When pressure sensitive marking tape is used, each stripe shall be a minimum of 4 inches wide and 48 inches long and shall be placed at intervals of no more than 25-foot centers on the lane separation line to delineate the path of travel for vehicles.

The contractor shall place temporary lane markers, crosswalk markings and turn arrows, as directed by the engineer, on new paving prior to opening the pavement to traffic.

The temporary pavement markings shall be maintained in serviceable condition by the contractor during the interval of time they are in use. All preliminary layout and marking in preparation for application and the application of the temporary pavement markings shall be the contractor's responsibility.

If specified or directed, the contractor shall remove the temporary pavement markings prior to placement of subsequent paving materials or permanent lane markings.

202.4.00 Measurement and Payment

202.4.01 General

Measurement and payment for temporary protection and direction of traffic will include, but not necessarily be limited to, the following work items:

a) Furnishing and installing tubular markers, flashers, and other traffic control devices not covered by other pay items;

b) Furnishing, placing, maintaining, moving and removing all devices and pavement markings;

c) Furnishing, placing, maintaining, and removing temporary sign covers;

d) Providing for and furnishing electrical energy;

e) Cleaning up and removing devices destroyed or damaged by public traffic;

f) Furnishing, placing, maintaining, and removing temporary guard rail installations;

g) Furnishing, placing, maintaining, and removing temporary concrete barriers as necessary, and for final removal of temporary concrete barriers from the project;

h) Furnishing, placing, maintaining, and removing temporary earth or aggregate mounds as a protective end treatment for temporary concrete barrier;

i) Furnishing and placing oiling road markers with covers and removing the covers;

j) Maintaining all directional and warning devices; and,

k) Furnishing all other labor, materials, and equipment necessary to perform the temporary protection and direction of traffic.

202.4.02 Lump Sum Basis
Temporary protection and traffic direction will be paid on a lump sum basis for all required when indicated in the bid schedule..

202.4.03 Unit Price Basis
When listed on the Bid Schedule, temporary protection and traffic direction will be measured and paid for at the unit price for each of the pay items listed in the bid schedule.

202.4.04 Incidental Basis
When not listed in the bid schedule, temporary protection and traffic direction, or any specific items necessary in the work, will be considered incidental work.

203 Clearing and Grubbing

203 Clearing and Grubbing

203.1.00 Description

This work consists of clearing, removal and disposal of all debris and vegetation such as stumps, trees, logs, roots, shrubs, vines, grass and weeds within the designated limits, and to preserve from injury or defacement such objects and vegetation as are designated to remain in place.

Clearing is defined as the cutting and removal of trees, bushes, vines and other vegetative growth at or above the surface of the ground.

Grubbing is defined as the removal of vegetative growth, roots and wood items remaining at or below the ground surface following the clearing operation.

203.2.00 Materials

None required.

203.3.00 Construction

203.3.01 Clearing

Trees and brush shall be cut such that no stump extends above the ground surface more than 6 inches.

203.3.02 Grubbing

203.3.02A Excavation Areas

All roots and embedded wood shall be removed to a depth not less than 6 inches below the natural or existing grade or slope surface to which the excavation is constructed. All stumps shall be completely removed.

203.3.02B Embankment Areas

All roots and embedded wood shall be removed to a depth not less than 1 foot below the natural or existing grade or slope surface on which the embankment is to be constructed. All stumps shall be completely removed

203.3.03 Disposal

Clearing and grubbing vegetation, debris and unsuitable soils shall be disposed of by the contractor in a manner satisfactory to the engineer and in compliance with federal, state, and local laws and ordinances.

203.3.04 Merchantable Timber

Merchantable timber shall become the property of the contractor.

203.4.00 Measurement and Payment

203.4.01 Acreage Basis

Where so described in the Bid Schedule, clearing and grubbing will be measured and paid for on an acreage basis, to the nearest 0.1 acre.

203.4.02 Lump Sum Basis

Where so described in the Bid Schedule, clearing and grubbing will be measured and paid for on a lump sum basis for all required.

203.4.03 Incidental Basis

When not listed in the bid schedule, clearing and grubbing will be considered incidental work.

204 Earthwork

204 Earthwork

204.1.00 Description

204.1.01 General

This work consists of excavating and grading for roadways, side streets, sidewalk and planting areas, alleys, cuts, embankments, slopes, roadway ditches, driveways, and all other earth moving work required in the construction of the project, including disposal of surplus material.

Excavation and grading specified as incidental to work items in under other sections of these specifications will not be included in this section.

204.1.02 Unclassified Excavation

Unclassified excavation is defined as all excavation regardless of the type, nature, or condition of the materials encountered. The contractor shall assume full responsibility to estimate the kind and extent of the various materials to be encountered.

204.1.03 Classified Excavation

204.1.03A Common Excavation

Common excavation is defined as removal of all material not classified as rock or boulder excavation.

204.1.03B Rock Excavation

Rock excavation is defined as removal of solid bedrock, or ledge rock, which in the opinion of the engineer cannot be excavated or removed by dozers with rippers, or hydraulic excavators, but which requires systematic drilling and blasting or the use of pneumatic rock splitters, hammers, and wedges.

If material that is classified as rock is mechanically removed with grading equipment, the volume of material removed shall be measured and paid for as common excavation.

204.1.03C Boulder Excavation

Boulder excavation is defined as the removal of masses of igneous, sedimentary or metamorphic stone material which has one or more dimensions of 36" or greater or a displacement of one cubic yard or more, which is removed without drilling, blasting or splitting.

204.1.03D Ditch Excavation

Ditch excavation is a specialized form of common excavation requiring work in an easement or other limited space to excavate ditches or channels not part of the roadway construction.

204.1.04 Borrow Excavation

Borrow excavation is defined as material obtained from borrow sources lying outside and independent of planned roadbed excavation or other required excavation occurring within the project limits.

204.1.05 Over-excavation

Over-excavation is the removal of unsuitable material below the limits designated for excavation.

204.2.00 Materials

204.2.01 Borrow and Embankment Materials

The contractor shall provide embankment and borrow materials of approved earth, sand, gravel or rock, or combinations thereof, free of peat, humus, muck, vegetative matter, organic matter or other materials detrimental to the construction of firm, dense, and sound embankment.

The contractor shall use all approved materials originating from the required excavations as far as practicable in the formation of embankments and subgrade, and for bedding, backfilling and other work as shown or directed.

204.3.00 Construction

204.3.01 Preservation of Existing Improvements

The contractor shall conduct operations in a manner that will protect existing highway facilities, utilities, railroad tracks, and other non-highway facilities. The contractor shall furnish and install sheet piling, cribbing bulkheads, shores, or whatever means may be necessary to support material carrying existing facilities, or to support the facilities themselves, and maintain such supports until no longer needed. The contractor shall protect temporary pavements,

facilities, utilities and installations until they are no longer required. When temporary supports and other protective means are no longer required, the contractor shall remove and dispose of them. Existing improvements damaged in the contractor's operations shall be restored or replaced in accordance with Section 105 at no expense to the owner.

204.3.02 Excavation of Existing Improvements
Earthwork includes excavating, hauling and depositing existing pavements, walks, driveways, surfacings, slabs, curbs, gutters and similar structures, and of all rock or gravel road surfacing materials when the materials are within the limits of the excavation.

The contractor shall remove and dispose of pipes, conduits, logs, timbers, concrete and other structures, materials, objects and matter encountered in the excavations, except items for which removal is otherwise specifically provided, as a part of the earthwork. The volumes of such items from within the excavation areas shown will be included in the excavation quantities.

The contractor shall remove the remaining ends of abandoned pipes or portions of other items partially removed under this work which would be left exposed on side slopes or at subgrade, to a minimum of 1 foot beyond or below the finished slope or subgrade. Abandoned pipes shall be capped or plugged, watertight, in accordance with the pipe manufacturer's recommendations or as directed.

204.3.03 Over-excavation
The contractor shall remove unsuitable sub-grade material as directed. Excavation below sub-grade shall be of the same classification as that above sub-grade provided it is removed in the same operation as the excavation above sub-grade. When the roadway excavation has been completed and it is required to move equipment in to excavate unsuitable material, or where special equipment is required, the work shall be performed as directed and will be paid for as over-excavation.

Excavations made below grade without authorization shall be restored to grade by the contractor, as directed, at no expense to the owner.

The contractor shall remove any material which is excavated, displaced, or loosened outside and beyond the required slopes, lines, or grades, regardless of whether the over-break is due to blasting, to the inherent character of any formation encountered, or to any other cause. Removal and disposal of over-break, and replacement with approved materials, shall be by the contractor at no expense to the owner except in cases where the engineer determines that such over-break was unavoidable.

204.3.04 Use of Explosives
The use of explosives shall conform to the provisions of Section 107. The contractor shall provide a state-certified explosives technician to supervise the drilling and blasting operations.

The use of explosives shall be avoided as far as practicable, and in no case shall tunnel blasting methods be used. When blasting is required, it shall be controlled in a manner that will avoid possible shattering or loosening of materials outside of the slope lines.

When excavation is made in hard, solid rock to depths of 10 feet or more, the blasting shall be done by the pre-splitting or pre-shearing method. The pre-splitting shall be accomplished by line drilling relief holes at uniform intervals along the top line and a long the specified slope line to subgrade depth, but not to exceed a vertical depth of 30 feet.

204.3.05 Preparation of Embankment Foundations
Prior to the construction of embankments, the contractor shall excavate unsuitable foundation material. Basements, trenches, and holes encountered within embankment limits shall be filled with approved material. Prior to backfilling, the contractor shall break concrete floors of basements as directed. The contractor shall break up and roughen the ground surface before embankment material is placed. Where called for on the plans, the sub-grade shall be benched prior to placing embankment. The natural ground underlying embankments shall be compacted to the density specified for the embankment material to be placed, and to the depth of the grubbing or a minimum of 1 foot.

204.3.06 Embankment Construction
Embankment construction shall include preparation of the areas upon which embankments are placed, construction of dikes, and the placement and compaction of approved embankment material for replacement of unsuitable material and

filing of holes, pits, and other depressions within the roadway area.

The contractor shall place embankments and fills in horizontal layers of 8 inches maximum depth and compact each layer to the density specified.

In the immediate vicinity of curbs, walks, driveways, inlets, manholes and similar structures, in holes, and where embankment and fill materials cannot be reached by the normal compacting equipment, the contractor shall compact to specified density by approved methods.

When the excavated material consists predominately of rock too large to be placed in the thickness prescribed, the material may be placed in thicknesses up to the average rock dimension not to exceed 3 feet. Each layer will be leveled and smoothed by distribution of spalls and finer fragments or earth. Where end dumping is employed, direct end dumping on the previously constructed layer of embankment will not be permitted. Rock shall be dumped on the layer of embankment being constructed and dozed ahead into place. The large rock shall not be placed where it will project above an elevation 2 feet below the finished subgrade.

When a rock fill is placed over any structure, the structure will be covered and compacted with a minimum of 2 feet of earth or other approved material before the rock is placed.

Embankments shall not be constructed when the embankment material or the foundation on which the embankment would be placed is frozen.

204.3.07 Slide Removal and Repair

When a slope slides back of the finished slope line or out of an embankment, the contractor shall remove the slide material or replace the embankment and refinish the slope, as directed. Only approved materials shall be used for the repair and reestablishment of slopes. Slope repair will be paid for as extra work but shall be incidental to embankment.

Slopes undercut at the base, disturbed or made unstable through contractor's negligence shall be restored as directed by the engineer at no expense to the owner.

204.3.08 Finishing Roadbed and Slopes

After the main excavation in rock or rocky cuts is completed, the contractor shall thoroughly test the slopes with bars or by other approved means and shall remove all loose, detached, broken, or otherwise unstable rock. The contractor shall remove jutting points and bring the entire cut slope area to a safe, trim and neat condition. The contractor shall dispose of the materials removed under this provision in the same manner as other excavated material.

As a part of the earthwork, the contractor shall perform special grading on areas which are shown as planting areas. The contractor shall finish planting areas to smooth flowing lines and to the grades and cross sections established or approved. Rock, boulders, vegetative matter, and other objectionable debris shall be removed as directed.

The contractor shall blend the tops of cut banks with the adjacent terrain.

The contractor shall trim all roadbeds, ditches, and other excavations and embankments to the established lines, grades, and cross sections. All surface features shall be left in a neat and well-finished condition.

The contractor shall backfill holes resulting from grubbing, removal work, basements, and trenches which lie outside the limits of required excavation or embankment construction with approved roadbed excavation material. The fill shall be smoothed and shaped to blend with the surrounding area.

Immediately prior to completion of the earthwork, the contractor shall clean the entire work area of debris and foreign matter.

204.3.09 Compaction

The maximum density of compacted materials will be determined by AASHTO T 99 or T 180 as specified on the plans.. The density of compacted materials in place will be determined by AASHTO T 191, T 205 or T 238, or other approved methods.

The contractor shall compact all embankments, fills, and backfills under structures and roadbeds to 95% of maximum density. All other locations shall be compacted to the density specified on the plans but in no case less than 90% of

maximum density.

Embankment or fill material within 1 foot below the established roadbed subgrade or structure foundation elevation shall be 1-1/2 inch maximum size.

The contractor shall adjust the moisture content of the materials to provide optimum moisture for compaction of embankments and backfills. Embankment or backfill materials shall not be placed in final position until moisture in excess of optimum moisture has been removed.

The contractor shall furnish and operate the nuclear gauge or shall retain an independent testing firm to perform the compaction testing. The testing shall be conducted under the observation of the engineer and performed on all surfaces regardless of density requirements unless otherwise directed by the engineer.

If the specified compaction is not obtained, the contractor shall notify the engineer. The contractor may be required to use a modified compaction procedure or apply additional compactive effort. If approved materials meeting the specifications cannot be compacted to the required density regardless of compactive effort or method, the engineer may reduce the required density or direct that alternate materials be used. In no case shall earthwork operations proceed until the contractor is able to compact the material to the satisfaction of the engineer.

204.3.10 Disposal of Excavated Materials
Excavated material in excess of that needed to complete the work or that does not meet the requirements for embankment materials shall be disposed of at no expense to the owner.

204.4.00 Measurement and Payment

204.4.01 Unclassified and Classified Excavation

204.4.01A Cubic Yard Basis

Unclassified and classified excavation shall include embankment of excavated materials on the project. When listed in the Bid Schedule unclassified and classified excavation will be measured on a cubic yard basis, by average end area to the nearest 0.1 yard, in original position prior to excavation. Pay quantities shall be computed to the neat lines and grades of excavation specified. The volume of boulder and rock excavation shall be deducted from the total volume of excavated material determined by neat line measure. The calculated remainder of the excavation shall be paid for by the class of material removed.

204.4.01B Lump Sum Basis

When listed on the Bid Schedule, unclassified and classified excavation will be measured and paid for on a lump sum basis for all required.

204.4.02 Boulder Excavation

When included in the Bid Schedule, boulder excavation will be measured in the field by the engineer prior to removal from the site. Boulders shall be measured for length, width, and height to the nearest 0.1 foot. The volume of each boulder shall be defined as the product of 85 percent of each of the three measured dimensions. Boulder excavation shall be paid on a cubic yard basis to the nearest 0.1 cubic yard when included in the Bid Schedule.

When boulder excavation is not included in the Bid Schedule, such excavation shall be incidental to excavation items.

204.4.03 Over-excavation

When listed in the bid schedule and authorized by the Engineer, over-excavation will be measured and paid for on a cubic yard in-place basis, to the nearest 0.1 yard.

When not listed in the bid schedule or not authorized by the Engineer, over-excavation will be incidental to the work and no separate payment shall be made for overexcavation.

204.4.04 Embankment

204.4.04A Cubic Yard Basis

When included in the Bid Schedule, embankment will be measured and paid for on a cubic yard in-place basis, to the nearest 0.1 yard. Quantities will be determined by average end area cross section measurement of the material within the neat lines above the ground or base elevations existing at the time embankment construction begins. No measurement or payment will be made for material required due to subsidence and settlement of the ground or foundation, for settlement of materials within the embankments, or for shrinkage, settlement, washout, slippage or

loss regardless of the cause.

204.4.04B Lump Sum Basis
When listed in the Bid Schedule, embankment will be measured and paid for on a lump sum basis for all required.

204.4.05 Borrow Excavation

204.4.05A Cubic Yard Basis
When included in the Bid Schedule, borrow excacavation incorporated as embankement in the project will be measured and paid for on a cubic yard in-place basis, to the nearest 0.1 yard. Quantities will be determined by average end area cross section measurement of the material within the neat lines above the ground or base elevations existing at the time embankment construction begins. No measurement or payment will be made for material required due to subsidence and settlement of the ground or foundation, for settlement of materials within the embankments, or for shrinkage, settlement, washout, slippage or loss regardless of the cause.

204.4.05B Lump Sum Basis
When listed in the Bid Schedule, Borrow Excavation for embankment on the project will be measured and paid for on a lump sum basis for all required.

204.4.06 Finishing Roadbed and Slopes

204.4.06A Lineal Foot Basis
When listed on the Bid Schedule, finishing roadbed and slopes will be measured and paid for on a lineal foot basis to the nearest foot. Measurement will be made horizontally along the centerline of the main roadway, excluding the length of bridges or openings for bridges.

204.4.06B Lump Sum Basis
When listed in the bid schedule, this work will be measured and paid for on a lump sum basis for all required.

204.4.07 Incidental Work
When not listed in the bid schedule excavation, embankment and finishing roadbed and slopes will be considered incidental work.

205 Watering

205 Watering

205.1.00 Description

This work consists of furnishing and applying water, or combinations of water and compatible binders or additives, for use in road or embankment construction and for the alleviation or prevention of dust nuisance.

Excluded from this section is watering used in connection with portland cement concrete construction and curing or for watering which is specified as incidental to work items in other sections of these specifications.

205.2.00 Materials

205.2.01 Water

Water used in the work shall be free of silts and other matter deleterious to the quality of the material to which it is applied or with which it is mixed. The contractor shall make arrangements for obtaining water and shall maintain an adequate supply of water at all times.

205.2.02 Binders and Additives

Binders and additives used in watering work shall be as specified.

205.3.00 Construction

The contractor shall water by means of tank trucks equipped with spray bars, by hose and nozzle, or by other approved means which insure uniform and controlled application. The use of splash boards will not be permitted.

The contractor shall perform watering at any hour of the day and on any day of the week necessary for proper performance or protection of the work and for alleviation of dust nuisance.

When compatible binder material or additive is combined with water in the work, the contractor shall mix it in conformance with the manufacturer's directions.

205.4.00 Measurement and Payment

205.4.01 Volume Basis

Water will be measured in units of 1,000 gallons to the nearest 0.1 unit, exclusive of binders and additives. Measurement will be made in tanks or tank trucks of predetermined and approved capacities or by reliable approved meters provided by the contractor. Payment will be made only for quantities approved for use in the work.

205.4.02 Weight Basis

Water will be measured in tons to the nearest 0.01 ton. Measurement and payment will be for the actual tons used based on weigh tickets presented for approval on the day the water is delivered. No measurement or payment will be allowed on tickets not so delivered and approved.

205.4.03 Binders and Additives

Binders and additives combined with water for watering purposes will be measured separately from the water and will be paid for at the unit prices listed in the bid schedule.

205.4.04 Incidental Basis

When not listed in the bid schedule, water, binders and additives will be considered incidental work.

206 Sub-grade

206 Sub-grade

206.1.00 Description

This work consists of the preparation of the sub-grade. Sub-grade is defined as the area of new or existing roads, streets, alleys, driveways, sidewalks, or other public places upon which additional materials are to be placed as a part of work covered in other sections or by future work. Sub-grade is classified as untreated or treated.

206.1.01 Untreated Sub-grade

The top one foot of material placed in embankments or unmoved from cuts in the normal grading of the roadbed and which is brought to true line and grade, shaped and compacted to provide a foundation for the pavement structure constitutes untreated sub-grade.

206.1.02 Treated Sub-grade

Sub-grade which is improved by the addition of stabilizers and prepared as in untreated sub-grade constitutes treated sub-grade.

206.2.00 Materials

206.2.01 Soil Stabilizing Materials

Soil stabilizing materials shall conform to the following requirements.

Material	Type	Grade
Hydrated Lime	AASHTO M 216, Type 1	Grade A
Granular Quicklime (CaO)	AASHTO T 27 and T 219 for grading and hydroxide content, with min. 85 percent Calcium Hydroxide	100 percent passing 3/8-inch sieve, max. 15 percent passing 100 sieve
Calcium Chloride	AASHTO M 144, sampling and testing in accordance with AASHTO T 143	-
Sodium Chloride	AASHTO M 143	-
Portland Cement	AASHTO M 85	Conform to Portland Cement in Section 212

Storage of materials shall conform to the requirements of Section 106.

206.2.02 Water

Water shall conform to the requirements of Section 205.

206.3.00 Construction

206.3.01 Preparation

Prior to starting sub-grade work, including backfill, all underground work contemplated in the area of the sub-grade shall be completed. This requirement includes work by the contractor, by the owner, or by others.

The contractor shall drain all depressions or ruts which contain water.

206.3.02 Untreated Sub-grade

The contractor shall remove unsuitable material as directed and replace with approved material. The sub-grade shall be excavated and shaped to line, grade, and cross section and compacted to the specified density. Compaction shall extend to a line one foot beyond the edge of the paving, curbs, or forms.

Sub-grade areas which are too wet to be compacted to specified density, but which in the judgement of the engineer otherwise meet the requirements, shall be scarified and aerated to provide optimum moisture content. The scarification and aeration shall be performed at no additional expense to the owner.

The engineer may authorize the removal and/or stabilizing of material as extra work.

206.3.03 Treated Sub-grade

206.3.03A General

The contractor shall blade, disc, harrow or scarify and thoroughly break up the surface of areas to be treated or aerated to the full depth and width as shown. Cemented soil clods shall be reduced to the size specified and soil brought to the required moisture content. Sub-grade material shall be shaped and sized to pass through the mixing machine.

Stabilizing materials shall be applied only when the temperature is above freezing and when wind and other weather conditions are not detrimental to the work or to the public. The contractor shall take all precautions necessary to prevent injury to persons, livestock or property. Any material which is spilled or deposited at places other than on areas designated to be treated shall be immediately picked up, buried or made harmless at no expense to the owner.

206.3.03B Addition of Stabilizing Material

The contractor shall apply stabilizing materials at a uniform rate as specified, using equipment and methods that will insure uniformity of distribution. The use of blade graders to distribute lime will not be permitted. Only equipment that is used for watering and for applying and mixing the stabilizing material shall be permitted to pass over the material until after it is mixed into the soil. If necessary, water shall be added during mixing operations to provide optimum moisture content.

206.3.03C Mixing

The contractor shall perform mixing operations until the treated sub-grade material is uniform and free of streaks or pockets, and all material, other than stones, will pass a 1-inch sieve.

The percent content of the stabilizing material shall not vary more than 1 percent from the amount specified.

206.3.03D Finishing

Immediately after mixing of a treated sub-grade, the contractor shall grade the mixture to specified line, grade and cross section and compact the mixture to the specified density.

The material shall be compacted and finished within 12 hours after compaction begins. If the contractor has not compacted and finished the material within 12 hours, the mixture shall be loosened and stabilizing material and water added as directed. The freshened material shall then be remixed, regraded and compacted, at no additional expense to the owner. During compaction, the contractor shall maintain the mixture at proper grade and cross section and at optimum moisture content.

206.3.03E Curing

The contractor shall limit traffic over treated sub-grade to wheel loads which do not cause any damage to the sub-grade and which do not visibly deflect, ravel or wear the surface. The contractor shall keep the finished surface moist and protected from rutting, spalling, displacement and disfiguration for a period of seven days or until a subsequent course of material is placed which will prevent drying of the mixture by evaporation or absorption.

206.3.04 Tolerances

The contractor shall rework areas found to be deficient in thickness by more than 0.04 foot, except that fresh stabilizing material shall be added in an amount equal to one half of the original amount. The contractor shall accomplish all reworking at no expense to the owner.

The finished surface of treated and untreated sub-grade shall not vary more than 0.04 foot from established grade and cross section at any point. The finished surface, when tested with a 12-foot straightedge, shall not vary from the testing edge by more than 0.04 foot at any point.

206.3.05 Compaction

The required density of treated and untreated sub-grade materials shall be not less than 95 percent of maximum density as determined by AASHTO T 99. Testing methods used for determining in-place density shall be according to AASHTO T 191, T 205 and T 238.

In addition to density requirements, the finished sub-grade shall be firm and unyielding. Unyielding means no more than 1/4-inch deflection of the sub-grade when proof-rolled with a fully loaded 10-12 CY dump truck. Compaction testing and proof-rolling shall be done within 24 hours prior to placing base material on the sub-grade.

Areas of visible deflection shall be over-excavated to a minimum of 12 inches or more, as directed, below sub-grade. Fabric shall be placed, and the over-excavated subbase area shall be backfilled up to sub-grade elevation with a single lift of 1-1/2" - 0" crushed rock and compacted. The density of the top 6 inches of the subbase rock shall be as specified for aggregate base. In addition, these areas shall be proof-rolled to verify they are firm and unyielding as specified above.

The contractor shall furnish and operate the nuclear gauge or shall retain an independent testing firm to perform the compaction testing. The testing shall be conducted under the observation of the engineer and performed on all surfaces regardless of density requirements unless otherwise directed by the engineer.

If the specified compaction is not obtained, the contractor shall notify the engineer. The contractor may be required to use a modified compaction procedure or apply additional compactive effort. If approved materials meeting the specifications cannot be compacted to the required density regardless of compactive effort or method, the engineer may reduce the required density or direct that alternate materials be used. In no case shall finishing and compaction of the sub-grade proceed until the contractor is able to compact the material to the satisfaction of the engineer.

206.4.00 Measurement and Payment

206.4.01 Untreated Sub-grade

Untreated sub-grade will be considered incidental work.

206.4.02 Treated Sub-grade

Treated sub-grade will be measured on the surface to the nearest 0.1 foot. Payment will be on a square yard basis, to the nearest 0.1 square yard.

206.4.03 Soil Stabilizing Materials

Soil stabilizing materials will be measured and paid for by the ton, dry weight, to the nearest 0.01 ton. Packaged materials will be accepted at the net weight shown by the manufacturer, subject to periodic verification and approval. The contractor shall provide a certificate with each shipment together with a certified copy of the weight of each delivery. Measurement and payment of stabilizing material will not include any which is lost, displaced, used in reworking, used in restoration work or used contrary to direction.

206.4.04 Incidental Work

When not listed in the bid schedule, draining water from the sub-grade; soil stabilization work; smoothing the sub-grade in preparation for staking; blading, shaping, and compacting the sub-grade, including roadbed materials, to final line, grade and cross section, and other anticipated items will be considered incidental work.

207 Aggregate Base

207 Aggregate Base

207.1.00 Description

This work consists of furnishing and placing one or more courses of aggregates, as subbase or base, on an approved sub-grade or subbase.

207.2.00 Materials

Base aggregates shall consist of crushed gravel or crushed rock, including sand.

207.2.01 Fracture of Gravel

Gravel shall have at least one fractured face on 50 percent of the material retained on each sieve size 1 1/2 inch and above and 70 percent for the material passing the 1 1/2-inch sieve and retained on each of the sieves down to 1/4 inch.

207.2.02 Durability

The source material from which aggregate base materials are obtained, produced or manufactured, shall meet the following qualifying test requirements.

Test	Test Method	Requirements
Degradation:		
Passing No. 20 sieve	OSHD TM 208	30% Max.
Sediment Height	OSHD TM 208	3" Max.
Abrasion:	OSHD TM 211	35% Max.

207.2.03 Sand Equivalent

Base aggregates to be incorporated in the work shall have a sand equivalent of not less than 30 when tested in conformance with OSHD TM 101.

207.2.04 Liquid Limit and Plasticity

Base aggregate shall meet the following requirements.

LIQUID LIMIT AND PLASTICITY INDEX VALUES

Percent of Material Passing No. 40 Sieve	Liquid Limit (Maximum) OSHD TM 102	Plasticity Index (Maximum) OSHD TM 103
0.0 to 5.0, inclusive	33	6
5.1 to 10.0, inclusive	30	5
10.1 to 15.0, inclusive	27	4
15.1 to 20.0, inclusive	24	3
20.1 to 25.0, inclusive	21	2
Over 25.0	21	0 or N.P.

207.2.05 Grading Requirements
Base aggregates shall conform to the following grading requirements.

GRADING REQUIREMENTS FOR BASE AGGREGATES

Separated Sizes:	2 1/2"-0	2"-0	1 1/2"-0	1"-0	3/4"-0
Sieve Size	Percentages Passing (by weight)				
3"	100				
2 1/2"	95-100	100			
2"	-	95-100	100		
1 1/2"	-	-	95-100	100	
1 1/4"	55-75	-	-	-	
1"	-	55-75	-	90-100	100
3/4"	-	-	55-75	-	90-100
1/2"	-	-	-	55-75	-
3/8"	-	-	-	-	55-75
1/4"	30-45	30-45	35-50	40-55	40-60
No. 10	12-27	12-27	14-30	16-33	16-36
No. 40	0-16	0-16	3-18	8-24	8-24
No. 200	0-9	0-9	0-8	0-8	0-10

The determination of sizes and grading shall be in conformance with AASHTO T27.

207.2.06 Acceptance
Aggregate base will be sampled for acceptance at one or more of the following times as determined by the engineer:

a) In its final state on the roadbed after all processing and prior to the placement of subsequent surfacing materials;

b) In the stockpile after all shaping work has been completed; or,

c) Immediately after crushing.

207.3.00 Construction

207.3.01 Stockpiling
The materials to be furnished in stockpiles shall be of the kinds, sizes and quality specified. Each designated size of material shall be placed in a separate stockpile.

Stockpiles shall be at least 8 feet high with side slopes of 1 1/2 horizontal to 1 vertical. The method used in placing the material in the stockpile shall be such as to minimize segregation of the aggregate particles.

207.3.02 Mixing
The materials shall be mixed until well blended. The contractor shall add water during mixing in an amount sufficient to provide optimum moisture content plus or minus 2 percent.

The subbase or base course materials shall be mixed by one of the following methods.

a) Stationary Plant Method - Materials mixed by means of a pug mill or other type of mixer, transported to the project at proper moisture content and placed by approved equipment;

b) Travel Plant Method - Materials mixed and placed on the project in a continuous operation; or,

c) Road Mix Method - Materials mixed on the project by motor graders or other approved equipment.

207.3.03 Placing

207.3.03A Weather Limitations

When, in the judgment of the engineer, weather conditions will be detrimental to the work, the contractor shall suspend operations until the weather is favorable. No aggregate base materials shall be placed in the snow or on a soft, muddy or frozen sub-grade.

207.3.03B Equipment

Equipment necessary for construction of aggregate base shall provide for efficient and continuous operations and shall conform to the following requirements.

a) Hauling equipment - Vehicles for hauling aggregate or mixtures of aggregate and water shall be capable of depositing the material into or in front of spreading equipment with minimum of segregation.

b) Spreading equipment - The equipment shall be capable of spreading and striking off material to the designated line, grade and transverse slope with a uniform surface texture free of excessive segregation or fracture of material.

207.3.03C Thickness of Lifts

If the required compacted depth of the subbase or base course exceeds 6 inches, it shall be constructed in two or more layers of approximately equal thickness. The maximum compacted thickness of any one layer shall not exceed 6 inches.

207.3.04 Compaction

207.3.04A Equipment

Equipment used to compact aggregate bases shall be self-propelled steel wheel or pneumatic tire rollers. Rollers shall be capable of compacting materials to a firm, even surface.

207.3.04B Density

During compaction, materials shall be maintained within 2 percent of the optimum moisture content. The contractor shall begin compaction of each layer immediately after the material is spread and continue until a density of not less than 95 percent of the maximum density has been achieved. Maximum density will be determined by AASHTO T99 method as corrected for oversize by AASHTO T224.

If the specified compaction is not obtained, the contractor shall notify the engineer. The contractor may be required to use a modified compaction procedure or apply additional compactive effort. If approved materials meeting the specifications cannot be compacted to the required density regardless of compactive effort or method, the engineer may reduce the required density or direct that alternate materials be used. In no case shall aggregate placement proceed until the contractor is able to compact the material to the satisfaction of the engineer.

In addition to density requirements, the finished sub-grade shall be firm and unyielding. Unyielding means no more than 1/4-inch deflection of the sub-grade when proof-rolled with a fully loaded 10-12 CY dump truck. Compaction testing and proof-rolling shall be done within 24 hours prior to placing base material on the sub-grade.

Areas of visible deflection shall be overexcavated to a minimum of 12 inches or more, as directed, below sub-grade. Fabric shall be placed, and the overexcavated subbase area shall be backfilled up to sub-grade elevation with a single lift of 1-1/2" - 0" crushed rock and compacted. The density of the top 6 inches of the subbase rock shall be as specified for aggregate base. In addition, these areas shall be proof-rolled to verify they are firm and unyielding as specified above.

The contractor shall furnish and operate the nuclear gauge or shall retain an independent testing firm to perform the compaction testing. The testing shall be conducted under the observation of the engineer and performed on all surfaces regardless of density requirements unless otherwise directed by the engineer.

207.3.05 Surface Tolerance

The surface of the aggregate base shall be within -0.04 foot to +0.02 foot of plan elevation at any one point. The final surface shall not deviate at any point more than 0.04 foot from the bottom of a 12-foot straightedge laid in any direction on the surface on either side of the roadway crown.

When directed by the engineer, the surface shall be tested with a 12-foot straightedge furnished and operated by the

contractor. The surface shall not vary from the testing edge by more than 0.04 foot at any point. The engineer will observe this testing and may require additional testing. The average of the variation from the design grade shall not be greater than 40 percent of the allowable maximum variation.

207.4.00 Measurement and Payment

207.4.01 Cubic Yard Basis

When listed on the Bid Schedule, aggregate base will be measured and paid for on a cubic yard basis, to the nearest 0.1 yard. Volume shall be determined by the average end area method based on neat lines as shown on the plans.

207.4.02 Ton Basis

When listed on the Bid Schedule, aggregates will be measured and paid for on a ton basis, to the nearest 0.01 ton as determined by certified scales.

207.4.03 Incidental Basis

When not listed in the bid schedule, base aggregates will be considered incidental work.

208 Asphalt Treated Base (ATB)

208 Asphalt Treated Base (ATB)

208.1.00 Description

ATB is a mixture of asphalt cement, well graded, high quality aggregate, mineral filler, and additives as required. The mixture is heated and plant mixed into a uniformly coated mass, hot laid on an approved base, and compacted to specified density.

208.2.00 Materials

208.2.01 Asphalt

Asphalt materials shall conform to the requirements of Section 211.

208.2.02 Aggregates

Aggregates for ATB shall conform to the requirements of Section 207. In addition to the sizes and gradings shown in Section 207, aggregate may consist of crushed open-graded material meeting one of the following gradations.

Sieve Size	------Gradations-----	
Passing	1"-0	3/4"-0
	Percentages (by weight)	
1"	100	-
3/4"	-	100
1/2"	45-75	60-80
No. 4	5-30	5-35
No. 10	0-6	0-10
No. 200	0-2	0-2

Sixty five percent of the material retained on the 1/4-inch screen shall have at least one fractured face.

208.2.03 Recycled Materials

The contractor may use processed old asphalt concrete materials in the production of plant-mix bituminous base. Salvaged materials recycled into the new bituminous base shall not exceed 30 percent, by weight, of the total mixture.

The old asphalt concrete proposed for use in the recycled mix shall contain hard, sound, durable aggregates.

208.2.04 Mix Formula and Tolerances

A job mix formula will be established for each aggregate source.

If there are no current approved mix formulas on file with the owner, the contractor shall submit a mix formula for the approval of the engineer. The formula may be a current OSHD mix design.

If the mix formula is not approved by the engineer, then a new mix formula will be established at the contractor's expense.

The proportions of aggregate and asphalt cement in the mixture, by weight, shall be within the following ranges:

Aggregate . . . . . 93.5 to 98.0 percent
Asphalt Cement. . . . . 2.0 to 6.5 percent

Within the above ranges, the job mix formula shall be comprised of either a single percentage each of aggregate and asphalt cement or a single percentage each of new aggregate, recycled asphalt concrete, and asphalt cement. The asphalt cement content shall not vary by more than 0.5 percent from the percentage listed in the job mix formula.

The mixture will have a retained strength of not less than 70 percent when tested in accordance with OSHD TM 308.

208.3.00 Construction

208.3.01 Weather Conditions

Weather conditions under which ATB may be constructed shall conform to Section 211.

208.3.02 Preparation of Sub-grade

Preparation of sub-grade shall conform to the requirements of Section 206.

208.3.03 Mixing

Mixing shall conform to the requirements of Section 211.

208.3.04 Temperature of Mix

The temperature of the ATB at the time of placement shall conform to the requirements of Section 211.

208.3.05 Placing

Placing shall conform to the requirements of Section 207, with the exception that motor graders may be used only where conditions preclude the use of other types of spreading equipment and only with the approval of the engineer.

Vertical faces of curbs, gutters, catch basins, manholes and other appurtenances, against which ATB is to be placed, shall be painted with emulsified asphalt.

Unless otherwise directed, a tack coat of emulsified asphalt shall be applied to each lift of ATB prior to placing succeeding lifts. The grade of emulsified asphalt shall be as approved and the rate of application shall be in the range of 0.03 to 0.10 gallons of retained asphalt per square yard.

208.3.06 Compaction

208.3.06A General

Compaction methods shall conform to the requirements of Section 211 except that the maximum thickness of each compacted lift shall be 6 inches.

208.3.06B Density Requirements

Density of dense-graded ATB shall conform to the requirements of Section 211. Compaction of open graded mixes shall be achieved by rolling until all roller marks disappear.

208.3.07 Surface Tolerance

The surface of the ATB shall be within -0.04 foot to +0.02 foot of plan elevation at any one point. The final surface shall not deviate at any point more than 0.04 foot from the bottom of a 12-foot straightedge laid in any direction on the surface on either side of the roadway crown.

When directed by the engineer the surface shall be tested with a 12-foot straightedge furnished and operated by the contractor. The surface shall not vary from the testing edge by more than 0.04 foot at any point. The engineer will observe this testing and may require additional testing. The average of the variation from the design grade shall not be greater than 40 percent of the maximum allowable deviation.

208.4.00 Measurement and Payment

208.4.01 Ton Basis

208.4.01A Single Unit Basis

ATB will be measured and paid for on a ton basis, to the nearest 0.01 ton. There will be no separate measurement or payment for asphalt cement contained in the mixture.

208.4.01B Separate Tonnages of Mixture and Asphalt Cement

When the bid schedule so indicates, ATB mixture and asphalt cement contained in the mixture will separately measured and paid for as follows.

1) The quantity of ATB will be measured and paid for on a ton basis, to the nearest 0.01 ton. No deduction will be made for the weight of the asphalt cement or any additive used in the mixture.

2) The asphalt cement or emulsified asphalt used in the ATB will be measured and paid for on a ton basis, to the nearest 0.01 ton. If weigh tickets or invoice and tank stickings are not available to determine quantities, the

quantities shall be based on extraction tests.

208.4.02 Square Yard Basis

ATB will be measured on the surface to the nearest 0.1 foot. Payment will be on a square yard basis, to the nearest 0.1 yard.

209 Cement Treated Base (CTB)

209 Cement Treated Base (CTB)

209.1.00 Description

This work consists of constructing a CTB composed of aggregate, cement and water spread on an approved base or sub-grade, compacted and cured.

209.2.00 Materials

209.2.01 Aggregate

The aggregate shall conform to the requirements of Section 207.

209.2.02 Portland Cement and Water

The portland cement and water shall conform to the requirements of Section 212.

209.2.03 Mix Design

The contractor shall furnish a mix design established in accordance with Section 212. The mixture shall be designed to ensure that at least 85 percent of resulting batches will attain a minimum compressive strength of 750 psi at seven days. Durability on freeze/thaw and wet/dry tests shall meet PCA standards.

209.2.04 Curing Seal

The asphalt used in the curing seal shall be either CRS-1 or CRS-2 emulsified asphalt as designated. The emulsified asphalt shall conform to the requirements of Section 210.

209.3.00 Construction

209.3.01 Weather Limitations

The CTB shall be constructed in accordance with the weather limitations set for portland cement concrete pavement construction in Section 212.

209.3.02 Plant Mix CTB

209.3.02A Mixing Plant

The CTB mixture shall be mixed at a plant of the batch type or of the continuous mixing type, capable of providing a mix of aggregate, cement, and water of uniform proportions and consistency.

209.3.02B Hauling and Placing

Vehicles for hauling the CTB mixture shall be watertight and capable of discharging the mix without segregation.

Mixture which has begun to harden or take an initial set prior to placement will be rejected.

Spreading of the CTB mixture shall be by equipment which is capable of spreading the material without segregation, dragging, or fracture of material. Placing shall be in widths which will hold the number of longitudinal joints to a minimum.

209.3.02C Thickness and Number of Layers

When the compacted depth of CTB exceeds 6 inches, it shall be constructed in two or more layers of approximately equal thickness. The maximum compacted thickness of any one layer shall not exceed 6 inches.

209.3.03 In-Place CTB

209.3.03A Preparation of Area

The materials to be incorporated in the base shall be broken up to the full depth of the new treated base so that all material will pass a 2-inch sieve. The surface shall then be brought to uniform grade and cross section prior to adding any new aggregate.

209.3.03B Incorporation of Cement and Water

Cement shall be uniformly applied at the rate established by the engineer. The equipment and method used shall ensure the uniformity of cement distribution throughout the material to be treated. Water shall be added during mixing operations to bring the mix to within -0 to +1 1/2 percent of the optimum moisture/density point. This moisture content shall be maintained until the mixing is completed.

209.3.03C Mixing
The initial mixing of the cement, water, and aggregate materials shall be started within two hours after the application of the cement. Mixing shall continue until a homogeneous mixture is obtained.

209.3.04 Placing and Finishing
The mixture shall be spread to specified line, grade, and cross section and the entire depth of the mixture shall be compacted to the specified density within two hours after mixing has been started.

209.3.05 Curing
Intermediate layers of CTB shall be kept continuously moist until the placement of succeeding layers of material. As soon as possible after the CTB is constructed, and while it is still moist, the surface and exposed edges shall be covered with an asphalt curing seal. The emulsified asphalt shall be applied by pressure spray method at a uniform rate between 0.25 gallon and 0.35 gallon per square yard of surface or more as necessary to provide a continuous, unbroken curing membrane. After the curing seal has been applied, the CTB shall cure for a period of four days.

The curing seal on any lift of CTB may be omitted if, within two hours after the start of mixing of the preceding lift, a succeeding lift of material (CTB, bituminous base or asphalt concrete) is placed. Vibratory rollers will not be permitted in the compaction of any succeeding lift of material during the period of time from 2 hours to 96 hours after mixing of any of the underlying lifts of CTB.

209.3.06 Compaction
209.3.06A Equipment
Equipment used to compact CTB shall be self-propelled steel wheel or pneumatic tire rollers. Rollers shall be capable of compacting the material to a firm, even surface.

209.3.06B Density
The contractor shall begin compaction of each layer immediately after the material is spread and continue until a density of not less than 95 percent of the maximum density has been achieved. Maximum density will be determined by OSHD TM 125.

If the specified compaction is not obtained, the contractor shall notify the engineer. The contractor may be required to use a modified compaction procedure or apply additional compactive effort. If approved materials meeting the specifications cannot be compacted to the required density regardless of compactive effort or method, the engineer may reduce the required density or direct that alternate materials be used. In no case shall CTB construction proceed until the contractor is able to compact the material to the satisfaction of the engineer.

209.3.07 Tolerances
The surface of the CTB shall be within -0.04 foot to +0.02 foot of plan elevation at any one point. The final surface shall not deviate at any point more than 0.04 foot from the bottom of a 12-foot straightedge laid in any direction on the surface on either side of the roadway crown.

When directed by the engineer, the surface shall be tested with a 12-foot straightedge furnished and operated by the contractor. The surface shall not vary from the testing edge by more than 0.04 foot at any point. The engineer will observe this testing and may require additional testing. The average of the variation from the design grade shall not be greater than 40 percent of the allowable.

209.3.08 Handling Traffic Over CTB
Traffic will not be allowed on the curing CTB mixture except as allowed by the engineer. At locations where traffic must be routed over the CTB, the mixture shall be made with Type III cement.

209.4.00 Measurement and Payment
209.4.01 Plant Mix CTB
Plant mix CTB mixture will be measured and paid for on a ton basis, to the nearest 0.01 ton.

When listed in the bid schedule, portland cement in the mixture will be measured and paid for on a ton basis, to the nearest 0.01 ton.

209.4.02 In-Place CTB
209.4.02A Portland Cement

Portland cement will be measured and paid for on a ton basis, to the nearest 0.01 ton.

209.4.02B Aggregate
New aggregate material will measured and paid for on a ton basis, to the nearest 0.01 ton.

209.4.02C CTB Construction
The work involved in constructing the in-place CTB, other than furnishing portland cement and new base aggregates, will be measured on the surface to the nearest 0.1 foot. Payment will be on a square yard basis, to the nearest 0.1 yard.

210 Asphalt Surface Treatments

210 Asphalt Surface Treatments

210.1.00 Description

This work consists of the application of asphalt materials, with or without aggregate cover materials, to approved roadway surfaces.

210.1.01 Asphalt Macadam

Asphalt macadam consists of multiple applications of asphalt and graded aggregate in alternating layers binding the aggregates together to produce a firm surfacing.

210.1.02 Prime Coat

A prime coat is a single application of emulsified asphalt to a prepared aggregate base. It may also include the application of cover aggregate.

210.1.03 Tack Coat

A tack coat is an application of emulsified asphalt or asphalt cement to an existing pavement prior to placing an overlying course of asphalt paving.

210.1.04 Aggregate Seal

An aggregate seal consists of one or more applications of emulsified asphalt to an existing pavement followed by an aggregate cover.

210.1.05 Fog Seal

A fog seal consists of a light application of emulsified asphalt to an existing pavement.

210.1.06 Sand Seal

A sand seal consists of an application of emulsified asphalt to an existing pavement followed by a cover of fine aggregate.

210.1.07 Slurry Seal

A slurry seal is a mixture of emulsified asphalt, fine aggregate and mineral filler applied to an existing pavement surface. The cured slurry shall have a homogenous appearance, fill all cracks, adhere firmly to the surface, and have skid resistant texture. Type I is intended for crack filling and fine seal. Type II is intended for a general seal and medium textured surface. Type III is intended for one course in a two-course slurry and produces a highly textured surface.

210.1.08 Crack Seal

A crack seal consists of an application of rubberized sealant to a crack in existing pavement.

210.1.09 Choke

Choke is a covering of fine aggregate to reduce the surface voids in preparation for an asphalt surface treatment.

210.2.00 Materials

210.2.01 Asphalt Macadam

210.2.01A Asphalt

Asphalt shall conform to the requirements of the Asphalt Penetration Macadam Table in the standard drawings.

210.2.01B Aggregate

Penetration macadam aggregate may be either crushed quarry stone or crushed gravel. Crushed gravel shall have at least one mechanically fractured face on at least 90 percent (by weight) of the material retained on a 1/4-inch sieve.

The material from which the coarse aggregates is produced shall meet the following qualifying test requirements.

Test	Test Method	Requirements
Degradation:		
Passing No. 20 Sieve	ODOT TM 208	30% Maximum
Sediment Height	ODOT TM 208	3" Maximum
Abrasion:	ODOT TM 211	30% Maximum

The determination of sizes and gradation will conform with AASHTO T 27. The gradation of the several designated

sizes that may be required in the work shall conform to the following table.

GRADING REQUIREMENTS
ASPHALT MACADAM AGGREGATES

Separated Sizes:	2 1/2-1 1/4"	1 1/2-3/4"	1 1/4-3/4"	3/4-1/2"	1/2-1/4"	1/4"-No.10
Sieve Size	Percentages Passing (by weight)					
3"	100					
2-1/2"	95-100					
2"	-	100				
1-1/2"	-	95-100	100			
1-1/4"	0-10	-	90-100			
1"	-	-	-	100		
3/4"	0-1	0-15	0-15	90-100	100	
1/2"	-	0-2	0-2	0-15	85-100	100
1/4"	-	-	-	0-3	0-15	85-100
No. 10	-	-	-	-	0-4	0-15
No. 40	-	-	-	-	-	0-5

The aggregate may be subjected to the Stripping Test for Bituminous Aggregate Mixtures, AASHTO T 182, using a sample of the asphalt to be used in the work. The retention of the asphalt shall, by observation, be greater than 95 percent. Aggregate failing to conform to this requirement will not be permitted in the work unless the contractor provides approved anti-stripping additives or employs approved measures which correct the deficiency.

At the time of spreading, the aggregate shall have a dry surface with no adherent films or coatings of dirt, clay, dust, or other deleterious matter that could impede adherence of the asphalt.

210.2.02 Prime Coat

210.2.02A Asphalt

Prime coat asphalt shall conform to the requirements of the Asphalt Table in the standard drawings.

210.2.02B Aggregate

Prime coat aggregate shall be 3/4"-0 conforming to the requirements of Section 207.

210.2.03 Tack Coat Asphalt

Tack coat asphalt shall conform to the requirements of the Asphalt Table in the standard drawings.

210.2.04 Aggregate Seal

210.2.04A Asphalt

Aggregate seal asphalt shall conform to the requirements of the Asphalt Table in the standard drawings.

210.2.04B Aggregate

Aggregate seal aggregate shall be 1/4"-#10 or 1/2"-1/4" as specified.

210.2.05 Fog Seal

Fog seal asphalt shall conform to the requirements of the Asphalt Table in the standard drawings.

210.2.06 Sand Seal

210.2.06A Asphalt

Sand seal asphalt shall conform to the requirements of the Asphalt Table in the standard drawings.

210.2.06B Aggregate

Sand seal aggregate shall be well-graded fine aggregate. Sieve analysis shall conform to the requirements of subsection 210.2.07B, Type I. Durability shall conform to the requirements of subsection 210.2.01B.

210.2.07 Slurry Seal

210.2.07A Asphalt

Slurry seal asphalt shall conform to the requirements of the Asphalt Table in the standard drawings.

The emulsion must pass the following specification:

General Specification	ASTM D2397
Stripping	ISSA TB116
Quick Set Mixing Grade	ISSA TB102
Wet Stripping	ISSA TB114
Viscosity (seconds) 77° F	20-50
Asphalt Content (residual)	57% min
Percent Sieve	0.10
PH	6.5 max
Settlement (5 days)	1% max
Penetration	40-110
Percent Solubility	97 min
Ductility (@ 77°F)	40 min

210.2.07B Aggregate

Slurry seal aggregate shall be clean, angular, durable, well graded, and uniform. The gradation of aggregate shall meet the following requirements.

Type of Slurry	I	II	III
General Usage	Crack filling and fine seal	General Seal medium textured surfaces	1st and/or 2nd application, two-course slurry, highly textured surfaces
Sieve Size (U.S. Standard Series)	Percent Passing		
3/8 in.	-	100	100
No. 4	100	90-100	70-90
No. 8	90-100	65-90	45-70
No. 16	65-90	45-70	28-50
No. 30	40-60	30-50	19-34
No. 50	25-42	18-30	12-25
No. 100	15-30	10-21	7-18
No. 200	10-20	5-15	5-15
Residual Asphalt Content % Dry Mass of Aggregate	10-16	7.5-13.5	6.5-12
Average Application Rate, lb/sq yd, Based on Mass of Dry Aggregate (±15%)	10	14	16

The slurry seal aggregate shall consist of natural or manufactured crushed stone such as granite, slag, limestone or other high quality aggregate or a combination thereof. Smooth textured sands of less than 1.25% water absorption shall not exceed 50% of the total aggregate blend.

When tested according to the following tests, normal aggregates shall meet the following requirements:

Test	Test Method	Requirements
Cleanliness	ASTM 2149	45 min
Soundness	ASTM C88	15% max ($Na_2 SO_4$) 20% max ($Mg SO_4$)
Hardness	ASTM C131	35% max
Sand Equivalent	ASTM D2419	70 min

Liquid retardants and mineral fillers may only be used when their quantity can be metered. The use of additives in the slurry mix (or individual materials) shall comply initially with the quantities predetermined by the mix design with field adjustments, if required, to improve the workability of the mix or gradation of the aggregate after approval by the engineer.

Portland cement, hydrated lime, limestone dust, fly ash or other approved filler required by the mix design shall meet the requirements of ASTM D242. These shall be considered as part of the dry aggregate.

210.2.07C Slurry Mixture

Before work begins, the contractor shall submit a signed original of a mix design covering the specific materials to be used on the project. This design must have been performed by a qualified laboratory. Previous lab reports covering the exact materials to be used may be accepted provided they were made during the calendar year. Once the materials are approved, no substitution will be permitted unless first tested and approved by the laboratory preparing the mix design.

A qualified laboratory is one that is recognized as such by the International Slurry Seal Association.

The laboratory report will show the results of tests performed on the individual materials, comparing their values to those required by this specification. The report will provide the following information on the slurry seal mixture.

Test	Test Method	Spec
Slurry Seal		
Consistency	ISSA T106	2-3 cm
Excess Asphalt	ISSA T109	50-70 gms/sq ft
Wet Stripping Test	ISSA T114	Pass
Compatibility	ISSA T115	*Pass
Quick Set Emulsion	ISSA T102	**Pass
Wet Track Abrasion	ASTM D3910	75 gms/sq ft max

* Mixing tests must pass at the maximum expected air temperature.
** Using job aggregate

The laboratory shall further report the quantitative effects of moisture content on the unit weight of the aggregate (bulking effect). The laboratory report must clearly show the proportions of aggregate, mineral filler (min and max), water (min and max), additive(s) (usage) and asphalt based on the dry aggregate weight.

All water used in the slurry mixture shall be potable and compatible with all the individual components of the slurry mix. Compatibility must be insured by the contractor.

210.2.08 Crack Seal

The rubberized crack sealant shall meet the requirements of the ASTM D 1190.

210.2.09 Choke Aggregate

Choke aggregate shall be crushed or uncrushed rock that conform to the following gradation according to AASHTO T 27 and is free of clay, loam, or other deleterious matter that could impede adherence of asphalt:

Sieve Size Passing	Percentages (By Weight)
3/8"	100
1/4"	95-100
No. 10	20-40
No. 40	6-18
No. 100	0-5

210.3.00 Construction

210.3.01 Asphalt Macadam

210.3.01A Weather and Seasonal Limitations

Asphalt macadam shall not be placed on any wet surface, when the air temperature is below 60° F, or when the engineer determines that weather conditions are detrimental to proper construction.

210.3.01B Equipment

Equipment shall be provided in sufficient number and capacity to provide coordinated and uniform progress. Power brooms, self-propelled aggregate spreaders, asphalt distributors, and hauling vehicles shall be pneumatic tired.

Mechanical spreaders shall be used for spreading aggregate less than 1 inch in maximum size and shall be designed to place the larger fraction of the aggregate ahead of the finer fraction.

The asphalt distributor shall be designed, equipped, maintained and operated to apply the asphalt uniformly at variable widths up to 15 feet at determinable and controlled rates from 0.06 to 2.0 gallons per square yard, with uniform pressure, and with an allowable variation from any specified rate not to exceed 0.02 gallons per square yard. Distributor equipment shall include a tachometer, pressure gages, accurate volume measuring devices or a calibrated tank, and a thermometer for measuring the temperature of tank contents.

Rollers shall be self-propelled steel wheeled or pneumatic tired. They shall be capable of compacting the materials to a firm, even surface. Steel wheeled rollers shall be capable of providing a weight of not less than 200 pounds per inch width of the compression roll or rolls. Pneumatic tire rollers shall be capable of exerting a ground pressure of not less than 80 pounds per square inch of tire contact area.

210.3.01C Sequence of Operations

Layers of aggregate shall be placed while the preceding layer of asphalt material is at or near its application temperature. Each layer of aggregate shall be shaped and compacted prior to being covered with the succeeding layer of asphalt. The seal coat layer of asphalt and aggregate shall not be applied until the underlying layers have been in place for at least 3 days and have stabilized.

210.3.01D Hauling and Spreading Aggregates

Hauling and spreading equipment shall not be operated on uncovered asphalt. Hand spreading shall be done to correct deficiencies or on areas inaccessible to mechanical equipment. Hauling over aggregate-covered asphalt shall be held to a minimum until the surface has become firm. All hauling on asphalt macadam shall be at moderate speeds which do not create loss of or hazardous movement of materials. Hauling shall be routed as uniformly as possible over the full width of the material in place.

210.3.01E Shaping and Compaction of Aggregates

Each layer of aggregate shall be shaped to prescribed line, grade, and cross section and shall then be dry-rolled until the material is interlocked, firm, partially bound with underlying asphalt, and until the aggregate does not creep or wave ahead of the roller.

Rolling shall normally commence at the low side of the prescribed cross section and progress with passes parallel to the roadway center line. Each pass shall overlap the preceding pass by at least one half the width of the roller.

Along curbs, walls, and at all places not accessible to or not compacted by specified rollers, the aggregate shall be tamped thoroughly with mechanical tampers or with hand tampers.

Irregularities in surface smoothness, non-uniformity of texture, segregation of materials, dirt pockets, spots of excess asphalt, and other deficiencies and defects shall be corrected by removal and replacement, addition of material,

repetition of construction operations, or other suitable means, as directed or approved by the engineer.

210.3.01F Application of Asphalt
Each layer of asphalt shall be uniformly applied at the rate specified. Building paper shall be placed over the end area of previously placed layers and the adjoining application shall start on the paper, after which the paper shall be removed and disposed of.

Rates of application shall not vary from prescribed rates by more than 10 percent. The contractor shall protect structures and vegetation from being spattered, stained or marred and shall remove stains and remedy disfigurements. Hand application or other approved means shall be used on areas inaccessible to the distributor.

During application of asphalt and until the asphalt is covered with aggregate, traffic shall be controlled with flaggers, pilot cars, detours, or other approved means.

210.3.01G Surface Tolerance
The top surface of the asphalt concrete pavement shall not vary by more than 0.03 foot when tested with a 12-foot straightedge either parallel with or perpendicular to the centerline. The straightedge shall be furnished and operated by the contractor. The engineer will observe this testing and may require additional testing.

The surface of the finished pavement shall be within 0.02 foot of the specified line, grade and cross section.

The contractor shall correct any surface tolerance deficiency by a method that has been approved by the engineer. All corrective work shall be completed within 10 work days following notification from the engineer. All corrective work, including furnishing of materials, shall be performed at the contractor's expense and no adjustment will be made in contract time.

210.3.01H Establishment
During the period preceding construction of the seal coat, during periods when partial construction is open to traffic, and for seven days following the original completion of the course, the contractor shall perform the following operations.

1) The course shall be bladed or broomed to correct bleeding of asphalt, to provide coverage with aggregates, to keep the surface free of ravel, traffic grooves, holes, and other deformations, and to eliminate other defects.

2) Rolling and compacting of materials shall be performed to maintain or restore firmness and stability to the materials.

3) Abutting shoulders shall be trimmed and materials which slough into side ditches shall be removed and disposed of in a manner satisfactory to the engineer.

The above operations may be performed under traffic and at frequencies which the engineer determines as being necessary to develop and establish the course to uniform firmness and stability.

210.3.02 Prime Coat
Except as specified below, the prime coat shall be constructed in conformance with subsections 210.3.01A through 210.3.01H.

210.3.02A Application Rates
The prime coat shall be constructed with a single layer of asphalt followed immediately with a single layer of cover aggregate.

Asphalt shall be spread at a uniform rate within a range of 0.25 to 0.40 gallons per square yard.

Cover aggregate shall be spread at a uniform rate of 0.006 to 0.009 cubic yards per square yard. The cover aggregate may be spread by spreader boxes provided no part of the spreading equipment contacts the liquid asphalt prior to placement of cover aggregate.

210.3.02B Establishment

The prime coat shall be allowed to cure and harden for a period of up to 3 days, as directed by the engineer, before a succeeding course is placed upon it. If so directed by the engineer, traffic shall be permitted to travel over the prime coat at any time after its construction. During the curing period, when in use by traffic, and until it is covered by a succeeding course, the prime coat shall be maintained by the contractor to the specified shape and condition.

210.3.03 Tack Coat

Tack coat shall be applied in accordance with the requirements of subsection 210.3.01F. The surface upon which the tack coat is applied shall be dry and shall be cleaned of dirt, dust, and other matter detrimental to the adherence of asphalt.

The asphalt shall be spread with pressure spray equipment which will provide for uniform coverage at the prescribed rates. The rate shall be as specified or as determined by the engineer and will be in the range of 0.02 to 0.06 gallon of retained asphalt per square yard. Tack coat shall be applied to completely cover all cold longitudinal and transverse joints as well as all prepared surfaces and between lifts. Tack coat shall not be applied during wet or cold weather or during darkness.

Tack coat shall be applied only so far in advance as is appropriate to insure a tacky condition of the asphalt at the time of placing the next course of pavement material. Application shall be scheduled so as to offer the least interference to traffic and to permit one-way traffic without pickup or tracking. The tack coat shall be covered the same day as applied.

210.3.04 Seal Coats

Except as specified below, seal coats shall be constructed in conformance with the requirements of subsections 210.3.01A through 210.3.01H. The application rates of asphalt and aggregate shall be within the tolerance ranges specified in the following table. The exact rates shall be as directed.

RATES OF APPLICATION PER SQUARE YARD

	Size of Aggregate	Lbs. of Aggregate	Gallons of Asphalt
Aggregate Seal (fine)	1/4"- #10	12 - 16	.20 - .40
Aggregate Seal (coarse)	1/2"- #4	25 - 35	.30 - .50
Fog Seal	None	None	.05 - .10
Sand Seal	#8 - #200	10 - 15	.10 - .15

210.3.05 Slurry Seal

210.3.05A General

Asphalt slurry seal shall be placed only when the pavement and air temperature is 55° F and rising. No slurry seal shall be applied when there is danger that the finished product will freeze before 24 hours. The mixture shall not be applied when weather conditions prolong opening to traffic beyond a reasonable time or if there is a chance of rain before it can be cured properly. The slurry seal shall not be applied during periods of high relative humidity or when cloudiness prevents adequate evaporation of water from the slurry. No slurry seal shall be applied before 9:00 am and must be able to support traffic by 4:00 pm.

All traffic shall be kept off the slurry seal until it has cured to a firm condition that will prevent pickup or making of the mixture. Where two (2) applications of the slurry mixture are required, the initial treatment shall be cured thoroughly prior to placing the succeeding application.

210.3.05B Equipment

The slurry mixture shall be prepared in a slurry machine equipped with a continuous flow pug mill capable of accurately delivering and automatically proportioning the aggregate, emulsified asphalt, water and filler to a pug mill mixer to form a homogeneous mass. Concrete transit mixer trucks shall not be allowed. The minimum slurry seal machine capacity shall be 7 cubic yards and the contractor shall have immediate access to backup equipment in case of an equipment failure.

The mixing cycle shall be sufficient to produce a uniform coating of the aggregate. It shall continue until the slurry mixture is discharged into the spreader box. The entire batch shall be discarded if there is evidence that the emulsion has broken.

The units shall be equipped with approved devices so that the machine can be accurately calibrated and the quantities of materials used during any one (1) period can be estimated. In the event these metering devices stop working, the slurry unit(s) will stop the application process until they are fixed.

The spreader box shall be equipped to prevent loss of slurry seal from all sides and with a flexible rear strike-off. It shall be capable of producing a uniform surface its full width. It shall have suitable means for side tracking to compensate for deviations in pavement geometry. Any type drag used shall be approved by the engineer and kept in a completely flexible condition at all times. The box shall be kept clean and build-up of asphalt and aggregate shall not be permitted.

Each slurry mixing unit to be used in performance of the work shall be calibrated in the presence of the engineer prior to construction. Previous calibration documentation covering the exact materials to be used may be accepted provided they were made during the calendar year. The documentation shall include an individual calibration of each material at various settings, which can be related to the machine's metering device(s). No machine will be allowed to work on the project until the calibration has been completed and/or accepted.

Suitable crack and surface cleaning equipment, barricading equipment, hand tools and any support equipment should be provided as necessary to perform the work.

210.3.05C Surface Preparation

Prepare the pavement on which the slurry seal is to be placed as follows:

210.3.05C1 Base Repairs

Where directed by the engineer, the contractor shall excavate and replace the surfacing materials as indicated in the plans and specifications. All work shall be performed in accordance with the applicable section.

210.3.05C2 Surface Repair

Where pavement is severely cracked, rutted, deformed, or otherwise distressed, the contractor shall place a leveling course or patch using Class "C" or "D" asphalt concrete; the class of mix to be used shall conform with subsection 211.3.17. Mixture shall be placed in accordance with Section 211.

210.3.05C3 Crack Sealing

Clean and fill cracks 1/8" and larger inside the proposed slurry seal area. Cracks shall be sealed in accordance with Section 210.

210.3.05C4 Tack Coat

On old, dry bituminous pavements and on rigid pavements, the engineer may direct that a tack coat be applied prior to placing the slurry seal. The tack coat shall be a diluted asphalt emulsion of the same type and grade specified for the slurry mix. The ratio of asphalt emulsion to water shall be 1:3 and the diluted material shall be applied uniformly with a pressure distributor at the rate of 0.05 to 0.10 gallon per square yard, as directed by the engineer. The tack coat shall be cured thoroughly prior to the application of the slurry seal.

210.3.05C5 Street Cleaning

Immediately prior to applying the slurry seal, the surface shall be cleared of all loose material, silt spots, vegetation, oil spots and other objectionable material. Any standard cleaning method will be acceptable. If water is used, cracks will be allowed to dry thoroughly before slurry sealing. Manholes, valve boxes, drop inlets and other service entrances will be protected from the slurry seal by a suitable method. The engineer shall approve the surface preparation prior to sealing.

210.3.05D Application

210.3.05D1 General

The surface should be pre-wetted by fogging ahead of the slurry box when required by local conditions. Water used in pre-wetting the surface shall be applied such that the entire surface is damp with no apparent flowing water in front of the slurry box. The rate of application of the fog spray shall be adjusted during the day to suit temperatures, surface texture, humidity and dryness of the pavement surface.

The slurry mixture shall be of the desired consistency upon leaving the mixer and no additional materials shall be added. The slurry mixture shall be fed into the moving spreader box at a sufficient rate to maintain an ample supply of the mixture across the full width of the strike-off squeegee at all times. The strike-off squeegee shall

be adjusted to provide the slurry thickness specified by the engineer, but shall not exceed 1/4" for a single course.

No streaks, such as those caused by oversized aggregate, will be left in the finished surface. If excess oversize aggregate develops, the job will be stopped until the contractor proves to the engineer that the situation has been corrected.

No excessive buildup, uncovered areas or unsightly appearance shall be permitted on longitudinal or transverse joints. An excessive overlap will not be permitted on longitudinal joints. The contractor shall provide suitable width spreading equipment to produce a minimum number of longitudinal joints throughout the project. When possible, longitudinal joints shall be placed on lane lines. Half passes and odd width passes will be used only in minimum amounts. If half passes are used, they shall not be the last pass of any paved area.

The slurry mixture shall possess sufficient stability so that premature breaking of the slurry seal in the spreader box does not occur. The mixture shall be homogeneous during and following mixing and spreading, it shall be free of excess water or emulsion and free of segregation of the emulsion and aggregate fines from the coarser aggregate.

Areas which cannot be reached with the slurry seal machine shall be surfaced using hand squeegees to provide complete and uniform slurry seal coverage. The area to be handworked shall be lightly dampened prior to mix placement and the slurry worked immediately. Care shall be exercised to leave no unsightly appearance from handwork. The same type finish as applied by the spreader box shall be required. Handwork shall be completed during the machine applying process.

Care shall be taken to insure straight lines along curbs, gutters and shoulders. No runoff on these areas will be permitted. Lines at intersections will be kept straight to provide a good appearance.

When extensive scaled areas are filled with slurry, each application shall be rolled by a self-propelled 10-ton pneumatic roller with a tire pressure of 50PSI (3.4 ATMS) and equipped with a water spray system. The surfaced area shall be subjected to a minimum of five (5) full coverages by the roller. Rolling should not commence until the slurry has cured enough so that it will not pick up on the tires of the roller.

210.3.05D2 Application Rate
The slurry seal mixture shall be of proper consistency at all times so as to provide the amount of mixture required by the surface condition. The average application rate as measured by the engineer shall be in conformance with the table in subsection 210.2.07B.

210.3.05D3 Test Section
A sample strip utilizing materials and machinery to be used on the job shall be layed. The strip shall consist of two (2) panels approximately 50 feet long, placed side by side to form a typical seam between them. The width of the panels shall be the same as the contractor plans to use on the streets. The strip shall be placed at least 24 hours prior to the beginning of the actual work. If it is determined by the engineer on the basis of this test strip that there are deficiencies in the mix design or method of application, the engineer may require the contractor to revise the mix design or repair or modify equipment or application. After all changes are made, a new sample strip shall be layed as directed by the engineer.

210.3.05D4 Sampling and Testing
The contractor shall permit the engineer to take samples of the aggregate and asphalt emulsion used in the project at the engineer's discretion. Gradation and sand equivalent tests may be run on the aggregate and residual asphalt content tests on the emulsion. Test results will be compared to specifications. Tests shall be run at the expense of the owner. The owner shall notify the contractor immediately if any test fails to meet the specifications.

Samples of the slurry seal shall be taken directly from the slurry unit(s). Consistency and residual asphalt content tests may be made on the samples and compared to the specifications. Tests will be run at the expense of the owner.

External gauges allowing constant monitoring of the rate of material usage, which are readable by the operator and from the ground, are required. The contractor shall submit a plan to be approved by the engineer for the monitoring of all dry materials. Alternate methods of determining compliance to mix design limits may be used only with written permission of the engineer.

It is the responsibility of the contractor to check stockpile moisture content and to set the machine accordingly to account for aggregate bulking.

Tolerances for individual materials as mixture are as follows:

(a) After the designed residual asphalt content is determined, a plus or minus one (1) percentage point variation will be permitted.

(b) The percent of aggregate passing each sieve shall not vary more than ± 4.0% from the job mix formula.

(c) The percent of aggregate passing shall not go from the high end to the low of the specified range of any two (2) successive sieves.

(d) The slurry consistency shall not vary more than ± 0.5 cm from the job mix formula after field adjustments.

If any two (2) successive tests fail on the stockpile material, the job shall be stopped. It is the responsibility of the contractor, at his own expense, to prove to the engineer that the conditions have been corrected. In any two (2) successive tests on the mix from the same machine fail, the use of the machine shall be suspended. It shall be the responsibility of the contractor, at contractor's expense, to prove to the engineer that the problems have been corrected and that the machine is working properly.

210.3.05D5 Curing

The rate of curing of the slurry seal shall be such that the area may be open to traffic within two (2) to three (3) hours after application without tracking or damage to the surface. Newly slurried areas shall be opened only when approved by the engineer. The owner shall not be responsible for any damage to the slurry seal prior to specific notice to open the area. Any damage to the slurry seal shall be repaired to the satisfaction of the engineer at no additional cost to the owner.

210.3.05D6 Clean Up

All areas, such as utility access covers, miscellaneous appurtenances, curbs and gutters and beyond the limits of the project, shall have the slurry seal removed as specified by the engineer. The contractor shall remove any debris associated with the performance of the work, on a daily basis.

The contractor shall be responsible for immediate clean up due to any spillage or deposit of petroleum products or other materials caused by contractor's operations. Damage to public or private property caused by the contractor's operations shall be repaired or replaced to an equal to or better than existing condition by the contractor at the contractor's expense.

210.3.06 Crack Seal

The cracks shall be prepared using a hot air lance or torch which utilizes a source of compressed air to blow out the crack. The prepared crack shall be clean and free of dust, loose particles, moisture and foreign materials such as organics. The crack shall be filled flush with the pavement surface using a pressure wand applicator. Pour pots will not be allowed. If cracks are overfilled and allowed to cool, the sealant shall be removed and replaced to an acceptable level at no additional cost to the owner. Traffic control shall be provided by the contractor to safely move traffic away from the work area and to prevent tires from tracking and lifting the unhardened filler. Allow crack filling material to cure before allowing traffic or placing subsequential surface treatments. The engineer shall mark the cracks or otherwise direct contractor covering which cracks are to be filled.

210.3.07 Choke

Place choke aggregate at a rate of 0.003 to 0.006 cubic yards per square yard so it is uniformly distributed over the surface as directed by the engineer. Eliminate any piles, ridges, or uneven distribution by spreading and/or removing with hand tools or mechanical means. Use a self-propelled, pneumatic-tired roller following the placement of choke. Make at least two complete roller coverages. Remove all excess aggregates, as directed by the engineer, by carefully brooming the surface.

210.4.00 Measurement and Payment

210.4.01 Asphalt Macadam

210.4.01A Aggregate

210.4.01A1 Ton Basis

Aggregates will be measured and paid for on a ton basis, to the nearest 0.01 ton.

210.4.01A2 Cubic Yard Basis

Aggregates will be measured and paid for on a cubic yard basis, to the nearest 0.1 yard, for the quantity of aggregate measured by average end area based on neat lines as shown or called on the plans.

210.4.01B Asphalt

Asphalt will be measured and paid for on a ton basis, to the nearest 0.01 ton.

210.4.01C Asphalt Emulsion

Asphalt emulsion will be measured and paid for on a ton basis, to the nearest 0.01 ton. Water added to the emulsion will not be paid for as asphalt emulsion.

210.4.01D Square Yard Basis

Asphalt macadam will be measured on the surface to the nearest 0.1 foot. Payment will be on a square yard basis, to the nearest 0.1 yard.

210.4.02 Prime Coat

Prime coat will be measured and paid for in accordance with the requirements of subsection 210.4.01.

210.4.03 Tack Coat

Tack coat will be measured and paid for in accordance with the requirements of subsection 210.4.01.

210.4.04 Seal Coats

Seal coat will be measured and paid for in accordance with the requirements of subsection 210.4.01.

210.4.05 Slurry Seal

Slurry seal will be measured and paid for on a square yard basis, to the nearest 0.1 yard of surface area in accordance with the plans and specifications. Payment shall constitute full compensation for furnishing and placing all materials, including crack sealing (unless otherwise specified), surface repairs, street cleaning, etc. and all equipment tools, labor and incidentals necessary to complete the work as specified. Delivery tickets from aggregate and asphalt suppliers shall be presented to the owner prior to payment.

210.4.06 Crack Seal

Crack seal will be measured and paid for on a lineal foot basis, to the nearest foot. Payment shall constitute full compensation for materials, in place, including preparation work, sealant, routing, backer rods, traffic control and incidentals necessary to complete the work specified.

210.4.07 Choke Aggregate

Choke will be measured and paid for in accordance with the requirements of Subsection 210.4.01A.

210.4.08 Base Repair

Base repairs shall be measured and paid for in accordance with Section 211.4.07.

210.4.09 Surface Repairs

AC mixture shall be measured and paid for in accordance with Section 211. All other work associated with surface repairs shall be incidental to slurry seal.

210.4.10 Incidental Basis

When not listed in the bid schedule, tack coats, seal coats, prime coats, and slurry seals will be considered incidental to the asphalt concrete pavement.

211 Asphalt Concrete Pavement

211 Asphalt Concrete Pavement

211.1.00 Description

This work consists of one or more courses of asphalt concrete pavement constructed on an approved base and to the lines, grades, thicknesses, and cross sections shown on the plans or established by the engineer.

211.1.01 Asphalt Concrete

Asphalt concrete is a hot mixture of asphalt cement; well-graded, high-quality aggregate; and mineral filler and additives as required; plant mixed into a uniformly coated mass, hot laid on a prepared base, and compacted.

211.1.02 Recycled Asphalt Pavement (RAP)

RAP is processed recycled asphalt pavement materials used in the production of new asphalt concrete pavement. The RAP materials proposed for use in the recycled mix shall contain hard, sound, durable aggregates and asphalt cement.

211.2.00 Materials

211.2.01 General

The asphalt concrete mixture shall be a well-graded, uniform, durable mix of the class or classes as shown on the plans or approved by the engineer. The components shall be within the broadband limits set forth in the following table unless modified by the job mix formula.

BROADBAND LIMITS

	DENSE GRADED MIXTURE			OPEN GRADED MIXTURE	
	Percentages of Total Aggregate (by weight) Passing				
Sieve Size	Class "B"	Class "C"	Class "D"	Class "E"	Class "F"
1"	99-100	-	-	-	99-100
3/4"	90-98	99-100	-	99-100	85-96
1/2"	75-91	90-100	99-100	90-98	55-71
1/4"	50-70	52-80	85-100	25-40	15-30
No. 10	21-41	21-46	37-57	2-12	5-15
No. 40	8-24	8-25	13-29	-	-
No. 200 *	2-7	3-8	4-9	1-5	1-6
Asphalt Cement **	4-8	4-8	4-8	4-8	4-8
Hydrated Lime or Portland Cement Filler ***				0.5-1.5	0.5-1.5

* Include lime or cement filler. When treatment of aggregate with lime is required, the percentage passing the #200 sieve will be increased by 0.5%.

** Percent of total mix by weight. The amount of new asphalt cement to be added to the recycled mixture will vary from 3 to 8 percent.

*** Percent of total aggregate and filler by weight.

Class "E" and Class "F" mixes are open-graded. Care shall be taken to ensure that separation of asphalt from the aggregate does not occur. Any noticeable separation at the point of delivery will be cause for rejection.

211.2.02 Asphalt Cement and Additives

211.2.02A Asphalt Cement

New asphalt cement shall meet the requirements of one of the asphalt cements listed in the ODOT's current publication *Specifications for Asphalt Materials*. Asphalt for asphalt concrete shall meet the requirements of the most current ODOT design criteria and shall conform to ODOT specifications. The appropriate grade asphalt shall

be determined by an evaluation of the mix design for each mix from each asphalt concrete supplier and as approved by the engineer.

211.2.02B Asphalt Cement Additives
Anti-stripping additives ordered and/or approved by the engineer shall be added to the asphalt cement and shall meet the requirements of the ODOT Standard Specifications.

211.2.02C Rubberized Asphalt Cement Crack Sealing Material
Crack sealant material shall be a hot applied rubberized asphalt cement complying with ASTM D 1190 and is listed on the current ODOT Qualified Products Listing.

211.2.03 New Aggregates
211.2.03A General
New aggregates shall be hard, sound, durable, and free of deleterious substances. Prior to producing aggregates, the contractor shall advise the engineer as to the type of bituminous mixing plant to be used and the size or sizes of coarse and fine aggregate to be produced.

The contractor shall modify or adjust crushing and screening operations as necessary to produce materials meeting the specifications. During production of aggregates, samples of each size shall be provided as frequently as the engineer considers necessary to determine conformance to the specifications.

The determination of sizes and gradings shall comply with ODOT TM 204. When treatment of aggregates with hydrated lime is required, all testing requirements will apply prior to treatment.

The aggregate shall be stockpiled and removed from stockpiles in a manner that will minimize segregation.

211.2.03B Fracture of Gravel
A minimum of 75 percent of crushed gravel retained on the 1/4-inch sieve shall have two fractured faces. A minimum of 75 percent of the material passing the 1/4-inch sieve but retained on the #10 sieve shall have one fractured face. All aggregate shall conform to ODOT TM 213.

211.2.03C Sand Equivalent
Sand Equivalent shall be not less than 45 when tested in accordance with ODOT TM 101.

211.2.03D Durability
The material from which the aggregates are produced and the crushed aggregates shall meet the following test requirements.

		Maximum Values	
		Coarse	Fine
Test	Test Method	Aggregates	Aggregates
Soundness (5 cycles)	ODOT TM 206	12%	12%
Degradation			
Passing No. 20 Sieve	ODOT TM 208	30%	30%
Sediment Height	ODOT TM 208	3"	4"
Abrasion	AASHTO T-96	30%	-

211.2.03E Deleterious Substances
The amount of deleterious substances in each test fraction of the crushed aggregate material shall not exceed the following values.

Test	Maximum Percentages ODOT Test Method	(by weight)
Lightweight Pieces	TM 222	1.0
Wood Particles	TM 225	0.1
Friable Particles		
Coarse Aggregate	TM 221	1.0
Fine Aggregate	TM 221	1.5
Flat and Elongated Pieces		
Coarse Aggregate	TM 229	5.0

The aggregates shall be free from all other deleterious substances such as soft or disintegrated pieces, clay, loam, or vegetative matter, either in a free state or adherent to the aggregate.

211.2.03F Coarse Aggregate Grading

That portion of the aggregate retained on a 1/4-inch sieve with allowable undersize will be known as coarse aggregate and shall be crushed rock or crushed gravel.

The grading of the separated sizes of coarse aggregate shall conform as closely as possible to the following target values.

Sieve Size Passing	Separate Sizes (Percentage of Weight) 3/4"-1/4" Target Value	Tolerance	3/4"-1/2" Target Value	Tolerance	1/2"-1/4" Target Value	Tolerance
1"	100	-1	100	-1	-	-
3/4"	90	+/- 5	75	+/- 7	100	- 1
1/2"	60	+/- 8	8	+/- 8	90	+/- 5
1/4"	8	+/- 8	7	+/- 7	8	+/- 8
#10	5	+/- 5	5	+/- 5	5	+/- 5
#40	3	+/- 3	3	+/- 3	3	+/- 3
#200	1	+/- 1	1	+/- 1	1	+/- 1

211.2.03G Fine Aggregate Grading

That portion of the aggregate passing the 1/4-inch sieve with allowable oversize shall be known as fine aggregate and shall consist of finely crushed rock or finely crushed gravel and fine sand. No more than 15 percent by weight of natural or uncrushed material passing the #10 sieve shall be re-blended into the total fine aggregate.

The grading of the fine aggregate shall conform as closely as possible to the following target values.

Sieve Size Passing	Separate Sizes (Percentage of Weight) 1/4"-0 ** Target Value	Tolerance	1/4"-#10 Target Value	Tolerance	#10-0 Target Value	Tolerance
3/8"	100	- 1	100	- 1	-	-
1/4"	93	+/- 7	90	+/- 10	100	- 1
#10	48	+/- 7	15	+/- 7	90	+/- 10
#40*	20	+/- 7	5	+/- 5	37	+/- 8
#200	7	+/- 3	2	+/- 2	12	+/- 4

* Not required for Class "E" and "F" mix aggregates.

** If the contractor elects to produce fine aggregates in the 1/4"- 0 size, the following percentages (by weight) shall apply.

Of the fraction passing the 1/4-inch sieve, the following percentage, by weight, shall pass the #10 sieve.

Class of Asphalt Concrete Mixture	Target Value	-------Tolerance-------- Weighted Individual Test	Average of All Tests
"B", "C", "D", and "F"	50	+/- 7	+/- 2
"E"	15	+/- 8	+/- 2

Of the fraction passing the #10 sieve, the following percentage, by weight, shall pass the #40 sieve.

	Target Value	Tolerance
"B", "C", and "D"	42	+/- 10

Of the fraction passing the #10 sieve, the following percentage, by weight, shall pass the #200 sieve.

	Target Value	Tolerance
"B", "C", "D", and "F"	14	+/- 5
"E"	24	+/- 4

211.2.03H Aggregate Treatment

When specified or directed, new aggregates shall be treated with lime in the following proportions to undergo an aging process.

Separated Sizes	Percent Hydrated Lime (by Weight of Aggregate)	Tolerance (Percent)
3/4"-1/4", 3/4"-1/2", 1/2"-1/4"	0.4	+ 0.2
1/4"-0	1.5	+ 0.2
1/4"-#10	1.0	+ 0.2
#10-0	2.0	+ 0.2

The treatment procedure shall comply with the most current ODOT specifications.

No additional payment will be made for lime treatment of aggregates.

211.2.03I Bulk Specific Gravity & Absorption

The values for the aggregate used to develop the JMF shall comply with the following:

Test	AASHTO Test Method	Values Coarse Aggregates	Fine Aggregates
Bulk Specific Gravity	T 84 & T 85	2.5 min	2.4 min
Absorption	T 84 & T 85	2.5 max	4.0 max

211.2.04 Recycled Aggregates

Recycled (also known as reclaimed) material used in the asphalt concrete pavement shall have a maximum size of 1 inch prior to entering the cold feed. Any reclaimed material larger than 1 inch shall be separated by screening or broken down by mechanical means to pass a 1-inch sieve and reincorporated with the balance of the reclaimed material to form a mixture acceptable to the engineer.

The reclaimed material shall be blended with new aggregate to provide a mix conforming to the job mix formula. If there is evidence that the reclaimed material is not breaking down during the heating and mixing of the asphalt concrete mixture, the engineer may elect to modify the maximum size requirement. The fraction of reclaimed material in the new pavement shall not exceed 30 percent of the total aggregate by weight.

The contractor shall have the option of using processed reclaimed asphalt pavement materials in the production of Class B base mixture only.

211.2.05 Portland Cement and Hydrated Lime
Portland cement filler shall meet the requirements of the ODOT Standard Specifications. Hydrated lime used as a filler or used to treat aggregates shall meet the requirements of AASHTO M 216, Type 1, Grade A. The contractor shall furnish manufacturer's certifications in conformance with Section 106.

211.2.06 Mineral Filler
Mineral filler shall meet the requirements of AASHTO M 17.

211.2.07 Temporary Surfacing
Asphalt concrete mixture for temporary surfacing, which is not to become a part of the final pavement, shall be a well-graded, uniform, durable mix using all new materials or a combination of new materials and RAP. The allowable percentage of RAP in the temporary surfacing shall be determined through an approved mix design.

The components of the mixture shall be within the broadband limits specified in subsection 211.2.01. Aggregates treated with lime in accordance with subsection 211.2.03H are acceptable.

The mixture will be accepted on the basis of test results for each 200 tons of mixture or by other testing the engineer deems necessary to ensure the mixture is appropriate for the intended use.

211.2.08 Job Mix Formula
The contractor shall provide specified mix formulated according to an approved job mix formula (JMF) developed by the contractor. The job mix formula shall be developed using Marshall method as described in the latest edition of MS-2 published by the Asphalt Institute. The job mix formula may also be developed by other industry-accepted methods if approved by the engineer. The Marshall design criteria to be used for a specific project shall be as shown in the following table for the traffic category provided by the engineer. A job mix formula will be required for each aggregate source. All mix designs shall be performed by an ODOT certified mix design technician.

The contractor shall supply the job mix design to the engineer for review fifteen (15) work days prior to production. The job mix formula shall be no more than two (2) years old.

No paving shall occur until the contractor receives written approval from the engineer of the contractor's job mix formula for each type of mix specified.

If a job mix formula is not approved by the engineer, then a new job mix formula will be established at the contractor's expense.

MARSHALL DESIGN CRITERIA

Traffic Index (TI)	TI ≤ 6		6 < TI ≤ 7.5		TI > 7.5	
Marshall Method	Surface & Base		Surface & Base		Surface & Base	
Mix Criteria	Min.	Max.	Min.	Max.	Min.	Max.
Compaction, number blows each end of specimen	35		50		75	
Stability, Newtons (lb.)	3336 (750)		5338 (1200)		8006 (1800)	
Flow, 0.25mm (0.01 in.)	8	18	8	16	8	14
Percent air voids	3	5	3	5	3	5
Percent voids in mineral aggregate (VMA) From MS-2 published by the Asphalt Institute	See Table III-5 in MS-2 published by the Asphalt Institute.					

In addition, the job mix formula shall be designed such that the mix, when tested in accordance with ODOT test methods, shall have a tensile strength ratio of at least 75.

The JMF shall establish the temperature of the mixture at time of placement per the ODOT Contractor Design Guidelines.

Where the special specifications for the work do not specify the Marshall mix formula criteria to use, the contractor shall design and provide the mix formulated per the Marshall Design Criteria directed by the engineer. The traffic index shall be as calculated by the engineer.

211.2.09 Tolerances

After the job mix formula is determined, the mixture shall conform to the formula within the following tolerances.

	Narrow Band Tolerance (from job mix formula)	
Constituents of Mixture	Base and Leveling Courses	Surface Course
Aggregate passing 1", 3/4", and 1/2" sieves specified in subsection 211.2.01	Within the broadband ranges specified in subsection 211.2.01	
Aggregate passing 1/4" sieve	+/- 6.0%	+/- 5.0%
Aggregate passing #10 sieve	+/- 5.0%	+/- 4.0%
Aggregate passing #40 sieve	+/- 5.0%	+/- 4.0%
Aggregate passing #200 sieve	+/- 2.0%	+/- 2.0%
Asphalt cement	+/- 0.6%	+ 0.5%/- 0.2%
Moisture content at time of discharge from the mixing plant (upper limit)	0.8% max.	0.7% max.

211.2.10 Modification of Mixes

The engineer reserves the right to modify specified mixes for use under various traffic conditions on various segments of the work and for feathering, spot patching, and other special purposes. The contractor shall provide mixes proportioned as directed by the engineer for such purposes.

Modifications of the mix as directed may require changes in the contractor's plan and sequence of operations. Such changes shall be allowed for by the contractor.

Upon written request from the contractor, the engineer may approve field adjustments to the job mix formula of up to 2 percent of the aggregate passing the 1/4-inch sieve, 1 percent for the aggregate passing the #10 sieve, and 0.5 percent for the aggregate passing the #200 sieve. These field adjustments to the job mix formula may be made by the engineer provided the change will produce material of equal or better quality. The above adjustments, or any further adjustments ordered by the engineer, will be considered the job mix formula. Adjustments beyond these limits will require development of a new job mix formula. The adjusted job mix formula, plus or minus the allowed tolerances, shall be within the broadband limits.

211.2.11 Process Control

211.2.11A General

The contractor shall be responsible for quality control, for all AC materials. In addition, supply process control testing results from samples on the aggregate to be incorporated in the project according to Section 211.2.11B.

211.2.11B Aggregates

Samples shall be for each size of aggregate and shall have been taken during production or from a stockpile according to AASHTO T 2 (before treating with hydrated lime, when lime is required). Supply test results on samples as follows:

Test	Section	Minimum Frequency
Fracture of Gravel	211.2.03B	One set per project
Sand Equivalent	211.2.03C	Three sets per project
Durability	211.2.03D	One set per project

Deleterious Substances	211.2.03E	One set per project
Sieve Analysis	211.2.03F & 211.2.03G	Three sets per project
Bulk Specific Gravity	211.2.03I	One set per project
Absorption	211.2.03I	One set per project

The engineer may perform any of the tests required in this subsection, and any additional tests, such as lightweight pieces, dust or clay coating, friable particles, plasticity index, soundness, degradation and abrasion, in determining acceptance of aggregates.

211.2.11C Recycled Asphalt Pavement (RAP) Materials
Sample and test RAP material for gradation and asphalt content at the rate of at least one test for each 500 tons of RAP processed as follows:

TEST	METHOD
Mechanical Analysis of Extracted Aggregate	AASHTO T 27
Extraction of Asphalt from Paving Material	ODOT TM 309

211.2.11D AC Production

211.2.11D1 Calibration
Determine the proper proportioning of the materials at the cold feed or hot bins. Do not begin production until calibration tests indicate that the specified proportions can be obtained. In calibrating for mixtures that contain RAP, determine gradation and asphalt content after blending and mixing at the plant.

211.2.11D2 Mixture Control
Make at least one test for each 2000 tons of mixture produced to determine the aggregate gradation and asphalt content. Sample either before or after blending and mixing at the plant. Sample mixture containing RAP for both gradation and asphalt content after mixing and tested according to ODOT TM 309.

211.2.11D3 Asphalt Content
Determine by one of the following methods:

a) Metering and Weighing - From the plant's asphalt metering or weighing system, and confirm by invoices and/or tank stickings;

b) Extraction - By ODOT TM 309, extraction of asphalt from paving mixture;

c) Nuclear - By ODOT TM 319;

d) Incineration - By ODOT test method for incineration.

211.2.11D4 Aggregate Gradation
Determine by one of the following methods:

a) Cold Feed - By sieve analysis, AASHTO T 11 and AASHTO T 27;

b) Extraction - By ODOT TM 309 (mechanical analysis of extracted aggregate);

c) Incineration - By ODOT test method for incineration.

211.2.11D5 Asphalt Antistrip Additive
Determine by the following (if not pre-blended by the asphalt supplier):

a) Metering and Weighing - From the plant's asphalt metering or weighing system, and confirm by invoices and/or tank stickings.

211.3.00 Construction

211.3.01 Pre-paving Conference
The contractor and subcontractors who are to be involved in the paving work shall meet with the engineer for a pre-

paving conference at a time mutually agreed upon. At this conference, the contractor shall discuss the proposed methods of accomplishing all phases of the paving work.

211.3.02 Weather Limitations

Asphalt concrete shall be placed on a dry prepared surface when the surface temperature is not less than specified below.

Nominal Specified Compacted Thickness of Individual Courses *	Wearing Course	All Other Courses
Less than 1 1/2"	60°F	60°F
1 1/2" to 2 1/2"	50°F	40°F
2 1/2" and over	40°F	40°F

The temperatures shown in the table in this section are not recommended temperatures for paving, but paving may be allowed at these temperatures on the condition that specified pavement compaction is achieved.

Asphalt concrete shall not be placed during rain or other adverse weather conditions, except that, if approved by the engineer, mix in transit at the time these adverse conditions occur may be laid if the mix has been covered during transit and is at the specified temperature, if the foundation is free from pools or flow of water, and if all other requirements of these specifications are met. Asphalt concrete mixtures shall not be placed when the foundation is frozen or when, in the opinion of the engineer, existing or expected weather conditions will prevent the proper handling, finishing, or compaction of the mixtures.

211.3.03 Asphalt Concrete Mixing Plant

211.3.03A DEQ Requirements

Prior to producing and furnishing asphalt concrete from a new or revised stationary plant location or a portable plant, the contractor shall furnish the following items to the engineer.

1) A current air contaminate discharge permit number for the plant being used;

2) The expiration date of the permit; and,

3) A written statement that the DEQ has been advised of the location of the plant and when operation is to commence.

The name and address of the air pollution authority having jurisdiction over the area may be obtained from the engineer.

211.3.03B Plant Scales

Scales shall be accurate to 0.5 percent throughout the range of use and shall be tested and adjusted as often as directed by the engineer to verify continued accuracy.

211.3.03C Mixing

All the components of the asphalt concrete mixing plant shall be utilized and operated in a manner to ensure compliance with this section. The combined materials shall be mixed until the asphalt cement is distributed thoroughly in the mixture and the aggregate particles are completely and uniformly coated.

The asphalt concrete shall be mixed by combining aggregate, asphalt, and additives at an approved central mixing plant equipped with controls to accurately measure and monitor the various components of the mix to produce a uniform homogeneous mixture at the specified temperature.

The discharge temperature of the mix will vary with the type of mixing plant, climatic conditions, and other variables. However, the temperature shall be sufficient to provide thorough mixing and coating and to provide a mass viscosity of the mix on the grade which will permit compaction to required density. Mix temperature and asphalt in storage shall not exceed 325 degrees F.

The temperature of the mix at discharge from the plant shall not exceed 325° F.

211.3.04 Drying, Heating, and Separating Aggregates into Designated Sizes

211.3.04A Drying

Aggregates shall be dried to the extent that any retained moisture will not result in visible defects in the mixture such as slumping loads, boils, or slicks.

211.3.04B Screening

In plants which have screens, the aggregates shall be separated, immediately after drying and heating, by screening into the sizes required for separate handling, storing and proportioning at the mixing plant.

211.3.05 Heating Asphalt Cement

Asphalt heating equipment shall be capable of uniformly heating the asphalt cement to the temperature specified.

The temperature of the asphalt cement when introduced in the mixture shall be not less than 250°F nor more than 350° F.

211.3.06 - This subsection is intentionally left blank.

211.3.07 Truck Scales

Each pay load of asphalt concrete mixture shall be weighed on scales meeting the requirements of Section 109 except as follows.

When vehicle scales meeting the requirements of Section 109 are available for check weighing, the contractor, upon written approval of the engineer, will be permitted to use an approved weigh hopper that is accurate within 0.5 percent throughout the range of use. Use of the hopper to determine pay weights will be discontinued when random check weighings indicate that the quantities are not accurate within 0.5 percent.

Each load of mixture shall have a weigh memo provided by the contractor.

211.3.08 Hauling Equipment

Vehicles used for hauling asphalt concrete mixtures shall have tight, clean, and smooth beds which have been thinly coated with paraffin oil, lime solution, soapy water, or other approved material to prevent the mixture from adhering to the beds. Do not use diesel oil unless approved by the engineer. During each application of approved coating material, and prior to loading, the vehicle bed shall be drained of all excess coating material.

Hauling vehicles shall be equipped with covers to protect against moisture intrusion and heat loss, and shall have a 3/8-inch diameter hole near the middle of the left side wall of the bed to allow access for a thermometer.

Vehicles which cause excess segregation, leak badly, or delay normal operations shall not be used.

211.3.09 Asphalt Concrete Pavers

Pavers shall be self-contained, power-propelled units equipped with augers and a screed or strike-off assembly, heated if necessary, and capable of spreading and finishing layers of asphalt concrete material to the widths, thicknesses, lines, grades, and cross sections required.

The paver shall be equipped with a receiving and distribution system of sufficient capacity for a uniform spreading operation and capable of placing the mixture uniformly in front of the screed without segregation of materials. Extensions added to the paver when used on travel lanes shall have the same augering and screeding equipment as the rest of the paver.

The paver shall be designed so minor irregularities in the surface of the base will not be reflected in the surface of the layer being placed. The weight of the paver shall be supported on tracks or wheels none of which shall contact the mixture being placed. The contact area of the screed or strike-off assembly shall be uniform over the entire width of the mixture being placed.

The screed or strike-off assembly shall produce a finished surface of the required smoothness and texture without tearing, shoving, or gouging the mixture. The paver shall be equipped with either a manual or electronic line and grade control.

All lifts of pavement shall be placed with an approved self-propelled paving machine.

211.3.10 Compactors
Rollers shall be steel wheel, pneumatic tire, vibratory or a combination of these types. They shall be in good condition and capable of reversing without backlash.

211.3.10A Steel Wheel Rollers
Steel wheeled rollers shall have a minimum gross static weight of 8 tons and a minimum static weight on the drive wheel of 250 pounds per inch of width. For finish rolling a 6-ton minimum gross static weight is acceptable and the 250 pounds per inch of width will not be required.

211.3.10B Vibratory Rollers
Vibratory rollers shall be equipped with amplitude and frequency controls and shall be specifically designed for compaction of asphalt concrete mixture. The rollers shall be capable of frequencies of not less than 2,000 vibrations per minute.

211.3.10C Pneumatic Rollers
The pneumatic-tired rollers shall be self-propelled, tandem, or multiple axle, multiple wheeled with smooth-tread pneumatic tires. The tires shall be of equal size and staggered on the axles at spacings and overlaps that will provide uniform compacting pressure for the full compacting width of the roller. Ground pressures shall be at least 80 pounds per square inch of tire contact area. Pneumatic-tired rollers shall be fully skirted to insulate the tires from significant heat loss during compaction.

Use pneumatic-tired rollers during the breakdown compaction sequence only.

211.3.11 Preparation of Foundation
All bases and foundations on which the pavement is to be constructed shall meet the applicable specifications and be approved prior to the start of paving. Existing bases and foundations shall be reconditioned as specified or directed.

Broken or ragged edges of existing paved surfaces underlying or abutting the new pavement shall be trimmed back to firm material. Surfaces against which asphalt concrete is to be placed shall be treated with an asphalt tack coat as specified in Section 210.

Depressed areas in existing pavement shall be tacked and leveled with an approved asphalt concrete mixture and compacted with a pneumatic tired roller. This leveling work shall be a separate operation and performed as specified. Leveling material shall be spread by means of a paving machine except in small or irregular areas where the engineer may permit the use of other equipment. At the direction of the engineer, leveled areas shall be retacked prior to placement of subsequent material.

Prior to placing each lift of asphalt concrete, tack coat asphalt shall be applied to completely cover all cold longitudinal joints and all prepared existing bituminous and Portland Cement concrete surfaces. The application rate shall be 0.04-0.08 gallon per square yard of surface area, with a residual asphalt of 0.02-0.03 gallon per square yard.

211.3.11A Preparation of Existing Pavement Surfaces for AC Overlay
The contractor shall loosen and remove all vegetation, clean the cracks, wash and sweep the street as directed by the engineer.

Cracks between 1/4-inch and 3/4-inch shall be cleaned with compressed air and filled with rubberized asphalt cement crack sealant.

Cracks larger than 3/4-inch shall be repaired with slurry or hot asphalt concrete. Holes shall be repaired with asphalt concrete.

The crack cleaning equipment, the crack sealing material, and the crack sealing applicator shall be approved by the engineer prior to use.

An approved crack sealant shall be installed in conformance with the manufacturer's instructions and

recommendations. Application shall be performed using an approved pressure feed wand system. Pour pot application will not be allowed. A copy of the manufacturer's specifications including application procedures shall be furnished to the engineer upon request. The engineer may order a test run of any application method or material prior to filling of cracks. The cracks shall be totally filled with a sealant from the pre-qualified list hereinbefore. The sealant shall completely fill the cracks.

All sunken pavement shall be pre-leveled with asphalt concrete as directed by the engineer prior to the placement of fabric or overlay.

All existing structures shall be protected from the overlay operation and shall be checked and cleaned as necessary after the overlay.

The pavement surface shall be dry prior to the preparation work and paving. Existing traffic buttons and epoxy shall be removed prior to the paving.

211.3.12 Asphalt Concrete Storage

Storing or holding of hot asphalt concrete mixture in open stockpiles will not be permitted.

Temporary storing or holding of hot asphalt concrete mixture in storage silos up to 24 hours will be permitted. Trucks shall be loaded from the storage silos in a manner that prevents segregation.

211.3.13 Delivery, Storage, and Handling of Aggregates

During production, hauling and storage, aggregates shall be handled in a manner that will prevent segregation of materials or intermingling of separate gradings or kinds of aggregates. Covers shall be used to protect the mixture when adverse weather or cold air temperature is encountered during hauling.

211.3.14 Control of Line and Grade

When specified in the contract, the engineer will establish references at reasonable intervals for line and grade control of the placing operations. The contractor shall furnish, place, and maintain supports, wires, devices, and materials as necessary to provide continuous line and grade reference control to the automatic paver control system on either or both sides of the paving machine.

With approval of the engineer, the line and grade reference control may be a floating beam device or multi-footed ski of a length and sensitivity that will control of the paver to the grade specified. After the paving of the first lane, a joint matcher or manual control of line and grade will be permitted with approval of the engineer.

211.3.15 Spreading, Temperature Control, and Finishing

211.3.15A Spreading

1) General - Asphalt pavers conforming to subsection 211.3.09 shall be used to distribute the mixture. Placing of the mixture shall be continuous and uniform.

In areas where patching, irregularities or unavoidable obstacles make the use of specified equipment impracticable, the mixture may be spread with other equipment approved by the engineer.

2) Dropoffs - When placing asphalt concrete pavement under traffic in courses in excess of a 2-inch thickness, work shall be scheduled so at the end of each working shift the full width of the area being paved, including shoulders, shall be complete to the same elevation with no longitudinal dropoffs.

When placing asphalt concrete pavement under traffic in courses between 1 and 2 inches in thickness, work shall be scheduled so that at the end of each working shift a strip of new pavement shall not extend beyond the adjoining strip of new pavement more than the distance normally covered by each shift. Prior to any suspension of operations for a period of one day or more, the full width of the area to be paved, including shoulders, shall be completed to the same elevation with no longitudinal dropoffs.

The transverse dropoff at the end of each strip shall be feathered out in accordance with subsection 211.3.16.

Where abrupt or sloped dropoffs occur within or at the edge of the paved surface, the contractor shall provide suitable warning signs.

3) Construction Joints - The width of pavement strips shall be adjusted to minimize the number of longitudinal joints required. Longitudinal joints in the wearing course shall be at a lane line or the edge line of a traffic lane. On median lanes and on shoulder areas, joints shall occur only at points designated by the engineer. The longitudinal joints in one layer shall offset those in the layer immediately below by a minimum of 6 inches. Underlying longitudinal joints shall be within 12 inches of the edge of a lane or within 12 inches of the center of a lane, except in irregular areas.

211.3.15B Temperature of Mixture

The temperature of the mixture at the time it is placed in final position shall be established by the job mix formula. The engineer may adjust the lay-down temperature in 10-degree increments to attain maximum workability and compaction. In no case shall the lay-down temperature of mixture be less than 240°F for dense graded mix, and 205°F for open graded mix.

211.3.15C Finishing and Details

Segregation of materials, non-uniform texture, fouled surfaces preventing full bonding between lifts of mixture, and other defects determined by the engineer as detrimental, shall be corrected by the contractor at no expense to the owner.

Where new asphalt concrete pavement is constructed to join or overlay existing asphalt concrete pavement, the contractor shall seal the joints and taper edges with CSS-1 and sand.

211.3.16 Transverse Joints

On wearing courses, pavement depth, line, and grade shall be maintained at least 4 feet beyond the selected transverse joint location. On all courses, a sloped end section shall be constructed. If subject to traffic, the end section shall be sloped at not less than 50:1. If not subject to traffic, the end section shall be sloped at a minimum of 10:1.

When paving is not expected to continue from the transverse joint until the following day or later, paper or other suitable material shall be placed under the material ahead of the transverse joint location.

Prior to continuing the permanent paving lift, the contractor shall remove the material beyond the joint to a vertical face against which paving will resume. The base shall be cleaned of all debris. A tack coat shall then be applied to the vertical edge and surface of the exposed area before paving is continued.

After placement and finishing of the new asphalt concrete, both sides of the joint shall be compacted to the specified density. The joint surface shall conform to the requirements of subsection 211.3.19.

211.3.17 Thickness and Number of Layers

The mixture shall be placed in the number of lifts and to the compacted thickness of each lift as shown on the plans. If the compacted thickness of each lift is not shown on the plans, the minimum and maximum compacted thickness for any lift shall be as follows:

	Base and Leveling Courses		Wearing Course	
	Minimum	Maximum	Minimum	Maximum
Class B	2"	4"	1 1/2"	2 1/2"
Class C	1"	2 1/2"	1"	2"
Class D	1/2"	1"	NA	NA
Class E	NA	NA	1"	2 1/2"
Class F	NA	NA	1 1/2"	2 1/2"

The placement of asphalt along the existing concrete gutters shall be raked in such a manner that the compacted asphalt shall not extend more than 1/4 inch above the gutter at its face or as directed by the engineer.

211.3.18 Compaction

Immediately after the asphalt concrete mixture has been spread, struck off and surface irregularities and other defects remedied, it shall be thoroughly and uniformly rolled until the mixture is compacted.

211.3.18A General
The type, number and weight of rollers shall be sufficient to compact the mixture while it is still within the specified temperature range. Pneumatic-tired rollers shall be used for break down compaction except on the wearing course where a single coverage with a vibratory roller shall proceed pneumatic-tired rolling. The use of equipment which crushes the aggregate will not be permitted. Rollers shall not be operated in vibratory mode when the temperature of the mixture has dropped below 180°F.

On streets less than 500 feet in length, a vibratory roller may replace pneumatic-tired rolling.

Steel roller wheels shall be moistened with water or other approved material to the least extent necessary to prevent pickup of mixture and not cause spotting or defacement of the surface of the mixture.

Rollers shall be operated at speeds recommended by the roller manufacturer and slow enough to avoid displacement of the mixture. The maximum speeds shall be 3 miles per hour for vibratory rollers, 4 miles per hour for steel-wheeled rollers, and 5 miles per hour for pneumatic-tired rollers.

Care shall be exercised not to displace the line and grade of edges. Displacement of any course occurring as a result of the reversing of the direction of a roller, or from other causes, shall be corrected at once by the use of approved rakes and addition of fresh mixture when required.

Any mixture that becomes loose and broken, contaminated, segregated, or is in any way defective, shall be removed and replaced with new mixture at no expense to the owner.

Finish rolling shall continue until all roller marks are eliminated.

Along curbs and walls, on walks, irregular areas, and other areas not practicably accessible to specified rollers, the mixture shall be compacted with approved self-propelled rollers, mechanical tampers, hot hand tampers, or heavy hand rollers. On depressed areas, a trench roller may be used or cleated compression strips may be used under the roller to transmit compression to the depressed area.

211.3.18B Compaction and Density Requirements for Dense Graded Mixes
For thin lifts of asphalt concrete placed on materials placed under the contract and specified by the engineer to be less than 1 1/2 inches thick, the mix shall be compacted as shown below for thin lift overlays. The type, number, and weight of rollers shall be sufficient to thoroughly compact the mix while it is still above 180°F. The minimum compaction level of 92 percent will not apply to thin lift paving.

For asphalt concrete with a thickness of 1 1/2 inches or greater placed on materials placed under the contract, the mixture shall be compacted to at least 92 percent of the theoretical maximum density as determined by ODOT TM 306.

For thin lift overlays or inlays (asphalt concrete placed on existing surfaces) less than 1 1/2 inches thick, the mixture shall be compacted by at least four (4) coverages of the breakdown roller, four (4) passes [two (2) coverages] of the intermediate roller and such additional coverages as the engineer may elect. Finish roll as specified above. For overlay and inlay lifts greater than 1 1/2 inches thick, the actual roller pattern shall be verified by use of a control strip conforming to the method specified in the ODOT Standard Specifications. All additional costs associated with the use of the control strip shall be the responsibility of the contractor.

On temporary surfacing, guardrail flares, mailbox turnouts, road approaches, and areas of restricted width (less than 6 feet wide) or limited length (less than 50 feet), regardless of thickness, compaction to a specified density will not be required. Continue the breakdown and intermediate rolling until the entire surface has been compacted with at least four coverages by the roller(s). Perform additional coverages, as directed and as necessary, to obtain thorough compaction and finish rolling of the AC.

The contractor shall furnish and operate the nuclear gauge or shall retain an independent testing firm to perform the compaction testing for assurance and acceptance testing. The testing shall be conducted under the observation of the engineer and performed on all surfaces regardless of density requirements unless otherwise directed by the engineer.

211.3.18C Compaction and Density Requirements for Open Graded Mixes
Compaction of open graded mixes (E & F) to a specified density will not be required.

Use only steel-wheeled roller(s) for compaction. Continue the breakdown and intermediate rolling until the entire surface has been compacted with at least 4 coverages by the roller(s). Perform additional coverages, as directed and as necessary, to obtain thorough compaction and finish rolling.

211.3.19 Pavement Smoothness
The completed surface of all courses of the mixture shall closely parallel that specified for the top surface of the finished pavement and shall be smooth, uniform in texture and conform to the specified crown and grade.

The top surface of the asphalt concrete pavement shall not vary by more than 0.02 foot when tested with a 12-foot straightedge either parallel with or perpendicular to the centerline. The straightedge shall be furnished and operated by the contractor. The engineer will observe this testing and may require additional testing.

The joint between the pavement and the top surface of utility structures, such as manhole covers and valve boxes located in the traveled way, shall meet the pavement surface tolerances.

The surface of the finished pavement shall be within 0.02 foot of the specified line, grade and cross section.

When tests show the pavement is not within the above tolerances, the contractor shall take immediate action to correct equipment or procedures in the paving operations to eliminate the unacceptable pavement roughness.

Any surface irregularities exceeding the above tolerances shall be corrected by the contractor using a method or methods listed below and approved by the engineer.

The engineer shall require one or more of the following corrective measures be performed on the deficient areas.

1) Remove and replace the surface course.

2) Place an overlay of a thickness approved by the engineer.

3) Grind the pavement surface utilizing diamond blades up to a maximum depth of 0.3-inch and apply an emulsion fog coat as directed by the engineer.

4) Other remedial actions as directed by the engineer.

After completion of the corrective work, if the engineer finds it is still not satisfactory, the contractor shall perform additional corrective work on areas not meeting the above tolerances.

All corrective work, including furnishing of materials, shall be performed within 10 workdays following notification from the engineer and at the contractor's expense. No adjustment in contract time will be made for corrective work.

Where surface irregularities are localized or where the engineer determines corrective work would not be in the owner's best interests, the engineer may deduct from payment due the contractor amounts equivalent to the engineer's estimate of work costs had the corrective work been done.

211.3.20 Special Protection Under Traffic
The following shall apply to pavement construction in addition to other required provisions for traffic: no traffic or equipment shall come in contact with the compacted mixture until it has cooled and set sufficiently to prevent marking; edges shall be protected from being broken down; and edge drop-off(s) one inch or more in height shall be marked with approved reflectorized and/or flashing warning devices visible by day and night to the traveling public, and placed at spacings as specified by the engineer. All warning devices shall comply with requirements of Section 202.

211.3.21 Temporary Pavement Markings
During paving operations, lane markings shall be placed and maintained each day throughout the project in accordance with Section 202.

211.3.22 Sampling and Testing

The contractor is responsible for process control and shall conduct sampling, testing, measurement and inspection as necessary to insure the finished pavement meets specifications.

The engineer will determine the suitability of the final product through final acceptance testing. Results of these tests will be used to determine payment deductions, if any, to be assessed against the contract.

The engineer shall be permitted to cut samples or to take cores from the compacted mixture for testing purposes. Where samples have been taken, the contractor shall furnish new material and fill the holes as directed with no compensation beyond the unit price for asphalt concrete in place.

211.3.22A Aggregate Gradation and Asphalt Content

The contractor shall take samples from the grade, unless otherwise directed by the engineer, on a random basis determined by the engineer. The samples shall be taken in the presence of the inspector for acceptance testing by the engineer. One (1) sample per 500 tons shall be taken, with a minimum of three (3) samples per project, of each mix design of asphalt concrete or portion thereof.

When samples are not obtained as required, the engineer may require the gradation and asphalt content to be determined by core samples. Core samples will be tested by an independent testing laboratory at the direction of the engineer. The contractor shall bear all cost associated with coring and testing.

211.3.22B Compaction

For final acceptance of the pavement, the density of each section of pavement will be determined by random acceptance tests using a nuclear gauge or laboratory analysis of pavement core samples. Density tests will be taken at five randomly selected sites for each section of pavement. The average of the five density tests will constitute the density of the pavement.

A section of pavement will be the area constructed from 500 consecutive tons of mixture or portion thereof. Acceptance tests will not be made within one foot of the edges of the panel or from areas where the specified compacted thickness is less than 1 1/2 inches.

When using a nuclear gauge, two readings will be obtained at each site, the second at right angles to the first. The two readings will be averaged to obtain the test density. For any section of pavement, if the contractor requests in writing within two work days after nuclear gauge test results are furnished to the contractor, pavement cores will be obtained at the same randomly selected sites used for the nuclear gauge tests. The density of the core samples will be determined by an independent testing laboratory. The average density of these five core samples will constitute the in-place density of the section of pavement and will prevail over nuclear results. If the density as determined by the core samples does not meet density requirements, the contractor shall bear the cost of coring and testing.

The engineer shall have the right to test any areas that appear defective in compaction. If the areas are found deficient, the engineer may require the contractor to bring the areas into conformance with the specifications.

Acceptance will not be made for mixture compacted to less than 88.0 percent of theoretical maximum density (Rice Density), or 94% of target density. The engineer may decide to allow the deficient pavement to remain in place. In that case, the engineer and the contractor will agree in writing that the pavement will remain in place.

If the contractor takes core samples to verify the densities, the holes shall be filled with like material and compacted and sealed to the engineer's satisfaction. The density of the core samples shall be tested by an independent testing laboratory in accordance with ASTM 2726. All verifying work performed by the contractor shall be at the contractor's expense.

Where in-place mixture fails to meet the compaction standard of 92 percent of theoretical maximum density, the engineer may accept the pavement and shall make payment to the contractor based on subsection 211.4.05B.

In addition to the specified unit price deduction, if the in-place compaction of more than 25 percent of the top lift mixture is 90.0 percent of Rice density or less, and at the engineer's discretion, the contractor shall fog seal the top lift of paving as specified in Section 210 and as directed. The fog seal shall be done at the contractor's expense.

Additional remedial work may be required to in-place mixture compacted to less than 88.0 percent as directed by the engineer.

Satisfactory compliance with performance standards described in subsection 211.3.18C for compaction of open-graded mixes (E & F) shall be determined by the engineer. Compaction of open-graded mixes (E & F) to a specified density is not required.

211.3.22C Pavement Thickness
The engineer will select locations for non-destructive measurement or core samples to determine pavement thickness.

If non-destructive measurement indicates a pavement section is less than the thickness shown on the plans, or is otherwise out of specification, the contractor may take cores at the same locations to verify the engineer's measurements. If the pavement section is found to comply with specifications, the coring and restoration will be paid for as extra work. Pavement found to be out of specification shall be subject to replacement or to payment at adjusted prices.

In determining deficient or excessive thickness in asphalt concrete overlays, the engineer shall adjust the cross section measurement sequence, average series of measurements, or take other appropriate steps to allow for the desirable leveling of low or high areas on the existing pavement.

Where a deficiency is found and the engineer determines the deficiency serious enough to impair the traffic service expected from the pavement, the area of such deficiency shall be removed by the contractor and shall be replaced with pavement meeting the specifications. The cost of the deficient pavement and of the removal shall be borne by the contractor.

211.3.23 Base Repairs/Street Patching
Where directed by the engineer, the contractor shall excavate and replace the surfacing materials as indicated in the plans and specifications. All work shall be performed in accordance with the applicable section.

211.4.00 Measurement and Payment

211.4.01 Ton Basis
Asphalt concrete will be measured and paid for on a ton basis, to the nearest 0.01 ton. There will be no separate measurement or payment for asphalt cement contained in the mixture.

211.4.02 Square Yard Basis
Asphalt concrete will be measured on the surface to the nearest 0.1 foot. Payment will be on a square yard basis, to the nearest 0.1 yard.

211.4.03 Separate Tonnages of Mixture and Asphalt Cement
When the bid schedule so indicates, the quantities of asphalt concrete mixture and asphalt cement contained in the mixture will be measured and paid for separately as follows.

a) Asphalt concrete mixture will be measured and paid for on a ton basis, to the nearest 0.01 ton. No deduction will be made for the weight of the asphalt cement or any additive used in the mixture as required by the specifications or ordered by the engineer.

b) Asphalt cement will be measured and paid for on a ton basis, to the nearest 0.01 ton. If invoice and tank stickings are not available, the quantities shall be based on extraction tests.

211.4.04 Patching and Leveling
Patching and leveling work will be measured and paid for in conformance with this subsection. If patching and leveling is not listed as a separate bid item, it shall be paid for at the unit price for the closest conforming asphalt concrete mixture by gradation in the bid schedule.

211.4.05 Payment Deductions and Rejection of Pavement
211.4.05A Aggregate Gradation and Asphalt Content
A deduction of 1.0 percent of the in-place price for asphalt concrete and cement will be made for each 1.0 percent

cumulative weighted deviation beyond the allowable tolerance of each component of the job mix formula specified in subsection 211.2.09.

The following factors shall be used to calculate deductions due to deviations from the job mix formula.

Deviation Weighting	
Asphalt Cement	12 x Deviation
200 minus	3 x Deviation
#10	1.5 x Deviation
#40	1.5 x Deviation
All Other Sizes	1 x Deviation

The cumulative weighted deviation is the sum of all weighted deviations as determined from the table above. A minimum of three samples shall be used to determine any reduction in payment. Where the cumulative weighted deviation equals or exceeds 15.0 percent, the materials shall be removed and replaced at no cost to the owner. The engineer shall determine the limits of the defective pavement.

When asphalt paving materials with a cumulative deviation of less than 15.0 percent are furnished, the engineer may require the contractor to remove and replace defective materials at no cost to the owner or shall deduct from payments to the contractor an amount equal to the cumulative weighted percentage deviations from the job mix formula.

211.4.05B Compaction

Asphalt concrete pavement which does not comply with compaction requirements shall be removed and replaced or, at the discretion of the engineer, be subject to a price reduction determined from the following table.

PRICE REDUCTION SCHEDULE

% MAXIMUM DENSITY (Normal Method)	% PAY *	% TARGET DENSITY (Control Strip Method)
92.0 and above	100	98.0 and above
91.5 - 91.9	95	97.5 - 97.9
91.0 - 91.4	90	97.0 - 97.4
90.5 - 90.9	85	96.5 - 96.9
90.0 - 90.4	80	96.0 - 96.4
89.5 - 89.9	70	95.5 - 95.9
89.0 - 89.4	60	95.0 - 95.4
88.1 - 89.0	0 - 50 **	94.0 - 95.0
88.0 and below	0	Below 94.0

* Applies to price for in-place asphalt concrete, including asphalt cement where measured and paid for separately.
** As determined by the engineer

211.4.05C Pavement Thickness

In determining payment reductions for deficient or excessive pavement thickness, a section of pavement will normally be one full roadway station (100 lineal feet). For non-roadway paving and in other situations where the engineer determines the above section is inappropriate, the engineer may establish a different unit of work on which to calculate average thicknesses and price reductions.

When pavement thickness, as determined by the engineer's measurements or test cores, is found deficient by more than the thickness of the specified surface course of asphalt concrete, the engineer may allow the contractor to place an additional lift of asphalt concrete to bring the total thickness of the pavement into conformance with the specifications.

When the pavement in any section of pavement is found deficient in thickness by less than the specified thickness of the surface course, and the engineer allows the pavement to remain in place, payment for that pavement will be made at an adjusted price determined from the following table.

% Deficiency in Thickness	% Reduction in Pay *
0.0 to 5.0	No deduction
5.0 to 10.0	0.5 x Deficiency
10.0 to 15.0	1.0 x Deficiency
15.0 to 20.0	1.5 x Deficiency
20.0 to 25.0	2.0 x Deficiency
25.0 to 30.0	2.5 x Deficiency

* Applies to price for in-place asphalt concrete, including asphalt cement where measured and paid for separately.

No payment will be made for any area of pavement found deficient in thickness by more than 30.0 percent even though the work is permitted by the engineer to remain in place.

When the pavement in any section is found to exceed the specified thickness by more than 0.02 foot, the engineer shall calculate the tonnage of material in the excess thickness of the pavement and shall deduct that quantity from tonnage payments due under the contract.

211.4.06 Asphalt Concrete Sawcut

When listed in the bid schedule, AC sawcut will be measured and paid on a lineal foot basis for each cut as marked in the field. When not listed in the bid schedule, AC sawcut shall be considered incidental.

212 Portland Cement Concrete Pavement

212 Portland Cement Concrete Pavement

212.1.00 Description

This work consists of constructing PCC pavement, with or without metal reinforcement, composed of portland cement, water, fine aggregate, coarse aggregate, and special purpose additives when required or permitted. The pavement shall be constructed on an approved base.

212.2.00 Materials

212.2.01 Fine Aggregates

212.2.01A General

Fine aggregate shall consist of natural sand or other materials with similar characteristics having hard, strong, durable particles.

Stone screening, if used, shall consist of particles resulting from the crushing of clean, tough, durable rock or gravel. Screenings shall conform to the specifications for fine aggregate.

Fine aggregates varying more than 0.20 from the fineness modulus of the fine aggregate used in the contractor's mix design shall not be used. The fineness modulus of the fine aggregate is determined by adding the percentages by weight retained on the following sieves having square openings, and dividing by 100: 3/8 in., No. 4, No. 8, No. 16, No. 30, No. 50, and No. 100.

212.2.01B Deleterious Substances

The amount of deleterious substances shall not exceed the following limits.

Oil, Salt, Acid, and Alkali	0 percent by weight
Friable Particles	3 percent by weight
Lightweight Particles	1 percent by weight
Material Passing No. 200 Sieve ..	4 percent by weight *

* If this material consists of fracture dust, essentially free of clay or shale and is non-plastic, the percentage may be increased to 6 percent.

212.2.01C Soundness

When fine aggregate is subjected to five repetitions of the sodium sulfate soundness test (OSHD TM 206), the weighted percentage of loss shall not be more than 10 percent by weight.

212.2.01D Organic Impurities

All fine aggregate shall meet the requirements of AASHTO M 6 for organic impurities.

212.2.01E Grading

Fine aggregate shall be graded within the following limits.

GRADING REQUIREMENTS
FINE AGGREGATE - PORTLAND CEMENT CONCRETE

Sieve Size Passing	Percentages (by weight)
3/8"	100
No. 4	90-100
No. 8	65-90
No. 16	45-75
No. 30	25-55
No. 50	5-30
No. 100	0-8

212.2.01F Sampling and Testing
Sampling and testing of fine aggregate shall be in accordance with the following methods.

1. Sampling	OSHD TM 214
2. Material Passing the No. 200 sieve	OSHD TM 205
3. Organic Impurities	OSHD TM 212
4. Sieve Analysis	OSHD TM 204
5. Soundness	OSHD TM 206
6. Friable Particles	OSHD TM 221
7. Lightweight Pieces	OSHD TM 222
8. Sand Equivalent	OSHD TM 101
9. Fineness Modulus	see subsection 212.2.01A

Testing for soundness and organic impurities will be on the source material from which the aggregates are produced and on the produced aggregates. Testing for deleterious substances, grading, and sand equivalent will be on the produced aggregates.

212.2.02 Coarse Aggregates

212.2.02A General
Coarse aggregate shall consist of rock, gravel, or other approved inert material of similar characteristics having hard, strong, durable pieces free from adherent coatings.

The size of coarse aggregate in PCC pavement shall be 1-1/2" - No. 4.

212.2.02B Deleterious Substances
The amount of deleterious substances shall not exceed the following.

	Percentages (by weight)
Lightweight pieces	0.25
Friable particles	2.00
Material passing No. 200 sieve	1.00-1.50
Wood waste	0.05

212.2.02C Durability
The material from which coarse aggregates are produced or manufactured shall meet the following qualifying test requirements.

TEST	TEST METHOD	REQUIREMENTS
Soundness (5 cycles)	OSHD TM 206	12% Maximum
Degradation:		
Passing No. 20 Sieve	OSHD TM 208	30% Maximum
Sediment Height	OSHD TM 208	3" Maximum
Abrasion:	OSHD TM 211	30% Maximum

212.2.02D Grading
The grading of each of the specified sizes of coarse aggregate shall be in conformance with the following.

GRADING REQUIREMENTS
COARSE AGGREGATE - PORTLAND CEMENT CONCRETE

Separated Sizes:	2"-1"	1-1/2"-3/4"	1"-No.4	3/4"-No.4
Sieve Size	Percentages Passing (by weight)			
2 1/2"	100			
2"	90-100	100		
1 1/2"	35-70	90-100	100	
1"	0-15	30-65	90-100	100
3/4"	-	0-15	50-80	90-100
3/8"	-	-	15-40	20-50
No. 4	-	-	0-10	0-10

Elongated pieces in the coarse aggregate will be determined as described in OSHD Test Method 229 N, with the proportional caliper device set at a ratio of 5:1, and shall not exceed 10 percent by weight of the material retained on the No. 4 sieve.

All determinations of sizes and gradings will be made by the use of laboratory sieves having square openings.

212.2.02E Fracture of Gravel
If gravel is used in the manufacture of aggregates for PCC, the coarse aggregate shall contain not less that 60 percent, by weight, of fragments which have at least one fractured face produced by mechanical crushing.

212.2.02F Sampling and Testing
Sampling and testing of coarse aggregate shall be in accordance with the following methods.

1. Sampling	OSHD TM 214
2. Material Passing the No. 200 Sieve	OSHD TM 205
3. Sieve Analysis	OSHD TM 204
4. Abrasion	OSHD TM 211
5. Soundness	OSHD TM 206
6. Friable Particles	OSHD TM 221
7. Degradation	OSHD TM 208
8. Lightweight Pieces	OSHD TM 222
9. Fracture	OSHD TM 213

Testing for abrasion, degradation, and soundness will be on the source material from which the aggregates are produced and on the produced aggregates. Testing for deleterious substances and grading will be on the produced aggregates.

212.2.03 Portland Cement
The portland cement shall be ASTM C 150 Type I-II, II or III.

Differing 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.

212.2.04 Blended Hydraulic Cement
Blended hydraulic cement shall be either portland-pozzolan cement or pozzolan-modified cement conforming to AASHTO M 240.

The pozzolan constituent shall be between 10 and 20 percent by weight of the blended cement.

Certifications for blended hydraulic cements shall be supplied in conformance with AASHTO M 240.

212.2.05 Pozzolan
Pozzolan shall be Class C or Class F and shall conform to ASTM C 618 with the following exceptions.

a) Loss on Ignition shall be 1.5 percent max.

b) Moisture Content shall be 1.0 percent max.

c) Available Alkalies shall be expressed as $NA_20+.658\ K_20$ and shall not exceed 1.5 percent.

212.2.06 Water
Water used in mixing PCC shall be clean and free of oil, salt, acid, alkali, sugar, vegetable matter, or other deleterious substances, and shall conform to AASHTO T 26. Water of approved potable quality may be used without testing.

212.2.07 Admixtures

212.2.07A Air-Entraining Admixtures
Air-entraining admixtures shall conform to AASHTO M 154.

Chloride content of admixtures used in concrete in contact with embedded metals shall not exceed 0.5 percent, by weight, of the weight of the admixture.

The admixture shall be able to produce 16 percent air in a portland cement mortar when tested in accordance with AASHTO T 137.

212.2.07B Water-Reducing, Retarding, and Accelerating Admixtures
Water-reducing, retarding, and accelerating admixtures shall conform to AASHTO M 194.

Chloride content of admixtures used in concrete in contact with embedded metals shall not exceed 0.5 percent, by weight, of the weight of the admixture.

212.2.08 Bar Reinforcement
Bar reinforcement shall conform to the requirements of Section 504.

212.2.09 Dowels
Dowels shall conform to AASHTO M 227, grade 70.

212.2.10 Tie Bars
Tie bars shall be deformed bars, clean and free of scale or rust.

212.2.11 Welded Wire Fabric
Welded wire fabric shall conform to AASHTO M 55. Deformed welded wire fabric shall comply with AASHTO M 221.

212.2.12 Joint Materials

212.2.12A Preformed Joint Fillers
Preformed joint fillers for concrete shall conform to AASHTO M 153 or AASHTO M 213 except that those furnished under AASHTO M 213 shall be tested in accordance with ASTM D 1751.

212.2.12B Preformed Elastomeric Joint Seals
Preformed elastomeric joint seals shall conform to AASHTO M 220.

212.2.12C Poured Filler
Poured filler for concrete joints shall conform to AASHTO M 173.

212.2.13 Curing Materials
Curing materials shall conform to the following requirements.

White Polyethylene Film for Curing Concrete: AASHTO M 171
Liquid Membrane-Forming Compounds for Curing Concrete: AASHTO M 148

212.2.14 Mix Design

The contractor shall furnish a mix design for approval by the engineer or may propose the use of a current mix design on file with the owner or with OSHD.

212.2.14A Classes of Concrete

The classes of concrete shall designate the compressive strength of the concrete in 28 days (psi) followed by the maximum size of aggregate to be used in the concrete, i.e.: Class 3300-1 1/2 shall indicate a compressive strength of 3300 psi in 28 days with 1 1/2 inch maximum size aggregate used in that concrete. The class of concrete used in the pavement shall be Class 3300-1 1/2 concrete, or as shown.

The following must be submitted with the mix design.

a) Mix design calculations.
b) Documentation of compressive strength according to ACI 301-84, subsection 3.9.
c) Test reports on aggregate, plastic concrete, compressive strength, and water.
d) Certifications of compliance for portland cement, fly ash, and admixtures.

212.2.14B Proportioning of Concrete Mix

The PCC mixture shall be designed in accordance with the requirements of ACI 211.1 or a modification employing the "absolute volume" method. This shall include the proportions by weight of cement, water, fine aggregate, coarse aggregate, air-entraining admixture, and any other materials or admixtures needed to produce a workable and durable concrete which conforms to the specifications.

When using 3/4 inch maximum size aggregate, the fine aggregate shall be between 40 percent and 48 percent of the total aggregate. When using 1 1/2 inch maximum size aggregate, the fine aggregate shall be between 35 percent and 45 percent of the total aggregate.

PORTLAND CEMENT CONTENT

(Compressive Strength, f'c)	Minimum Cement Content
<3,000	518 Pounds (5.5 sacks)
>3,000	564 Pounds (6.0 sacks)

212.2.14C Pozzolan

Fly ash may be used in PCC as an additive or to replace a portion of the portland cement. The replacement ratio shall be 1.2 pounds of fly ash for each pound of cement replaced. In no case shall the total weight of fly ash in the mix exceed 100 lbs. per cubic yard of concrete.

212.2.14D Admixtures

The quantity of each admixture to be used in the PCC mix shall be determined by trial batches prior to its use in PCC incorporated in the work. The admixture shall be used according to the manufacturer's recommendations and at a rate sufficient to achieve the properties indicated in subsection 212.2.15.

212.2.15 PCC Mixture Tolerances and Limits

The PCC shall be a workable mixture, uniform in composition and consistency, having the following properties or limits.

Material or Property	Percent of		Quantity	Specification or Test Method
Entrained air	Plastic Mix		4.0%-7.0%	AASHTO T 152
Fly ash	Cement plus fly ash		20% max.	ASTM C 311
Concrete Temperature	(When Placed)	50° F min. 90° F max.		ASTM C 1064
Slump	-	3-1/2" max.		AASHTO T 119

Cement Content and Water/Cement Ratio

Cement Content * lb/cu.yd.)	Max. Water-Cement Ratio ** (lb./lb.)
<592	0.50
≥658	0.48

* Includes fly ash when used.

** For concrete containing fly ash, the water-cement ratio shall be based on the total weight of portland cement plus the weight of fly ash.

212.2.16 Plastic PCC

Compliance of the plastic PCC will be based on tests performed by the contractor and on any check tests performed by the engineer.

Test	Test Method AASHTO	ODOT
Molding Concrete Specimens in the Field. . . .	T 23	
Sampling Fresh Concrete.	T 141	
Slump.	T 119	
Cement Content	T 121	ODOT TM 713
Air Content.	T 152	ODOT TM 714
Water-cement Ratio		ODOT TM 729
Yield.	T 121	
Concrete Temperature		ASTM C 1064

212.3.00 Construction

212.3.01 Process Control

The contractor is responsible for process control and shall conduct sampling, testing, measurement, and inspections required to insure the finished pavement meets specifications.

212.3.02 Equipment

The plant, equipment, and tools used in the work must be approved as to design, capacity, and condition.

212.3.03 Weather Limitations

The contractor shall coordinate all operations involved in constructing the pavement so the work will result in a finished pavement conforming to specifications regardless of the daily or seasonal variations in weather, temperature and humidity under which the work is permitted to proceed.

PCC shall not be placed during periods of rain. PCC shall not be placed on frozen bases. Placement shall not occur when descending air temperature falls below 40° F, nor shall it resume until ascending air temperature reaches 35° F. Air temperature shall be measured in the shade and away from artificial heat.

The contractor shall protect the pavement from weather damage. The contractor shall protect unhardened PCC from precipitation with protective material. When PCC is being placed during cold weather, and the air temperature is forecast to drop below 35° F, the contractor shall prevent the PCC from freezing for a minimum of seven days after placing.

Weather-damaged pavement shall be removed and replaced at no expense to the owner.

212.3.04 Preparation of Base

Before paving operations begin, the base shall be brought to the finished condition required by the specifications. If the equipment used by the contractor requires additional width for support, the contractor shall provide the support necessary to assure the equipment maintains proper grade and cross section.

Manholes, inlets, and other such structures shall be completed, adjusted, cured, and otherwise prepared, as applicable, and made clean and ready to have concrete placed in contact with them. Manhole frames and other independent metal structures in the pavement area shall be prepared with an approved bond-preventing agent.

A minimum 2-inch thick leveling course of 3/4"-0 crushed rock shall be placed under all concrete pavement.

212.3.05 Construction Widths

When the pavement consists of two traffic lanes or less, the full width shall be constructed monolithically.

When the pavement is three or more traffic lanes wide, the sequence of paving and paving widths shall be as specified or as approved by the engineer.

212.3.06 Mixing PCC
PCC shall be mixed at a central plant or in truck mixers. Material containing frost or lumps of hardened material shall not be used. The mixing time for batch plant mixers shall be at least 60 seconds for mixers of one cubic yard capacity or less. Mixing time shall be increased by 15 seconds for each cubic yard or fraction of increased capacity. PCC mixed in truck mixers shall be mixed a minimum of 70 and a maximum of 100 revolutions at the rated mixing speed of the mixer. PCC shall be mixed only in the quantity required for immediate use.

PCC shall not be retempered by adding water or by other means.

212.3.07 Placing PCC and Reinforcement
Damage to the sub-grade, base or reinforcement shall be corrected prior to placement of the PCC.

212.3.07A Placing PCC
The PCC shall be placed in final position, in one layer, so that a minimum of finishing will be necessary to provide a dense, homogeneous pavement conforming to specified grade and cross section. PCC shall not be used if it is not in place within 1 1/2 hours after being mixed, or has begun to take an initial set prior to placement.

The pavement shall be consolidated and finished with a slipform paving machine. The machine shall be operated with as nearly continuous forward movement as possible. The machine shall vibrate the concrete with vibrating tubes or arms working in the concrete for the full width and depth of the pavement being placed. If, for any reason, it is necessary to stop the forward motion of the paver, the vibratory and tamping elements shall stopped at the same time.

In areas where mechanical placement of concrete pavement is not possible and hand forming is required, place the forms and receive form approval from the engineer prior to pouring the concrete. Place the concrete as close to its final position as possible. Consolidate the concrete pavement, using mechanical vibrators satisfactory to the engineer. The vibrators shall be operated vertically and moved continuously so they will not cause segregation. The vibrators shall not come in contact with the forms or the reinforcement and shall not be used to move the mix horizontally.

Hand spreading and distributing shall be with shovels, not rakes. Hand vibrators shall be used to consolidate the pavement in the area within 6 feet each side of construction and isolation joints.

212.3.07B Placing Reinforcement
Provision shall be made for placing dowels, tie bars, and other devices called for by the plans, during placement of the PCC. Reinforcement shall be placed on supporting devices and maintained in position while the PCC is being placed.

212.3.08 Dowels
Dowel bars shall be smooth, round, coated with plastic, grease, heavy oil, or other approved material that will neither bond with nor be harmful to the PCC. Dowels shall be placed in a supporting framework that holds the dowels parallel with each other, parallel with the surface of the pavement and perpendicular to the joint. Maximum alignment tolerance shall be 5 degrees or 1/4" in the length of the dowel.

212.3.09 Joints
Joints in PCC pavement will be referred to as contraction, construction (cold), dummy, or isolation (expansion). Any of these may be transverse or longitudinal. All joints and joint filler shall extend to pavement edges or to each other.

All joints shall be constructed normal to the surface of the pavement. Joints shall not vary from specified line by more than 1/4 inch. The tops of joint filler shall be within 1/8 inch of pavement surface but shall not protrude above the surface.

Joints which contain preformed filler are to be constructed prior to the final floating and surface finishing of the PCC.

Transverse contraction joints of the weakened plane or dummy type shall be constructed at such locations as are required to confine the contraction joint spacing to a maximum of 15-feet. The joints shall be formed to a depth of 1/4 of the thickness of the concrete and to a width of about 1/8-inch. Joint edges shall be tooled. Transverse contraction

joints in pavement shall align with joints in curb and with structures located in the pavement.

Isolation (expansion) joints shall be straight and at right angles to the alignment, vertical to the surface, and shall provide complete separation of the Portland cement concrete. Joint material shall be installed using a 2 x 4 as a support prior to pouring the concrete. Isolation (expansion) joints shall be constructed opposite existing isolation (expansion) joints.

212.3.09A Longitudinal Joints
Longitudinal joints shall be of the contact type or weakened-plane type, as shown.

212.3.09B Construction Joints
Construction joints shall be constructed when there is an interruption of 30 minutes in placing operations. Care shall be taken when forming construction joints to assure that the reinforcement and its supports are not displaced, distorted, or otherwise disturbed.

212.3.10 Surface Finishing
After the PCC has been given a preliminary finish, the surface of the pavement shall be checked by the contractor with a straightedge device not less than 12 feet in length. Each successive check with the straightedge device shall lap the previous check path by at least half the length of the straightedge. Surface deviations exceeding 0.01 foot shall be corrected.

Upon completion of the surface floating, but before any required edge tooling or joint tooling, and before initial set of the surface PCC, the pavement shall be given a textured finish.

The textured finish shall be accomplished by a steel tine tool that will mark the finished PCC to a depth of 1/8 inch plus or minus 1/16 of an inch. The markings shall be about 1/8 inch in width, randomly spaced, averaging about 3/4 inch on center.

212.3.11 Edge Tooling
The free edges of new pavement and joints with previously placed PCC shall be tooled to remove laitance and mortar resulting from finishing operations and to provide a clean rounded edge to the new pavement. Tooling shall not form ridges on the surface of the concrete.

212.3.12 Curing of PCC
Immediately after the surface finishing and edging has been completed, the entire exposed surface of the PCC shall be covered and cured for at least 72 hours in accordance with one of the following provisions.

212.3.12A Liquid Membrane-Forming Compounds
Clear liquid membrane-forming compound shall be applied uniformly to the damp concrete by pressure-spray methods at the manufacturer's recommended rate, but not less than one gallon per 150 square feet. The compound shall form an impervious membrane when tested in accordance with ODOT TM 721.

212.3.12B Polyethylene Film
White or clear polyethylene film, a minimum of 4 mils in thickness, shall be applied to damp concrete as soon as the film can be placed without marring or discoloring the surface. The membrane shall be placed in contact with the surface, shall extend beyond the sides or edges of the slabs or forms, and shall be held in position to maintain a moisture proof covering. Laps shall be sufficient to maintain waterproofing equivalent to the sheeting.

212.3.13 Protection of Concrete
The contractor shall erect and maintain suitable barriers to protect the concrete from traffic or other detrimental trespass until the pavement is opened to traffic. If necessary, the contractor shall provide watchmen. Concrete damaged as a result of detrimental trespass shall be replaced or repaired at the direction of the engineer at no expense to the owner.

No public vehicular traffic will be allowed to travel on newly placed concrete until it has attained 65 percent of its 28-day design strength.

The contractor shall not allow construction equipment or construction trucks with a GVW of 20,000 pounds or greater

on newly placed PCC until the concrete attains the full specified 28-day compressive strength.

212.3.14 Compressive Strength
Acceptance sampling and testing for strength will be based on 28-day strength tests. The contractor shall prepare a minimum of five cylinders for each 500 square yards of concrete placed or portion thereof. The engineer may require that the contractor furnish additional prepared test cylinders for check testing by the engineer. Compliance of the hardened PCC will be based on tests performed by the contractor and on any check tests performed by the engineer.

Cylinders will be sampled, prepared, and cured according to AASHTO T 141 and T 23 for compressive strength testing. Three of each set of five cylinders shall be tested at 28 days, according to AASHTO T 22. Sampling and testing shall comply with Section 106.

The average of the 28-day compressive strength tests of the three cylinders will constitute the strength test value. If any one of the three cylinders tested indicates a compressive strength more than ten percent below the average strength of the other two cylinders, the results from that cylinder will be discarded and the test strength value will be based on the average strength of the two remaining cylinders.

The engineer may require removal and replacement of any work incorporating concrete that fails to comply with compressive strength requirements. If deficient PCC is allowed by the engineer to remain in place, payment will be adjusted in conformance with subsection 212.4.03.

212.3.15 Surface Tolerance and Testing
The surface of finished pavement shall not deviate from longitudinal and transverse smoothness more than the prescribed limits. Testing shall be done under the supervision of the engineer with equipment furnished and operated by the contractor at the contractor's expense as soon as the hardness of the concrete permits. The surface of the pavement shall be within 0.02 feet of the specified line, grade and cross section.

212.3.15A Smoothness
For travel lanes, testing for longitudinal and transverse smoothness shall be done with a 12-foot straightedge. The extent of the testing will be determined by the engineer. The pavement surface shall not deviate from the straightedge at any point by more than 0.02 foot.

212.3.15B Graphic Profile Testing and Tolerance
When specified, the longitudinal surface of all travel lanes of the concrete pavement shall be tested for smoothness by the graphic profile method. The profilograph shall be the California type, complete with recorder, for determining the profile index of highway pavement. The pavement shall have a profile index of 7.0 inches per mile or less for each wheel path in each 0.1-mile segment or partial segment, and shall have no individual deviation of 0.3 inch or more.

212.3.16 Correction of Deficiencies
If the pavement does not conform to the prescribed limits of deviation, the following corrections shall apply.

212.3.16A Plastic PCC Failure to Meet Straightedge
The paving operations shall be stopped until revised methods, changes in equipment, or correction of procedures are made or proposed for trial, and are approved by the engineer.

212.3.16B Hardened PCC Failure to Meet Smoothness Requirements
For any segment or partial segment failing to meet the straightedge or profilograph test requirements, the contractor shall take corrective action as follows.

a) Profiling by use of an abrasive grinder equipped with a cutting head comprised of multiple diamond blades. All areas corrected by grinding shall have the required surface texture restored by sawing with diamond-blade saws.

b) Removal of the pavement and replacement with pavement conforming to the plans and specifications.

212.3.17 Pavement Thickness
The engineer will select locations for non-destructive measurement or core samples to determine pavement thickness. If non-destructive measurements indicate the pavement is less than the thickness shown on the plans, or is otherwise out

of specification, the contractor may take cores at the same locations to verify the engineer's measurements. The contractor shall restore the cored areas using materials and methods complying with the specifications.

Pavement found to be out of specification shall be subject to replacement or to payment at adjusted prices. If the pavement is found to comply with specifications, coring and restoration work performed by the contractor will be paid for as extra work.

Pavement deficient in thickness by more than 15% shall be removed and replaced by the contractor at no expense to the owner. Pavement deficient in thickness by less that 15% shall be subject to price adjustment. If the pavement is found to comply with specifications, coring and restoration work performed by the contractor will be paid for as extra work.

212.4.00 Measurement and Payment

212.4.01 Pavement

PCC pavement will be measured on the surface to the nearest 0.1 foot. Payment will be on a square foot basis, to the nearest 0.1 foot. Payment for leveling course rock shall be incidental to the price of the concrete pavement.

212.4.02 Price Adjustment for Variation in Thickness

No additional payment over the contract unit price will be made for pavement having a thickness greater than shown on the plans. When the finished pavement is deficient in thickness, and the engineer allows it to remain in place, payment may be allowed at a maximum adjusted price determined from the following table.

% of Specified Thickness	% Pay *
95.0 and above	100
90.0 - 94.9	80
85.0 - 89.9	65
Below 85.0	0

* Applies to the in-place price for portland cement concrete pavement.

No payment will be made for any area of pavement found deficient in thickness by more than 15 percent, even though such pavement is permitted by the engineer to remain in place.

212.4.03 Price Adjustment for Variation in Compressive Strength

No additional payment over the contract unit price will be made for work incorporating concrete having a compressive strength greater than that specified. When the 28-day compressive strength is deficient in strength by 25 percent or less, and the work is allowed by the engineer to remain in place, the engineer may allow payment for the work at the adjusted price as specified in the following table.

% Deficiency in Strength	% Reduction in Pay *
0 - 5.0	No Deduction
5.0 - 25.0	2.0 x Deficiency

* Applies to the in-place price for portland cement concrete pavement.

No payment will be made for any work constructed of concrete found deficient in compressive strength by more than 25 percent even though the work is permitted by the engineer to remain in place.

212.4.04 P.C.C. Sawcut

When listed in the bid schedule, P.C.C. sawcut will be measured and paid on a lineal foot basis for each cut as marked in the field.

213 Curbs and Gutters

213 Curbs and Gutters

213.1.00 Description

This work consists of the construction of curb, gutter, combination curb and gutter, islands, and traffic separators, collectively referred to as structures.

213.2.00 Materials

213.2.01 Portland Cement Concrete (PCC)

PCC shall conform to the requirements of Section 212.

PCC in formed or extruded structures shall be Class 3300. PCC in precast units shall be Class 4000.

213.2.02 Asphalt Concrete

Asphalt concrete shall conform to the requirements of Section 211 and shall be of the class specified.

213.2.03 Aggregate

Aggregate materials for base, foundation courses, leveling courses or bedding shall conform to the requirements of Section 207.

213.2.04 Metal Reinforcement

Metal reinforcement shall conform to the requirements of Section 212.

213.2.05 Dowels

Dowels shall conform to the requirements of Section 212.

213.2.06 Joint Materials

Joint materials shall conform to the requirements of Section 212.

213.2.07 Epoxy Cement

Epoxy cement shall be a two-component epoxy resin adhesive conforming to the requirements of AASHTO M 235.

213.2.08 Curing Materials

Curing materials shall conform to the requirements of Section 212.

213.3.00 Construction

213.3.01 Preparation of Base

213.3.01A Earthwork

When roadway earthwork is called for under the same contract as structure construction under this section, excavation, backfilling and berm construction for the structures shall conform to the requirements of Section 204.

When the contract includes structure construction under this section, but does not call for roadway earthwork, the contractor shall perform required earthwork as follows.

1) Make structure excavations to the required depths and widths. Finish bases to firm, even surfaces.

2) Remove all unstable and unsuitable material and replace with material as directed.

3) Backfill prior excavations in the vicinity of the new structures with approved material placed and compacted in conformance with Section 204.

4) Trim and shape areas adjacent to the work to a neat condition and restore disturbed areas to their original condition.

213.3.01B Aggregate Foundation or Bedding

If shown on the plans, structures shall be constructed on aggregate foundations. Foundation courses or beddings involving the furnishing of new aggregate material shall be constructed in conformance to the requirements of

Section 207. When structures are to be constructed on areas where approved material is already in place, the material shall be reused as bedding at no cost to the owner.

213.3.01C Base for PCC
Bases upon which PCC structures are to be constructed shall be firm and free of unsuitable material. Surfaces shall be thoroughly dampened prior to placement of concrete.

When concrete is placed by mechanical extrusion or slipform methods, vertical dowel fastening to underlying concrete or asphalt may be eliminated and the bond between new concrete and underlying concrete or asphalt may be achieved with approved epoxy cement applied in conformance with the manufacturer's recommendations.

213.3.01D Base for Asphalt Concrete
Bases upon which asphalt structures are to be constructed shall be firm and free of unsuitable material.

Where asphalt concrete is to come in contact with previously placed PCC, asphalt concrete or bituminous surfaces, the area of contact shall be given an application of epoxy cement as specified for use with PCC or a light coating of emulsified asphalt of the type designated by the engineer and conforming to the requirements for tack coat in Section 210.

Where dowel fastenings between new asphalt concrete and the underlying foundation are shown, the dowels may be eliminated when the asphalt concrete is placed by the mechanical extrusion method provided an application of epoxy cement, as specified for use with PCC, is used to provide positive bond between the new and old materials.

213.3.02 Forms and Equipment
213.3.02A Forms
Materials and procedures shall conform to the requirements of Section 503.

213.3.02B Equipment
Equipment as described in Sections 211 and 212, may be modified as approved by the engineer.

213.3.03 Dowels, Tie Bars, Reinforcement
Dowels, tie bars, and reinforcement shall be installed in conformance with Section 212.

213.3.04 Curb and Gutter and Valley Gutter
When thick-lift asphalt concrete paving section is used, the thickness of the concrete gutter shall be the same as the thickness of the pavement.

Concrete valley gutter and fillets shall be constructed in accordance with the standard drawings.

213.3.05 Placing, Finishing and Curing
213.3.05A General
No asphalt or concrete shall be placed until the base and forms, where used, have been inspected and approved by the engineer.

Existing curbs, walks, driveways and other such structures shall be cut back by saw cutting to permit the new construction.

213.3.05B Asphalt Concrete Structures
Asphalt concrete structures may be placed by mechanical extrusion or between suitable forms.

213.3.05C PCC Structures
PCC structures may be placed by mechanical extrusion, by slipform methods or between suitable forms.

If the structures are constructed by mechanical extrusion or slipform methods, the slump shall not exceed 2 inches. The contractor shall feed the concrete into the machine at a uniform rate and operate the machine to produce a well compacted mass of concrete.

If forms are used, the slump of concrete shall not exceed 4 inches. The contractor shall remove forms from formed

structures after the concrete has reached initial set but before the concrete has cured.

The top and face of finished structures shall have a uniform texture and smooth surface, be free from chips, cracks, humps, sags, honeycombs, and other irregularities, and shall be true and straight. The top surface shall be of uniform width. Minor defects shall be repaired but plastering will not be permitted on exposed surfaces. Honeycombed and other structurally defective concrete shall be removed and replaced at no expense to the owner.

After the concrete has been placed and finished, it shall be cured in accordance with Section 212. The concrete structure shall be kept from contact and strain for a least seven days.

213.3.06 Joints

Transverse isolation joints shall be provided opposite abutting joints in adjacent pavement and structures, over isolation joints in underlying concrete, at the end of curved portions of structures, at connections to existing structures, and at other locations as required so the maximum joint spacing is 15 feet. The joints shall be formed by grooving, by insertion and removal plates or otherdevices, by sawing, or by other means approved by the engineer. The top width of joints shall be not less than 1/8 inch, not greater than 1/4 inch, and the depth shall be one third to one half the depth of the concrete. If the joints are constructed by sawing, the sawing shall be performed without spalling of the adjacent concrete and before the occurrence of uncontrolled cracking.

The width of joints and thickness of filler shall match those of the joints in abutting or underlying concrete. Isolation joints shall be at right angles to the structure, normal to the surface, and shall provide complete separation.

Isolation joints shall be constructed around poles, posts, boxes and other fixtures which protrude through, into, or against the concrete.

213.3.07 Weep Holes

Weep holes shall be placed at all points where natural drainage flow is impaired by the curb and opposite down spouts and foundation drains on adjacent buildings. At least one weep hole will be provided per lot. Weep holes shall conform with the standard drawings.

213.3.08 Tolerance

When a 12-foot straightedge is laid on the top or face of the structure, the surface shall not vary more than 0.02 foot from the edge of the straightedge, except at grade changes or vertical curves.

The contractor shall construct all structures within 0.02 foot of the specified line, within grade, cross section slope, and thickness.

213.4.00 Measurement and Payment

213.4.01 Curb or Curb and Gutter

Curb or curb and gutter will be measured along the face of the curb to the nearest 0.1 foot. Payment will be on a lineal foot basis, to the nearest foot.

213.4.02 Concrete Valley Gutter

Concrete valley gutter will be measured along the centerline of the gutter to the nearest 0.1 foot. Payment will be on a lineal foot basis, to the nearest foot.

213.4.03 Traffic Islands

Traffic islands will be measured and paid for by the component parts of curb, and sidewalk.

213.4.04 Incidental Work

When not listed in the bid schedule, dowels, tie bars, reinforcement, joints, weep holes, curing materials, and other anticipated items will be considered incidental work.

214 Driveways and Entrances

214 Driveways and Entrances

214.1.00 Description

This work consists of the construction of asphalt concrete or PCC paved driveways and entrances.

214.2.00 Materials

214.2.01 Aggregate Base

Materials for base, foundation and leveling courses shall conform to the requirements for 3/4"-0 described in Section 207.

214.2.02 PCC

PCC shall conform to the requirements of Section 212 and shall be Class 3300.

214.2.03 Asphalt Concrete

Asphalt concrete shall conform to the requirements of Section 211. Unless otherwise specified, asphalt concrete shall be Class "C".

214.2.04 Dowels, Tie Bars, Reinforcement

Dowels, tie bars and reinforcement shall conform to the requirements of Section 212.

214.2.05 Joint Materials

Joint materials shall conform to the requirements of Section 212.

214.2.06 Epoxy Cement

Epoxy cement shall be a 2-component epoxy resin adhesive conforming to the requirements of AASHTO M 235.

214.2.07 Curing Materials

Curing materials shall conform to the requirements of Section 212.

214.3.00 Construction

214.3.01 Preparation of Sub-grade and Base

Preparation work shall conform to the requirements of Sections 204 and 207. No asphalt or concrete shall be placed until the base has been approved by the engineer.

214.3.02 Forming

Forming shall conform to the requirements of Section 503, except as herein specified for dowels, tie bars, and reinforcement.

214.3.03 Dowels, Tie Bars, Reinforcement

Dowels, tie bars, and reinforcement shall be installed in conformance with Section 212.

214.3.04 Joints

Joints shall conform to the requirements of Section 213.

214.3.05 Surfacing

The placing of asphalt concrete and PCC surfacing shall conform to the requirements of Section 211 and Section 212.

214.3.06 Finishing

The concrete shall be floated and finished at the proper time. Joints shall be tooled with a 1/4-inch radius and the edges of panels shall be tooled with a one half inch radius.

The surface shall be broomed transverse to the direction of traffic.

Finished surfaces shall be free from humps, sags, or other irregularities and shall be constructed within 0.02 feet of the specified line, grade, cross section, slope, and thickness. When a 12-foot straightedge is laid on the top surface, the surface shall not vary more than 0.02 foot from the edge of the straightedge, except at grade changes or vertical curves.

214.3.07 Curing

Curing shall conform to the requirements of Section 212. Vehicular traffic shall be kept off the concrete surface for

seven days, or longer if directed.

214.4.00 Measurement and Payment

214.4.01 Driveways

214.4.01A Square Yard Basis

Driveways will be measured on the surface to the nearest 0.1 foot. Payment will be on a square yard basis, to the nearest 0.1 square yard.

214.4.01B Unit Price Basis

Driveways will be measured and paid for on a unit price basis for the number constructed.

214.4.02 Aggregate Base

Aggregate base construction will be measured and paid for in accordance with Section 207.

214.4.03 Joints

Joints will be measured and paid for on a lineal foot basis, to the nearest foot.

214.4.04 Incidental Work

When not listed in the bid schedule, excavation, selected materials, aggregate bases, dowels, tie bars, reinforcement, water, joints, and other anticipated items will be considered incidental work.

215 Sidewalks and Pathways

215 Sidewalks and Pathways

215.1.00 Description

This work consists of the construction of PCC or asphalt concrete sidewalks and pathways on approved bases.

215.2.00 Materials

215.2.01 Aggregate Base

Aggregate base material shall be 3/4"-0 and shall conform to the requirements of Section 207.

215.2.02 Asphalt Concrete

Asphalt concrete shall be Class "C" and shall conform to the requirements of Section 211.

215.2.03 PCC

PCC shall be class 3300-3/4" and shall conform to the requirements of Section 212.

215.2.04 Joint Materials

Joint materials shall conform to the requirements of Section 212.

215.2.05 Curing Materials

Curing materials shall conform to the requirements of Section 212.

215.3.00 Construction

215.3.01 Earthwork

Earthwork shall conform to the requirements of Section 204.

215.3.02 Aggregate Base

Aggregate base shall conform to the requirements of Section 207. The aggregate base shall be thoroughly dampened prior to placing PCC.

215.3.03 Forming

Forming shall conform to the requirements of Section 503.

215.3.04 PCC

Placing of PCC shall conform to the requirements of Section 212. Jointing shall conform to the requirements of Section 213.

215.3.05 Asphalt Concrete

Placing of asphalt concrete shall conform to the requirements of Section 211.

215.3.06 Finishing

Finishing shall conform to the requirements of Section 214.

215.3.07 Curing

Curing shall conform to the requirements of Section 212.

215.4.00 Measurement and Payment

215.4.01 Sidewalks and Pathways

215.4.01A Lump Sum Basis

Sidewalks and pathways will be measured and paid for on a lump sum basis for all required.

215.4.01B Lineal Foot Basis

Sidewalks and pathways will be measured and paid for on a lineal foot basis, to the nearest foot. Length shall be measured along the center line of the sidewalk or pathway.

215.4.01C Square Yard Basis

Sidewalks and pathways will be measured on the surface to the nearest 0.1 foot. Payment will be on a square yard basis, to the nearest 0.1 yard.

215.4.02 Aggregate Base
Aggregate base construction will be measured and paid for in accordance with Section 207.

215.4.03 Joints
Joints will be measured and paid for on a lineal foot basis, to the nearest foot, for the types listed in the bid schedule.

215.4.04 Incidental Work
When not listed in the bid schedule, sidewalk excavation, selected materials, aggregate bases, water, joints, weep hole drain pipe, and other anticipated items will be considered incidental work.

216 Adjustment of Incidental Structures to Grade

216 Adjustment of Incidental Structures to Grade

216.1.00 Description

This work consists of adjusting the tops of manholes, sumps, catch basins, inlets, valve boxes, meter boxes, monument boxes and similar structures to the required elevation and/or horizontal alignment.

216.2.00 Materials

216.2.01 General

Materials used in the adjustment of incidental structures may be new materials or materials salvaged from the existing installation and brought to a condition approved for reuse.

216.2.02 Aggregate Base

Aggregate base shall conform to the requirements of Section 207.

216.2.03 PCC

PCC shall conform to the requirements of Section 212.

216.2.04 Asphalt Concrete

Asphalt concrete shall conform to the requirements of Section 211.

216.2.05 Tack Coat

Tack coat shall conform to the requirements of Section 210.

216.2.06 Seal Coat

Seal coat shall conform to the requirements of Section 210.

216.2.07 Precast Concrete Manhole Sections

Precast concrete manhole sections and catch basins shall conform to the requirements of Section 306 and Section 307.

216.2.08 Frames, Grates and Covers

Frames, grates and covers shall conform to the requirements of Section 306 and Section 307.

216.2.09 Mortar

Mortar shall conform to the requirements of Section 306.

216.2.10 Metal Reinforcement

Metal reinforcement shall conform to the requirements of Section 504.

216.3.00 Construction

216.3.01 Excavation and Backfill

Excavation and backfill shall conform to the requirements of Section 301.

Excavation shall be unclassified and shall include whatever materials are encountered to the depths shown.

216.3.02 Salvaging Frames, Grates and Covers

Salvaging frames, grates, and covers shall conform to the requirements of Section 308.

216.3.03 Adjustment of Manholes and Masonry Structures

Adjustment of manholes and masonry structures shall conform to the requirements of Section 308.

216.3.04 Adjusting Concrete, Masonry, or Metal Structures

Concrete, masonry, or metal inlets, valve boxes, meter boxes, monument boxes and other like structures shall be raised or lowered to grade. In raising the structure, the contractor shall add approved extensions to the structure to enclose and protect its contents as intended. The contractor may replace the structure with a new structure of approved design. Salvaged structures not reused on the project shall become the property of the contractor. See also Section 308.

216.4.00 Measurement and Payment

216.4.01 Unit Price Basis

Adjustment of incidental structures to grade will be paid for at the unit price for each of the pay items listed in the bid schedule.

216.4.02 Incidental Basis

When not listed in the bid schedule, adjustment of incidental structures to grade will be considered incidental work.

217 Illumination

The work necessary in furnishing and installing illumination equipment and materials and removing or modifying existing facilities shall conform to the requirements of the ODOT Standard Specifications.

218 Traffic Signals

The work necessary in furnishing and installing traffic signals, equipment, and materials and removing or modifying existing facilities shall conform to the requirements of the ODOT Standard Specifications

219 Signing, Pavement Markings, and Pavement Markers

The work necessary in furnishing, fabricating, erecting and removal of signs and sign structures, furnishing and installing striping and pavement markings, and furnishing and installing striping and pavement markers shall conform to the requirements of the ODOT Standard Specifications.

220 Safety Structures

The work necessary in construction of guardrail median, shoulder barrier, impact attenuators, guide posts, and other safety structures shall conform to the requirements of the ODOT Standard Specifications.

221 Landscaping

The work necessary in constructing lawn, grass, shrub, and tree areas shall conform to the requirements of the ODOT Standard Specifications.

222 Geotextile Fabrics

222 Geotextile Fabrics

222.1.00 Description

This work consists of furnishing and placing geotextiles over roadbed sub-grades and beneath pavement overlays as shown on the plans and at other locations as directed.

A fabric manufactured specifically for use in civil engineering applications. Fibers used in the manufacture of geotextiles consist of long chain synthetic polymers. At least 85 percent (85%) by weight of the long chain polymers are polyolephins, polyesters or polyamides.

222.1.01 Sub-grade Geotextile

For installation on sub-grades and in other material separation applications.

222.1.02 Pavement Overlay Geotextile

For installation beneath an asphalt concrete overlay.

222.1.03 Embankment Geotextile

For installation within or under embankments for stabilization.

222.1.04 Riprap Geotextile

For installation behind and beneath riprap, buttresses, inlays, shear keys and erosion control applications.

222.1.05 Drainage Geotextile

For installation in subsurface drains or other drainage locations.

222.2.00 Materials

The fabric shall be composed of a polymeric yarn or fiber oriented into a stable network which retains its relative structure during handling, placement and design service life. Fabric may be rejected by the engineer if dimensional stability or resistance of the fabric to ambient temperatures, acid and alkaline conditions and microorganisms/insects does not appear to be satisfactory for the intended purpose. The fabric shall be free of any chemical treatment or coating which might significantly reduce permeability. The selvage of fabric shall be such that the outer fibers are prevented from pulling away from the fabric. Fabrics must be for the intended purpose, have dimensional stability and be free of defects or tears.

222.2.01 Sub-grade Geotextile

Both woven and nonwoven fabrics are acceptable.

Geotextile Fabric Property	Test Method	
Grab tensile strength	ASTM D 1682 Modified	180 mins.
Grab elongation, percent.	ASTM D 1682 Modified	15 mins.
Burst strength (diaphragm method), psi. .	ASTM D 3786 Modified	290 mins.
Puncture strength	ASTM D 3787 Modified	80 mins.
AOS (Apparent Opening Size), U.S. Std. sieve	ODOT TM 814	30 mins.
Water permeability, cm/sec.	ASTM D 4491	0.004 mins.

222.2.02 Pavement Overlay Geotextile

Only nonwoven fabrics are acceptable.

Geotextile Fabric Property	Test Method	
Grab tensile strength, lbs.	ASTM D 1682 Modified	100 mins.
Grab elongation, percent.	ASTM D 1682 Modified	50 mins.
Asphalt retention	ODOT TM 817	0.20 mins.
Melting point	ASTM D 276	300°F

222.2.03 Embankment Geotextile

Both woven and nonwoven fabrics are acceptable. Slit film or slit tape fabrics will not be permitted.

Geotextile Fabric Property	Test Method	
Grab tensile strength, lbs.	ASTM D 1682 Modified	230 mins.
Grab elongation, percent.	ASTM D 1682 Modified	15 mins.
Burst strength (diaphragm method), psi. .	ASTM D 3786 Modified	430 mins.
Puncture strength	ASTM D 3787 Modified	110 mins.
aos (Apparent Opening Size), U.S. Std. sieve	ODOT TM 815	30 mins.
Water permeability, cm/sec.	ASTM D 4491	0.005 mins

222.2.04 Drainage Geotextile
Drainage geotextile shall conform to Section 305.

222.3.00 Construction

222.3.01 General

222.3.01A Equipment
Use field seam stitching equipment that provides an acceptable lock-type stitch as recommended by the geotextile manufacturer and approved by the engineer.

Design, equip, maintain, and operate the asphalt distributor according to subsection 210.3.01B.

222.3.01B Acquisition and Storage
Provide complete rolls of geotextile as furnished by the manufacturer and protect against damage and deterioration. Store all geotextile rolls in a dry place and off the ground at all times according to ASTM D 4873. Cover all rolls and partial rolls with a dark protective covering when received. The geotextile will be rejected for use if the engineer determines it has defects, deterioration, or has been damaged.

222.3.01C Placement
Prepare the surface receiving the geotextile to a smooth condition free of obstructions, depressions, and debris unless otherwise directed. Do not drag the geotextile on the ground or mishandle in any way.

Place the geotextile with the machine direction oriented up-down the slope. Lap the upper sheets over the top of the lower sheets. When the geotextile is placed on a slope steeper than 6:1, securely anchor the laps to the ground with pins or stakes as necessary to prevent slippage or tearing of the geotextile. Start placement of fill material on the geotextile at the toe of the slope and proceed upwards.

If geotextile is placed under water or in areas where water will flow, the geotextile may be placed with the direction parallel to the direction of water flow instead of the placement direction specified above. Overlap sheets so the upstream sheet is placed over the top of the downstream sheet. Adequately secure the geotextile to prevent slippage. As the geotextile is placed under water, place the backfill material on it to the required thickness. Do not place geotextile more than 50 feet ahead of the specified cover material.

222.3.01D Overlaps
Minimum overlap requirement for geotextiles are:

Geotextile Application	Minimum Overlap Requirement, Inches
Drains	12
Embankment Stabilization	24
Pavement Overlays	**
Riprap and Rock Buttresses	24
Roadbed Sub-grade Stabilization	24

** Use sufficient overlap to insure closure, but not more than 6 inches.

If the engineer determines the specified overlap is not sufficient, increase the overlap to provide adequate coverage or sew the geotextile together in the field. If field sewn, the provision of subsections 222.3.01A and 222.3.01E apply.

222.3.01E Field Seams

Obtain the engineer's approval before field seaming and stitching. Sew field seams with polymeric thread consisting of polypropylene, polyester, or kevlar, and as resistant to deterioration as the geotextile being sewn. Use a color of thread that contrasts with the geotextile being sewn so the stitches are exposed for inspection when the geotextile is placed. Seams shall meet testing requirements that include wide strip tensile strength test results and verifies that seam tensile strength and seam grab tensile strength meets or exceeds 90% of the minimum specified tensile strength values for the geotextile.

Use two rows of lock-type stitching, Type 401, to make the seams, as shown. The two (2) rows of stitching shall be 1/2 inch apart with a tolerance of ± 1/4 inch and not cross except for restitching.

The minimum seam allowance, that is, the minimum distance from the edge of geotextile to the nearest stitchline, is:

Seam Type (See Plans)	Minimum Seam Allowance
Flat or Prayer, Seam Type Ssa-1	1-1/2 inches
"J" Seam, Type Ssn-1	1 inch
Butterfly-folded Seam, Type Ssd-1	1 inch

Obtain the geotextile manufacturer's recommendation for the type of seam and stitch to be used. If the contractor does not obtain and provide the foregoing technical information, use a "J" seam with at least 3 stitches per inch. The flat or prayer seam may be used for repair of damaged in-place geotextile.

222.3.01F Protection of Geotextile
Protect the geotextile at all times from ultraviolet (UV) rays, contamination by surface runoff, and construction activities.

Traffic or construction equipment will not be permitted directly on the geotextile except as authorized in subsection 222.3.03E or as directed.

When placed for construction, cover the geotextile with specified cover material as soon as possible. Do not leave in uncovered condition for more than five (5) days unless otherwise specified by the type of geotextile.

Place cover material on the geotextile in a manner that the geotextile is not torn, punctured, or shifted. Use a minimum 6-inches thick cover layer or twice the maximum aggregate size, whichever is thicker. End-dumping cover material directly on the geotextile will not be permitted.

Limit construction vehicles in size and weight so rutting in the initial layer above the textile is not more than 3 inches deep or 1/2 the layer thickness, whichever is less. Turning on the first layer will not be permitted.

222.3.01G Repair of Geotextile
Repair or replace all torn, punctured, or contaminated geotextile during construction at no cost to the division. Repair by placing a patch of the specified geotextile over the affected area. Overlap the existing geotextile with the patch according to subsection 222.3.01D. Where geotextile seams are required to be sewn, repair any damaged sheet by sewing unless otherwise indicated on the plans or special provisions or as directed.

222.3.02 Sub-grade Geotextile
For roadbed sub-grade separation, prepare the sub-grade according to Section 204.

Correct geotextile failures, as evidenced by soil pumping or roadbed distortion, by removing any covering material in the affected area and placing a geotextile patch on the exposed geotextile according to subsection 222.3.06. Cover the patch with the specified cover material and compact before proceeding.

222.3.03 Pavement Overlay Geotextile
222.3.03A General
Place geotextile and pavement overlay in four basic steps :

1) Surface preparation

2) Sealant application

3) Geotextile placement

4) Overlay placement

222.3.03B Weather Limitations
Do not place sealant and geotextile unless the weather limitations of subsection 211.3.02 are met, as appropriate, except the minimum air temperature shall be 50° F for paving grade asphalt sealant replacement and 60° F for asphalt emulsion sealant placement.

222.3.03C Surface Preparation
Prepare the pavement surface on which the sealant is to be placed as follows:

222.3.03C1 Base Repairs
Where directed by the engineer, the contractor shall excavate and replace the surfacing materials as indicated in the plans and specifications. All work shall be performed in accordance with the section applicable.

222.3.03C2 Crack Sealing
Clean and fill all cracks 1/4" and larger inside the proposed resurfacing area. Cracks shall be sealed in accordance with Section 210.

222.3.03C3 Surface Repair
Where pavement is severely cracked, rutted, deformed or otherwise distressed, place a leveling course or patch unless otherwise directed by the engineer. Mixture shall be placed in accordance with Section 211.

222.3.03C4 Street Cleaning
Any organic materials in cracks or joints not removed during crack sealing shall be removed prior to street cleaning. All streets to be resurfaced shall be flushed and swept until all loose material is removed in order to ensure proper bonding. Existing lane markers (buttons or reflectors) shall be removed prior as part of street cleaning, prior to geotextile placement.

222.3.03D Sealant Application
Prior to installing the fabric on the existing pavement surface, a sealant shall be applied at the rate of 0.25 gallons per square yard (g.s.y.). Within street intersections, the application rate shall be reduced to 0.20 g.s.y.

The asphalt for the sealant shall be uncut asphalt cement of normal paving grade unless otherwise directed by the engineer. Application shall be by distributor's equipment, wherever possible, with hand spraying kept to a minimum. Temperature of the asphalt must be sufficiently high to permit a uniform spray pattern. For asphalt cements, the minimum temperature is 290 ° F, but shall not exceed 325° F when fabric is placed to avoid damaging the fabric.

If, in the opinion of the engineer, the asphalt binder has cooled sufficiently so that uniform distribution is not being achieved, the asphalt binder shall be removed from the job until recommended temperature and distribution can be achieved.

The target width of sealant application shall be geotextile width plus 2 to 6 inches. Asphalt drools or spills shall be cleaned from the road surface to avoid flushing and possible fabric movement at these asphalt rich areas.

222.3.03E Geotextile Placement
The fabric shall be placed into the asphalt tack coat prior to the time it has cooled and lost its tackiness. The fabric shall be placed so that it is taut, wrinkle-free and laid straight within the binder area. The fabric shall be broomed in order to establish uniform contact with the binder. The fabric is unrolled so that the bearded (fuzzy) side is unwound into the tack coat. When asphalt emulsions are used, allow the asphalt to separate from the water (break) before placing geotextile.

Slit wrinkles or folds exceeding 1 inch and lay flat. Shingle-lap not more than 6 inches in the direction of the paving. Broom and/or pneumatic roll to maximize geotextile contact with the pavement surface. Additional hand-placed sealant material may be required at laps as determined.

Transverse and longitudinal joints shall be made by overlapping the fabric 3 to 4 inches. At the joints, extra binder shall be uniformly applied by a hand sprayer at the rate of 0.2 gallons per square yard.

Limit traffic to necessary construction equipment and emergency vehicles on the geotextile before and during paving unless otherwise directed. Turn the paver and other vehicles gradually. Keep turning to a minimum to avoid geotextile movement and damage. Avoid abrupt starts and stops.

222.3.03F Overlay Placement

Place the overlay the same day the geotextile is placed. Remove sealant that bleeds through the geotextile. Do not windrow asphalt concrete material on the geotextile ahead of the paving machine. Do not use an asphalt concrete material pickup machine.

222.3.04 Embankment Geotextile

Construct embankment stabilization according to details shown on the plans. Place the geotextile layers so the geotextile machine direction is transverse to the embankment centerline. Spread the geotextile so all slack wrinkles are eliminated. Construct embankment in uniform layers according to Section 204.

222.3.05 Riprap Geotextile

Furnishing and placing of riprap geotextile shall conform to the requirements of the ODOT Standard Specifications.

222.3.06 Drainage Geotextile

Furnishing and placing of drainage geotextile shall conform to the requirements of Section 305 and subsection 222.3.01.

222.4.00 Measurement and Payment

222.4.01 Geotextile Fabric

Payment shall constitute full compensation for geotextile fabric, in place, including preparation work and sealants. No separate payment will be made for constructing laps, seams, joints or patches, unless the engineer orders more than the specified lap, in which case, the added lap width will be included in the measurement.

222.4.01A Square Yard Basis

Geotextile fabric will be measured and paid for on a square yard basis, to the nearest 1.0 yard, for surface area covered in accordance with the plans or as required by the engineer.

222.4.01B Lineal Foot Basis

Geotextile fabric used in uniform applications, such as trenches and constant widths, will be paid for on a lineal foot basis, to the nearest 1.0 foot, for the length of the trench or roadway that the fabric is used on.

222.4.02 Base Repair

Base repairs shall be measured and paid for in accordance with Section 211.

222.4.03 Crack Sealing

Crack sealing shall be measured and paid for in accordance with Section 210.

222.4.04 Surface Repair

AC mixture shall be measured and paid for in accordance with Section 211. All other work associated with surface repairs shall be incidental to pavement overlay geotextile.

222.4.05 Street Cleaning

Street cleaning and all other work associated with street cleaning shall be considered incidental to pavement overlay geotextile.

223 Cleanup

223 Cleanup

223.1.00 Description

This work consists of cleaning and removal of all refuse and unused materials resulting from the work and preparing the project site for acceptance by the owner.

223.2.00 Materials

The contractor shall provide all materials required to accomplish the work as specified.

223.3.00 Construction

The contractor shall perform all necessary work as described herein and in Section 105.

223.3.01 Surface Dressing

Slopes, sidewalk areas, planting areas, ditches, and the roadway shall be smoothed and dressed to the required cross section and grade without damaging the work or existing improvements, trees or shrubs.

Upon completion of the cleanup, the project shall appear uniform in all respects. Existing planting areas shall be graded to match the elevation of the sidewalk or curb with allowance made for settlement.

223.3.02 Cleaning Drains

Drainage facilities such as inlets, catch basins, culverts and open ditches shall be cleaned of all excess material or debris resulting from the work.

223.3.03 Cleaning Paved Surfaces and Appurtenances

Pavement surfaces, curbs, gutters, walls, sidewalks, manhole covers, monuments, poles, vaults, signs and other items within the limits of the project shall be cleaned as directed.

223.3.04 Restoring Planted Areas

Former grassed and planted areas shall be hand raked and dragged to be free from rocks, gravel, clay or any other foreign material, and ready in all respects for seeding.

The finished surface shall be free-draining and free from holes, rough spots, or other surface features detrimental to a seeded area.

223.3.05 Restoring Mobilization, Borrow and Disposal Areas

Uprooted stumps, felled trees, rock, discarded materials, rubbish, and debris shall be removed. Equipment, tools and supplies shall be removed and the areas restored to a neat and orderly condition.

223.3.06 Disposal of Waste Material

Excess excavated material or construction debris shall be removed and disposed of as approved. Where brush and trees beyond the limits of the project have been disturbed, they shall be remove and dispose of and restored as directed at no expense to the owner.

223.3.07 Removal of Temporary Signs

Warning, regulatory, guide, or project signs shall not be removed prior to formal acceptance, except as directed.

223.3.08 Replacement of Permanent Signs

Permanent roadway signing removed during the course of the work shall be replaced as directed by the engineer.

223.4.00 Measurement and Payment

223.4.01 Lump Sum Basis

Clean up will be paid on a lump sum basis for all required.

223.4.02 Incidental Basis

When not listed in the bid schedule, cleanup will be considered incidental work.

224 Recycled Asphalt Concrete Materials

224 Recycled Asphalt Concrete Materials

224.1.00 Description

224.1.01 Cold Plane Pavement Removal

This work consists of removing existing pavement and bridge deck surfaces to prepare a foundation for placing new surfacing.

224.1.02 Recycled Asphalt Concrete Base

This work consists of placing and compacting pavement grindings as a base on an approved sub-grade or subbase to the lines, grades, thicknesses, and cross sections shown on the plans or established by the engineer.

224.1.03 Recycled Asphalt Concrete Walks

This work consists of placing and compacting pavement grindings as a sidewalk on an approved sub-grade or subbase to the lines, grades, thicknesses, and cross sections shown on the plans or established by the engineer.

224.2.00 Materials

224.2.01 Pavement Grindings

Pavement grindings are the material removed from an existing roadway surface during cold pavement removal.

The pavement grindings material shall meet the following requirements:

Sieve Size Passing	Percentages (by weight)
2"	100

224.3.00 Construction

224.3.01 Cold Plane Pavement Removal

Planing machines or grinders shall be specially designed and built for milling of bituminous pavements without the addition of heat and shall have the ability to plane portland cement concrete patches in the bituminous pavement. The cutting drum shall be a minimum of 6 feet wide, totally enclosed, and shall be equipped with replaceable cutting teeth placed in a pattern to produce a uniformly rough grooved or ridged surface approved by the engineer.

The machine shall have a positive means for controlling cross slope, depth and grade. The machine shall be capable of a deep cut of 3 inches in one pass without producing fumes or smoke. The machine shall produce the required milled grade tolerance of 0.02 foot by reference from either the existing pavement or from an independent grade control as measured with a 12-foot straight edge. Also any variation of the top of ridges from a 12-foot straight edge between any two ridge contact points shall not exceed 0.02 foot.

The machine shall be self-propelled and have an effective means for removing loosened material from the surface and for preventing dust from escaping into the air. The machine shall be capable of removing the pavement next to the gutter and be designed so that the operator can observe the milling operation at all times without leaving the controls. The contractor shall provide a smaller machine if necessary with a 12-inch minimum width cutting drum to trim areas inaccessible to the larger machine at manholes, valve boxes, curb returns, intersections, etc.

During the milling operation, the contractor shall sweep the street and remove all loosened material from the project site. All bituminous pavement grindings removed shall become the property of the City and shall be placed or stockpiled as specified. Any excess material not used on the project shall be stockpiled where directed.

In milled areas which will be under traffic that have a difference in elevation of 1 inch or greater and will not be paved within the same day, the contractor shall construct and maintain 2-foot minimum width asphalt concrete pavement wedges. The wedges shall be placed completely across the milled area at intersections, points of beginning and ending of the milling operation, and around manholes, valve boxes, and other structures as directed to provide a transition from the existing street surface to the milled surface. No additional payment will be made for constructing and maintaining asphalt concrete pavement wedges. The transition may be omitted where the difference in elevation is less than 1 inch. Difference in elevation shall be measured with a 12-foot straight edge measured 12 inches from the edge of existing pavement or structure to the milled surface.

224.3.02 Recycled Asphalt Concrete

224.3.02A General

Pavement grindings used as a base, shoulders and walks, shall not be from stockpiled material unless otherwise

directed.

An approved granular ground sterilant shall be applied to sub-grade as per manufacturer's specifications after finish grading and just prior to placing asphalt grindings. The contractor shall be responsible for re-sterilization of the sub-grade due to regrading or excessive rain as determined by the engineer.

224.3.02B Thickness and Number of Layers
Pavement grindings shall be constructed in layers of approximately equal thickness with a maximum depth of 4 inches unless otherwise directed by the engineer.

224.3.02C Compaction
The surface of each layer of pavement grindings placed as base material shall be compacted by use of three-wheel steel roller having a minimum gross static weight of 10 tons and a minimum gross static weight on the drive wheel of 250 pounds per inch of width; vibratory rollers will not be allowed. Make at least three complete roller coverages.

Rolling shall continue until there is no appreciable reaction or yielding under the roller as determined by the engineer.

The final lift of pavement grindings placed as base material shall be compacted further with a self-propelled, pneumatic-tired roller following the placement of choke aggregate according to 210.3.07. Make at least two complete coverages with the pneumatic-tired roller immediately following application of choke aggregate. Use nonvibratory, tandem-wheeled steel rollers to finish rolling and continue until roller marks are eliminated.

The surface of pavement grindings placed as walks and shoulders shall be compacted with small self-propelled rollers, mechanical tampers or hand rollers as directed by the engineer.

224.3.02D Surface Tolerance
The surface of each layer of material, when tested with a 12-foot straightedge, shall not vary from the testing edge by more than 0.04 foot at any point. The contractor shall furnish the straightedge and operate it under the direction of the engineer.

The finished surface shall not vary more than 0.04 foot from established grade and cross section at any point.

224.4.00 Measurement and Payment

224.4.01 Cold Plane Pavement Removal
Cold plane pavement removal will be measured and paid for on a square yard basis, to the nearest 0.1 yard.

224.4.02 Sub-grade Sterilant
Ground sterilant shall be incidental to the construction of recycled asphalt pavement materials and no separate or additional payment will be made.

224.4.03 Recycled Asphalt Concrete Base
Recycled asphalt concrete base will be measured and paid for on a square yard basis, to the nearest 0.1 yard.

224.4.04 Recycled Asphalt Concrete Walks
Recycled asphalt concrete walks will be measured and paid for on a square yard basis to the nearest 0.1 yard.

Division 3 - Sanitary Sewers and Storm Drains

301 Trench Excavation, Bedding and Backfill

301 Trench Excavation, Bedding and Backfill

301.1.00 Description

This work consists of trench excavation, trench foundation, pipe bedding, pipe zone material, trench backfill, embankment and surface removal, and replacement.

301.1.01 Trench Excavation

Trench excavation is defined as the removal of all material encountered in the trench to the depths as shown or as directed. Trench excavation shall be classified as either common or rock excavation.

301.1.01A Common Excavation

Common excavation is defined as the removal of all material which is not classified as rock excavation.

301.1.01B Rock Excavation

Rock excavation is defined as solid ledge rock, which in the opinion of the engineer requires, for its removal, drilling and blasting, wedging, sledging, barring, or breaking up with power-operated tools.

No soft or disintegrated rock; hard-pan or cemented gravel that can be removed with a hand pick or power operated excavator or shovel; no loose, shaken, or previously blasted rock or broken stone in rock fillings or elsewhere; and no rock outside of the minimum limits of measurement allowed, which may fall into the excavation, will be measured or allowed.

301.1.01C Boulder Excavation

Boulder excavation is defined as the removal of masses of igneous, sedimentary or metamorphic stone material which has one or more dimensions of 36" or greater or a displacement of one cubic yard or more, which is removed without drilling, blasting or splitting.

301.1.02 Trench Foundation

Trench foundation is defined as the bottom of the trench on which the pipe bedding is to lay and which provides support for the pipe.

301.1.03 Pipe Bedding

Pipe bedding is defined as the furnishing, placing and compacting of specified materials on the trench foundation so as to uniformly support the barrel of the pipe to the springline. The total bedding depth shall be a minimum of 6 inches below the outside bell of the pipe.

301.1.04 Pipe Zone

The pipe zone is defined as the furnishing, placing and compacting of specified materials for the full width of the trench from the top of the bedding to a point 12 inches above the top outside surface of the barrel of the pipe.

301.1.05 Trench Backfill

Trench backfill is defined as the furnishing, placing, and compacting (except CDF) of material in the trench between the top of the pipe zone material and the bottom of the pavement base rock, ground surface, or surface material.

301.1.06 Embankment

Embankment is defined as furnishing, placing, and compacting of the embankment material to the depth and configuration specified.

301.1.07 Surface Removal

Surface removal is defined as the removal of surface material such as topsoil, sod, pavement, sidewalks, gravel, etc., which requires special consideration in order to accomplish.

301.2.00 Materials

Materials may be native or imported as specified. Materials proposed for use in the work shall not be used without the approval of the engineer.

301.2.01 Trench Foundation

The trench foundation shall be undisturbed native material. Where ground water or other unstable conditions exist and the native material cannot support the pipe, additional excavation may be required. The trench shall be stabilized with pipe bedding material.

301.2.02 Pipe Bedding

Pipe bedding material shall be crushed rock with a maximum size of 3/4 inch, well graded from coarse to fine. Clean beach, pit run, or reject crusher sand, or other materials may be approved as a substitute for gravel in trenches that have no groundwater in the pipe zone.

301.2.03 Pipe Zone

The pipe zone material shall consist of bedding material as described in subsection 301.2.02.

301.2.04 Trench Backfill

301.2.04A Class A Backfill

Class A backfill shall be native or common material which, in the opinion of the engineer, meets the characteristics required for the specific surface loading or other criteria of the backfill zone.

301.2.04B Class B Backfill

Class B backfill shall be granular material consisting of gravel or crushed rock meeting the requirements of Section 207. Designated size shall be 3/4"-0.

301.2.04C Class C Backfill

Class C backfill shall be clean sand with no particle size larger than 1/4 inch.

301.2.04D Class D Backfill

Pit run or bar run material well graded from coarse to fine. The maximum dimension shall be 3 inches.

301.2.04E Controlled Density Fill (CDF)

CDF shall be a low strength, highly flowable mixture of Portland cement, Pozzolan (fly ash), fine aggregates, water and admixtures, if necessary, which results in a hardened, dense, non-settling, hand-excavatable fill.

Portland cement, Pozzolan, fine aggregates, water, and admixtures for CDF shall conform to Section 212, except that Portland cement shall be type I-II or II.

301.2.04E1 CDF Mix Design

The contractor shall furnish a mix design for approval. The mixture shall be designed to ensure that the material placed has a 7-day compressive strength of between 50 psi and 150 psi. The compressive strength shall be tested using 4-inch mortar cubes per ASTM C 109.

Within 24 hours the material shall be capable of supporting vehicular traffic without rutting.

301.2.05 Embankment

Embankment materials shall be as shown on the plan.

301.2.06 Embankment Geotextile Fabric

Embankment geotextile fabric shall be composed of a polymeric yarn or fiber oriented into a stable network which retains its relative structure during handling, placement, and design service life. Fabric may be rejected by the engineer if dimensional stability or resistance of the fabric to ambient temperatures, acid, and alkaline conditions and microorganisms/insects does not appear to be satisfactory for the intended purpose. The fabric shall be free of any chemical treatment or coating which might significantly reduce permeability. The selvage of fabric shall be such that the outer fibers are prevented from pulling away from the fabric. Embankment and foundation geotextile fabrics shall conform to the following requirements.

Geotextile Fabric Property	Test Method	
Grab tensile strength, lbs.	ASTM D 1682 Modified	180 mins.
Burst strength (diaphragm method), psi.	ASTM D 3786 Modified	290 mins.
AOS (Apparent Opening Size), ... U.S. Std. sieve	OSHD TM 815	30-50
Water permeability, cm./sec.	ASTM D 4491	0.02-0.04 mins.
Ultraviolet stability, percent strength retained	ASTM D 4355	70 mins.

301.3.00 Construction

301.3.01 Trench Excavation

301.3.01A General

All trench excavation and backfill shall conform to the requirements of regulatory agencies having jurisdiction over the work or within the work site.

301.3.01B Clearing the Right of Way

Where clearing of the right of way is necessary, it shall be completed prior to the start of the trenching.

The contractor shall observe all federal and state laws relating to fire permits and local regulations relating to burning materials. Under no conditions shall excavated materials be permitted to cover brush prior to clearing and disposal of the brush.

301.3.01C Open Trench Limit

The length of open trench shall be kept to a minimum. The engineer shall be the sole judge of the amount of trench allowed open based upon work conditions of the area. In normal cases, the open trench length shall not exceed 100 feet. Related construction such as pavement, road gravel, concrete restoration, etc., shall be completed within 800 feet of the open trench limit.

301.3.01D Trench Width

Trench width at the ground surface shall be kept to the minimum necessary to install the pipe in a safe manner but not less than 24 inches. In all cases, trenches must be of sufficient width to allow for shoring and permit proper joining of the pipe and backfilling of material along the sides of the pipe. The minimum trench width in the pipe zone must provide a clear working space of 6 inches outside the maximum outside diameter of the pipe. Excavation for manholes and other structures shall be wide enough to provide a minimum of 12 inches between the structure surface and the sides of the excavation.

The top of the trench shall be confined to rights of way or easements. Special written agreements to extend the width may be made with the affected property owners, provided the agreements are first approved by the engineer.

301.3.01E Trench Grade

The contractor shall excavate the trench to the lines and grades shown or as established by the engineer, with proper allowance for pipe thickness, pipe bedding and foundation stabilization. The foundation upon which the bedding is to be placed shall be firm, undisturbed, and true to grade. If the trench is excavated below grade without authorization, the contractor shall restore to grade with material of the type specified for pipe bedding at no expense to the owner. The material shall be placed over the full width of the trench, in compacted layers not exceeding 6 inches.

301.3.01F Disposal of Excess Material

Excavated material shall be placed at locations and in such a manner that it does not create a hazard to pedestrian or vehicular traffic, or interfere with the function of existing drainage facilities.

The contractor shall make arrangements for and dispose of all excess material not required elsewhere on the project at no cost to the owner.

301.3.01G Trench Protection

The contractor shall provide the materials, labor and equipment necessary to protect trenches at all times. The trench protection shall provide safe working conditions in the trench and protect the work, existing property, utilities, pavement, etc. The method of protection shall be according to the contractor's design. The contractor may elect to use a

combination of shoring, overbreak, tunneling, boring, sliding trench shields, or other methods of accomplishing the work provided the method meets with the approval of all applicable local, state, and federal safety codes.

Damages resulting from improper shoring, improper removal of shoring or from failure to shore shall be the sole responsibility of the contractor.

301.3.01H Existing Abandoned Facilities

The contractor shall remove and dispose of existing abandoned sewer pipe, structures, and other facilities as necessary to construct the sewer. The cost of such removal will be considered incidental to the item trench excavation and backfill.

301.3.02 Rock Excavation

Where ledge rock meeting the definition of rock as described above is encountered during trench excavation, the rock shall be removed to provide a minimum of 6 inches of clearance to each side of and below all pipe and appurtenances. The contractor will be required to excavate and remove the overburden and expose the rock to allow the engineer to profile or cross section the rock for measurement of pay quantity. The measurement shall be completed prior to removal of the rock.

The use of explosives shall comply with the requirements of Section 107. No blasting shall occur without obtaining prior approval of the engineer and the appropriate permits. The contractor shall provide all tools and devices required for loading and using explosives, blasting caps, and accessories. When blasting rock in trenches, cover the area to be shot with blasting mats or other protective material to prevent the scattering of rock fragments outside of the excavation.

The contractor shall assume all liability and responsibility connected with or accruing from blasting or the use of explosives or dangerous material.

301.3.03 Dewatering

The contractor shall promptly remove and dispose of all water entering the trench during the time the trench is being prepared for the pipe laying, during the laying of the pipe and until the backfill at the pipe zone has been completed. The contractor shall dispose of the water in a suitable manner without damage to adjacent property.

Groundwater shall be controlled to prevent softening of the bottom of excavations or formation of "quick" conditions or "boils." Dewatering systems shall be designed and operated so as to prevent removal of the natural soils and so that the groundwater level outside the excavation is not reduced to the extent that would damage or endanger adjacent structures or property.

301.3.04 Trench Foundation

When, in the judgment of the engineer, the existing material in the bottom of the trench is unsuitable for supporting the pipe, the contractor shall excavate below grade, as directed. The excavated material shall be replaced with foundation material meeting the requirements of subsection 301.2.01. If unsuitable foundation material is removed in the same operation and manner as trench excavation, the removal will be measured and paid for as trench excavation. Otherwise, the removal will be paid as trench foundation.

301.3.05 Pipe Bedding

The contractor shall spread the bedding smoothly to proper grade so that the pipe is uniformly supported along the barrel and shall excavate bell holes at each joint to permit proper assembly and inspection of the joint. Bedding under the pipe shall provide a firm, unyielding support along the entire pipe length. The contractor shall place subsequent lifts of not more than 1 foot in thickness up to the springline of the pipe, bringing lifts up together on both sides of the pipe. The material under the pipe haunches shall be thoroughly compacted.

301.3.06 Pipe Zone

Pipe zone material shall be carefully placed around the pipe and thoroughly compacted in 6-inch layers to provide complete support of the pipe and to prevent deflection or damage. The contractor shall prevent pipe from movement either horizontally or vertically during placement and compaction of pipe zone material.

301.3.07 Trench Backfill

301.3.07A General

The engineer may sample excavated material to determine the suitability of the Class A material for use as backfill. If the material is found to be suitable, the contractor may elect to use the material in place of the specified backfill. The

contractor shall take reasonable precautions to prevent excavated material from becoming saturated beyond the critical moisture limits and replace any saturated Class A material with Class B, C, or D material, as specified, at no additional expense to the owner.

Whenever temporary steel plates are installed over the street cut, they shall be capable of carrying a minimum of H-20 loading. The steel plates shall have a minimum of 12 inches bearing on all sides of a cut. The steel plates shall be anchored to minimize shifting. All steel plates shall have their edges shimmed with cold mix asphalt.

301.3.07B Class A, B, C, or D Backfill

The contractor shall backfill the trench above the pipe zone in successive lifts. Backfill shall not be allowed to free-fall into the trench until at least 3 feet of cover is provided over the top of the pipe. The method of compaction shall be modified as necessary to protect the pipe.

The contractor shall compact each lift to a minimum of 95 percent of the maximum density as determined by AASHTO T 99, Method D. If the specified compaction is not obtained, the contractor may be required to use a modified compaction procedure and/or reduce the thickness of lifts. If approved materials meeting the specifications cannot be compacted to the required density regardless of compactive effort or method, the engineer may reduce the required density or direct that alternate materials be used. In no case shall excavation and pipe laying operations proceed until the contractor is able to compact the backfill to the satisfaction of the engineer.

When the backfilling is complete, the contractor shall finish the surface area as specified. In paved or graveled areas the contractor shall maintain the surface of the trench backfill level with the existing grade with 3/4"-0 crushed aggregate material, or asphalt concrete, if directed, until final pavement replacement is completed and accepted by the owner.

301.3.07C Controlled Density Fill (CDF)

Backfill the trench above the pipe zone with CDF material. If the CDF is to be used as a temporary surfacing, backfill the CDF to the top of the trench and strike it off to provide a smooth surface. If the CDF is not to be used as a temporary surfacing, backfill the CDF up to the bottom of the proposed resurfacing. No compaction of CDF is allowed. The CDF shall be steel-plated to protect it from traffic a minimum of 24 hours. After 24 hours, the CDF may be paved, or opened to traffic until permanent surface restoration is completed, if it has hardened sufficiently to prevent rutting.

301.3.08 Structural Embankments

The contractor shall construct embankment to support the pipeline in accordance with the details shown on the plans. The contractor shall spread excess excavated trench material suitable for embankment, or approved imported material when directed, in maximum 1-foot lifts for the full width of the embankment cross section and compact to a minimum of 95 percent of maximum density for the full depth of the fill as determined by AASHTO T 99.

The contractor shall moisten or dry layers of fill as required to obtain the compaction specified and compact the embankment to final cross section before the trench excavation for the pipe is made.

301.3.09 Compaction

If the compaction specified for trench backfill or embankment is not obtained, the contractor will be required to use a modified compaction procedure. If approved materials meeting the specifications cannot be compacted to the required density regardless of compactive effort or method, the engineer may reduce the required density or direct that alternate materials be used. In no case shall embankment or backfill operations proceed until the contractor is able to compact the backfill material to the satisfaction of the engineer.

301.3.10 Embankment Geotextile Fabrics

Fabric shall be protected against damage and deterioration until incorporated into the work. The fabric shall be dry at the time of installation. Fabric will be rejected if, at the time of installation, it has defects, deterioration, or damage, as determined by the engineer.

The minimum overlap of fabric panels shall be 2 feet.

301.3.11 Surface Removal

301.3.11A Topsoil

Where trenches cross lawns, garden areas, pastures, cultivated fields, or other areas on which reasonable topsoil conditions exist, the contractor shall remove the topsoil to the specified depth and place the material in a stockpile. The

contractor shall not mix the topsoil with other excavated material. After the trench has been backfilled, the topsoil shall be replaced.

In lieu of stockpiling the topsoil, approved imported topsoil may be substituted, to a depth specified or approved, at no expense to the owner.

The contractor shall maintain the finished grade of the topsoil level with the area adjacent to the trench until final acceptance by the engineer and shall repair damage to adjacent topsoil caused by work operations. The contractor shall remove all rock, gravel, clay, and any other foreign materials from the surface, regrade, and add topsoil as required.

301.3.11B Pavement, Curb and Sidewalk

Cuts in bituminous pavement, portland cement concrete pavement, curbs, and sidewalks, regardless of thickness, shall be made with a pavement saw. The width of the opening shall be the minimum necessary for the excavation and shall follow lines parallel to the pipe.

301.4.00 Measurement and Payment

301.4.01 Trench Excavation and Backfill

301.4.01A Lineal Foot Basis

Trench excavation and backfill will be measured and paid for on a lineal foot basis, to the nearest foot. Measurement will be along the pipe from center to center of manholes, catch basins, or other structures, or to the end of the pipe where no structures exist, with no deduction for structures or fittings.

301.4.01B Lineal Foot Basis (Depth Method)

Trench excavation shall be measured and paid for on a lineal foot basis, to the nearest foot, for the length of trench in each of the depth ranges listed in the bid schedule.

The depth will be measured from the original ground to the bottom of bedding material, where the trench is in an easement, and from sub-grade to bottom of bedding material where the trench lies below a road prism and from surface of paving to bottom of bedding material where the trench lies below an existing paved road. Depth will be measured from the plan profile using the computed depth of subgrade and bedding where applicable at intervals of 25 feet along the centerline of the trench beginning at the center of the downstream manhole. The average depth between measuring points will be the depth used for computing payment for each section of the trench.

The length of trench shall be measured in accordance with subsection 301.4.01A.

301.4.01C Cubic Yard Basis

Trench excavation and backfill shall be measured and paid for on a cubic yard basis, to the nearest 0.1 yard Measurement shall be to the nearest 0.01 foot and computed on the following basis.

Length. The length will be the horizontal distance measured along the centerline of the trench. Measurement shall be continuous through manhole or structure locations unless the bid schedule carries separate items of excavation applicable to the manholes or structures.

Width. The width will be the diameter of the bell of the pipe plus 12 inches, with a minimum of 24 inches.

Depth. The depth will be the vertical distance from the original ground or paved surface to the invert of the pipe. The depth will be measured at intervals of 25 feet, or as directed by the engineer, along the centerline of the trench and the average depth between points will be used for the volume computations.

The volume of boulder and rock excavation shall be deducted from the total volume of excavated material determined by neat line measure. The calculated remainder of the excavation shall be paid for by the class of material removed.

301.4.02 Rock and Boulder Excavation

301.4.02A Rock Excavation

Rock excavation shall be measured and paid for on a cubic yard basis to the nearest 0.1 cubic yard. Measurement shall be of the actual dimensions of rock removed within the following limits.

The length will be the horizontal distance measured along the centerline of the trench. The measurement will exclude manholes and other structures, which will be measured separately. The width shall be the width of the rock removed but not greater than the outside diameter of the pipe bell plus 12 inches.

The depth of the rock excavation shall be measured at 25 foot intervals, or as directed by the engineer, along the center line of the trench. The average depth between measurement points shall be used for the computations but not more than 6 inches below the outside bell of the pipe.

Rock excavation quantities for manholes and other structures shall be computed from the actual rock excavated to a depth 6 inches below the bottom of the structure and an area within a line parallel with and 1 foot outside of the actual dimensions of the manhole or structure.

301.4.02B Boulder Excavation
Boulder excavation will be measured in the field by the Engineer prior to removal from the site. Boulders shall be measured for length, width, and height to the nearest 0.1 foot. The volume of each boulder shall be defined as the product of 85 percent of each of the three measured dimensions.Boulder excavation shall be paid on a cubic yard basis to the nearest 0.1 cubic yard.

301.4.03 Trench Protection
Shoring, mobile trench shields, overbreak, and other trench protection measures will be considered incidental work.

301.4.04 Trench Foundation
Payment for this item shall include removal of unsuitable material and replacement as necessary to provide for a stable foundation for the pipe.

301.4.04A Ton Basis
Trench foundation will measured and paid for on a ton basis, to the nearest 0.01 ton. The pay quantity will be based on weigh tickets from scales meeting the requirements of Section 109. Weigh tickets shall be presented to the engineer for his signature on the day the material is delivered.

301.4.04B Cubic Yard Basis
Trench foundation shall be measured and paid for on a cubic yard basis, to the nearest 0.1 yard. Measurement shall be to the nearest 0.01 foot and computed on the following basis.

Depth shall be the actual depth of trench foundation placed as specified. Length and width shall be measured in accordance with the provisions of subsection 301.4.01C

301.4.04C Extra Work Basis
When not listed in the bid schedule, trench foundation will be paid for as extra work.

301.4.05 Pipe Bedding
Pipe bedding will be considered incidental work.

301.4.06 Pipe Zone Backfill
When suitable material exists at the trench side, as determined by the engineer, pipe zone backfill shall be considered incidental work. When Class B, C, or D backfill is required and approved by the engineer, measurement and payment will be as follows.

301.4.06A Ton Basis
Pipe zone backfill will be measured and paid for in accordance with the provisions of subsection 301.4.04A.

301.4.06B Cubic Yard Basis
Pipe zone backfill shall be measured and paid for on a cubic yard basis, to the nearest 0.1 yard. Measurement shall be to the nearest 0.01 foot and computed on the following basis.

Depth shall be the actual depth of trench foundation placed as specified. Length and width shall be measured in accordance with the provisions of subsection 301.4.01C. The volume of material displaced by pipe and structures will be deducted from the calculated backfill volume to determine the final pay quantity.

301.4.07 Embankment

Embankment materials will be measured in place and paid for on a cubic yard basis, to the nearest 0.1 yard. Trench excavation, bedding, and backfill placed in the completed embankment will be measured and paid for at the unit prices listed in the bid schedule.

301.4.08 Embankment Geotextile Fabric

Embankment geotextile fabric will be measured and paid for on a square yard basis, to the nearest 0.1 yard, for the surface area covered in accordance with the plans or as required by the engineer. No separate measurement will be made for construction of laps, seams, joints, or patches, unless the engineer orders more than the specified lap, in which case the added lap width will be included in the measurement.

301.4.09 Imported Topsoil

Imported topsoil will be measured and paid for on ton basis, to the nearest 0.01 ton. Measurement will be based on weigh tickets from scales meeting the requirements of Section 109.

301.4.10 Incidental Basis

When not listed in the bid schedule, trench excavation, dewatering, geotextile fabric, pipe zone material, backfill material, imported topsoil, maintenance of backfilled trenches, and other anticipated items will be considered incidental work.

302 Tunneling, Boring, Jacking

302 Tunneling, Boring, Jacking

302.1.00 Description

302.1.01 Tunneling

Tunneling shall include all methods by which the underground passageway is first excavated and then the lining materials are brought in and placed.

302.1.02 Boring

Boring shall include all methods by which a conduit is pushed or pulled into place and by which the excavation method precludes the stationing of a worker within the conduit without stopping or removing the excavation equipment.

302.1.03 Jacking

Jacking shall include all methods by which a conduit is pushed or pulled into place with one or more workers inside to excavate and assist in keeping the conduit on the required grade and alignment.

302.2.00 Materials

302.2.01 Pipe Bedding and Pipe Zone Material

Pipe bedding and pipe zone material shall conform to the requirements of Section 301.

302.2.02 Pipe

Pipe materials shall conform to the strength, class and type specified.

302.2.03 Casing

The contractor shall provide casing of a size to permit proper construction to the required lines and grades. Casing shall be of smooth steel pipe or concrete pipe suitable for the purpose intended.

The class of casing specified is based upon the superimposed loads and not upon the stresses resulting from jacking or boring operations. Any increase in casing strength to withstand jacking or boring operations shall be the responsibility of the contractor.

Jacked casings shall be equipped with nipples at the springline and the crown at 10-foot centers when pressure grouting is specified.

Optionally, the casing may be constructed of galvanized standard offset tunnel liner plate with gauge and section modulus as approved. Nipples for pressure grouting, when specified, shall be installed at the springline and crown at 10-foot centers.

302.2.04 Grout

Grout for filling the annular space between the carrier pipe and casing pipe shall be proportioned one part portland cement, five parts sand, and seven parts pea gravel, by volume, or as approved.

Grout for pressure grouting outside jacked carrier or casing pipe shall be one part portland cement and three parts sand, by volume, or as approved.

302.3.00 Construction

302.3.01 General

The work shall conform to all federal, state and local laws and regulations pertaining to tunneling and specifically to the standards set forth in the current volume of the Oregon Safety Code for Places of Employment, Chapter 24, Safety Code for Mining, Tunneling and Quarrying, published by the Oregon Industrial Accident Commission.

302.3.02 Excavation

Excavation shall be unclassified and shall include whatever materials are encountered to the depths shown or required.

302.3.03 Tunneling Details Required

The contractor shall submit details of the following to the engineer for approval before beginning tunnel construction.

a) Tunnel shaft bracing and dimensions
b) Tunnel supports

c) Method of backpacking tunnel supports
d) Bracing to prevent lining from shifting or flotation
e) Backfill material or pressure concrete mix design, placement method, and equipment
f) Poling plate dimensions and details, when required

302.3.04 Jacking and Boring Details Required
The contractor shall submit details of the following to the engineer for approval before beginning jacking or boring.

a) Jacking pit construction
b) Jacking pit bracing
c) Casing or conduit
d) Jacking head
e) Excavation method
f) Tee or wye installation
g) A substitute design for any part of the system that must be changed as a result of the jacking or boring operation
h) Any structure that is required because of the particular method or procedure used by the contractor
i) If placed in a casing: bracing to prevent pipe shift and flotation, and the materials, method and equipment for backfilling
j) Backfill material or pressure grout mix and the placement method and equipment.

302.3.05 Tunneling
Tunneling will be permitted only where specified or approved. All proposed construction methods and materials shall be approved by the engineer before the start of construction.

The subgrade upon which the pipe is to be constructed shall be firm, thoroughly compacted, true to grade, and with at least 6 inches of approved bedding material under the pipe. If the material in the bottom of the tunnel is ledge rock, excavation of the tunnel shall extend to a depth below the bottom of the pipe and a bedding of crushed aggregate or concrete shall be provided as specified in Section 301. Excavation below grade, which is made without approval, shall be restored to grade by backfilling with approved bedding material at no expense to the owner.

302.3.06 Jacking and Boring
Jacking or boring may be allowed in lieu of the open trench method or tunneling with approval of the engineer. All conduit shall be jacked or bored to the required line and grade.

The leading section of conduit shall be equipped with a jacking head. All excavation shall be carried out entirely within the jacking head.

Should appreciable loss of surrounding material occur during the jacking or boring operation the voids shall be backpacked or grouted before the completion of the shift. All voids shall be filled or backpacked with grout or granular material as approved.

302.3.07 Concrete Pipe and Box Sections
The contractor shall protect the driving ends of concrete conduit against spalling and other damage. Intermediate joints shall be similarly protected by the installation of sufficient bearing shims to properly distribute the bearing stresses. Any section of conduit showing signs of failure shall be removed and replaced with a new section or with an approved cast-in-place section which is adequate to carry the loads imposed upon it.

302.3.08 Smooth Steel Casing
Sections of smooth steel casing to be jacked or bored shall be joined by welding the joints with a continuous weld for the full circumference or by other approved means. The contractor shall provide joints which are capable of resisting the jacking or boring forces.

Pipe installed in casing shall be braced to prevent shifting or flotation. The void between the casing and pipe shall be filled with grout or other material as specified or approved.

302.3.09 Grouting Voids Outside Casing

When grouting is specified or approved, the contractor shall completely fill the void space between the tunnel and casing or liner plate with approved grout. After the casing or carrier pipe has been jacked or tunneled into position, the contractor shall pressure grout through the grout holes provided to fill all voids outside the pipe using the following sequence:

a) Grout at the springline hole at one end and pump grout until it appears in the grout hole at the crown;
b) Grout through the opposite springline hole until grout appears at the hole in the crown;
c) Grout through the hole at the crown until grout appears in the next set of holes along the pipe;
d) Plug the holes at the starting point and move to the next set of holes; and,
e) Repeat the sequence until the full length of the pipe has been grouted.

302.3.10 Cased or Tunneled Pipe

Where timber cradles are shown, the contractor shall provide a strapped timber cradle under the barrel of the carrier pipe. The barrel shall bear continuously on the cradles.

302.3.11 Placing Fill in Casing

Where shown, the contractor shall completely fill the annular space between the pipe and the casing, tunnel liner or tunnel wall with approved grout or sand to prevent pipe flotation. The contractor shall accomplish the filling by pouring or pumping from the two ends and from intermediate points as necessary. Grouting, once commenced at any one point, shall be completed without stopping. The contractor shall accomplish sand filling by similar methods using a gunite machine, or other approved equipment.

302.3.12 Railroad Crossings

All work to be performed by the contractor in railroad rights of way shall be performed in compliance with the railroad permit.

302.4.00 Measurement and Payment

302.4.01 Tunneling, Boring and Jacking

Tunneled, bored or jacked conduit will be measured and paid for at the unit price for each size and type listed in the bid schedule.

Where casing is shown or is used at the option of the contractor, the cost of the casing and the backfill between the pipe and the casing shall be considered incidental work.

Where jacking, boring, tunneling, or open trench is used in lieu of another method at the contractor's option, measurement and payment shall be made as originally bid.

302.4.02 Tees and Wyes

Tees and wyes in a tunneled, jacked or bored conduit will be paid for at the same unit prices bid for tees and wyes installed in an open trench.

303 Sanitary Sewer Pipe and Fittings

303 Sanitary Sewer Pipe and Fittings

303.1.00 Description

This work consists of the installation of sanitary sewer pipe and fittings.

303.2.00 Materials

303.2.01 General

Sanitary sewer pipe shall have flexible elastomeric gasket joints. Materials and strength specifications shall be as specified for the particular kind of pipe and fittings required.

Joints on all fittings shall be the same as the joints used on the pipe. Caps or plugs shall be furnished with each fitting, outlet, or stub as required with the same type gasket and/or joint as the pipe.

303.2.02 Ductile Iron Pipe

Ductile iron pipe shall conform to the requirements of ANSI A21.51 or AWWA C 151, cement lined, push-on joint. Twelve inch and smaller pipe shall be Class 52. Fourteen inch and larger pipe shall be Class 51

303.2.03 Reinforced Concrete Pipe

Reinforced concrete non-pressure pipe shall conform to the requirements of ASTM C 76 or C 655. The pipe shall meet the design requirements of wall B.

Reinforced concrete low-head pressure pipe shall conform to the requirements of ASTM C 361.

303.2.04 Polyvinyl Chloride (PVC) Pipe

PVC pipe shall conform to ASTM D 3034 or ASTM F 679, or ASTM F 794 and have a minimum wall stiffness of 46 psi or an SDR of 35.

303.2.05 Jointing Materials

303.2.05A Concrete Pipe

Gaskets shall conform to the requirements of ASTM C 443.

303.2.05B Ductile Iron Pipe

Push-on joints shall conform to the requirements of AWWA C 111 and ANSI A21.11. Mechanical joints shall conform to the requirements of ANSI A21.11.

303.2.05C PVC Pipe

Gaskets shall conform to the requirements of ASTM 1869.

Threaded connections shall conform to the requirements of ASTM D 2464 for Schedule 80 pipe.

303.2.06 Fittings

303.2.06A General

Tee or wye fittings shall be provided in the sewer main for side sewers. All fittings shall be of sufficient strength to withstand all handling and load stresses encountered. All fittings shall be of the same materials as the pipe, except that "Insert-s-tee" fittings or approved wye substututes may be allowed. Material joining the fittings to the pipe shall be free from cracks and shall adhere tightly to each joining surface.

All fittings shall be capped or plugged and gasketed with the same gasket material as used in the pipe joint, fitted with an approved mechanical stopper, or have an integrally cast knockout plug. The cap or plug shall be capable of withstanding test pressures without leaking and, when later removed, shall permit continuation of piping with jointing similar to joints in the installed line.

303.2.06B Concrete Pipe

Fittings on 18 inch and smaller concrete pipe shall be shop fabricated. Fittings on pipe 21 inches and larger may be field or shop fabricated. Fabrication details for fittings shall be approved prior to delivery of fittings to the job site.

Fittings fabricated by inserting a stub into a hole cut in the pipe shall be grouted with a non-shrinking grout. Surfaces to receive grout shall be coated with an epoxy bonding agent prior to grouting. Fitting stubs shall not protrude inside of the sewer pipe.

303.2.06C Ductile Iron Pipe
Fittings shall be mechanical or push-on of the class specified and shall conform to AWWA C 110 or ANSI A21.10. and shall be of a class at least equal to that of the adjacent pipe.

303.2.06D PVC Pipe
Fittings shall conform to the applicable portions of ASTM D 3034 or ASTM F 794 . Fitting joints shall be the same as the pipe joints.

303.2.07 Mechanical Couplings
Mechanical couplings for steel, cast iron and ductile iron pipe shall be wrought steel or cast iron. The diameter of the coupling shall be manufacturer-approved for use with the outside diameter of the pipe on which the coupling is installed. Steel style mechanical couplings shall be used to connect the pipeline to existing steel pipelines. Cast style mechanical couplings shall be used in the pipeline or to connect the pipeline to existing cast iron or ductile iron pipelines.

303.2.08 Cleanouts
Cleanouts shall be constructed of rigid pipe materials and fittings.

303.2.09 Material Certification
The manufacturer or fabricator shall furnish appropriate certification, based on manufacturer's routine quality control tests, that the materials in the pipe meet the specifications.

303.2.10 Acceptance Testing - Concrete Pipe

303.2.10A Reinforced Concrete Pipe Core Tests
Acceptance for reinforced concrete pipe 60 inches in diameter and smaller shall conform to paragraph 4.1.1 of ASTM C 76. Acceptance of pipe larger than 60 inches may, at the option of the engineer, conform to paragraph 4.1.2 of ASTM C 76. Cores shall be taken and tested in conformance with ASTM C 497.

Rubber joint concrete pipe shall conform to ASTM 443.

303.2.10B Concrete Pipe Field Permeability Tests
The engineer may require field permeability tests on a maximum of 5 percent of each lot, class, or size of pipe in conformance with ASTM C 497 on pipe 24 inches in diameter and smaller.

The contractor shall provide all the necessary labor, equipment, water, and materials at the site for performing field permeability tests.

At the option of the pipe supplier, and with the approval of the engineer, individual field permeability tests may be performed at the point of manufacture.

303.2.10C Concrete Pipe Plant Air Test

The engineer may require that each length of concrete pipe 12 inches diameter and smaller be given an individual air test at the point of manufacture. Test equipment shall be approved by the engineer and the test pressure shall be a minimum of 10 psi. Each length shall show no appreciable loss of air after 5 seconds.

When individual air testing is performed, no field or shop permeability tests will be required.

303.3.00 Construction

303.3.01 Line and Grade
Survey line and grade control hubs will be provided by the engineer or the Contractor as specified in the plans or construction documents.

Variance from established line and grade shall not be greater than 1/32 inch per inch of pipe diameter and not to exceed 1/2 inch, provided that such variation does not result in a level or reverse sloping invert; provided also, that variation in the invert elevation between adjoining ends of pipe, due to non-concentricity of joining surface and pipe interior surfaces, does not exceed 1/64 inch per inch of pipe diameter, or 1/2 inch maximum.

303.3.02 Pipe Distribution and Handling
The contractor shall unload pipe only by approved means.

Pipe and fittings shall be inspected by the contractor prior to lowering into the trench to insure no cracked, broken, or otherwise defective materials are used. The contractor shall clean ends of pipe thoroughly, remove foreign matter and dirt from inside of pipe, and keep the pipe clean during laying and joining.

303.3.03 Laying Pipe on Curves
The contractor shall lay pipe on horizontal or vertical curves in accordance with the manufacturer's recommendations.

303.3.04 Concrete Closure Collars
Concrete closure collars shall be used only when approved, and then only to make connections between dissimilar pipe or where standard rubber gasketed joints are impractical. The collars shall be placed using an approved commercial concrete bonding agent applied to all surfaces in contact with the collar. Where concrete closure collars are necessary to join PVC pipe, the PVC surface shall first be prepared for bonding to the concrete by applying a dense coating of clean mortar sand to the pipe using PVC solvent cement. After the cement has cured, an approved commercial concrete bonding agent shall be applied to the sand surface prior to placement of the concrete.

303.3.05 Installation of Service Tees and Wyes
The contractor shall provide a compacted base of pipe bedding material under all tees, wyes and branch fittings, extending to the springline of the fittings.

Service lines may not be connected to manholes unless approved by the engineer.

All service lines shall be capped with watertight plugs or caps suitable for resisting the pressures of hydrostatic or air testing.

The maximum line or grade change accomplished with any one fitting shall not exceed 45 degrees and shall be accomplished with long radius curves or bends.

303.3.06 Pipe Placing and Jointing
Trench excavation, bedding, and backfill shall be in accordance with Section 301.

303.3.06A General
Pipe laying shall proceed upgrade with spigot ends in the direction of flow. Joints will be assembled in accordance with the recommendations of the manufacturer of the type of joint used. The trench bottom shall form a continuous and uniform bearing and support for the pipe at every point between joints.

The contractor shall prevent excavated or other foreign material from getting into the pipe. The contractor shall plug or close off pipes which are stubbed off for future connection. When cutting and/or machining of the pipe is necessary, the contractor shall use only the tools and methods recommended by the pipe manufacturer.

303.3.06B Concrete and Ductile Iron Pipe
Elliptical reinforced pipe shall be laid so that the top or bottom marks are not more than 5 degrees from vertical.

303.3.06C PVC Pipe
The pipe shall be joined in conformance with the manufacturer's recommendations.

The contractor shall cut the pipe in a neat manner, at right angles to the axis of the pipe, and shall dress the cut end in conformance with the pipe manufacturer's recommendations.

303.3.07 Deflection at Joints

When deflecting the pipe from a straight line, either in the vertical or horizontal plane, or when long radius curves are shown, the amount of deflection allowed shall not exceed that recommended by the pipe manufacturer.

303.3.08 Requirements Prior to Tests

303.3.08A General

All gravity systems and appurtenances shall successfully pass a hydrostatic or air test prior to acceptance and shall be free of visible infiltration of water. Information regarding air testing may be obtained from the engineer. Manholes shall be tested as specified in Section 306.

On pipe 30 inches in diameter and larger, individual joints may be tested by an approved joint testing device. All details of the testing procedure shall meet the approval of the engineer.

303.3.08B Plugging of Tees, Wyes, Stubs, and Service Connections

The contractor shall plug all wyes, tees, stubs, and service connections with gasketed caps or plugs securely fastened or blocked to withstand test pressures.

303.3.08C Testing Equipment

The contractor shall furnish all necessary testing equipment and perform the tests in a manner satisfactory to the engineer. Any arrangement of testing equipment which will provide observable and accurate measurements of either air or water leakage under the specified conditions will be permitted. Gauges shall be calibrated and certified at the direction of the engineer. The certification shall be available with the gauge.

303.3.08D Cleaning

Prior to the testing and inspection of the system the contractor shall flush and clean all parts of the system and remove all debris.

303.3.09 Pipe and Joint Testing

303.3.09A General

After completion of the system, including service connections, and backfilling and compaction, the contractor shall conduct a low-pressure air test or a hydrostatic test. The contractor shall provide all equipment and personnel for the test. Tests shall be conducted during normal working hours.

The method, equipment and personnel used in testing shall be subject to the approval of the engineer. The engineer may, at any time, require a calibration check of the instrumentation used. The engineer may require testing of manhole-to-manhole sections as they are completed in order to expedite the acceptance of the system and allow connections.

303.3.09A1 Safety Precautions

Only qualified personnel will be permitted to conduct the test. All plugs used to close the sewer for the testing shall be capable of resisting the expected internal pressures and shall be securely braced, if necessary.

Testing equipment shall be placed above ground and personnel will not be permitted to enter a manhole or trench while a line is pressurized. The air or water pressure shall be released before the plugs are removed.

303.3.09A2 Ground Water

The presence of ground water will affect the results of the test. The contractor shall determine the average height of ground water over the lines immediately before starting the test. The method of checking the ground water height shall be as approved.

303.3.09B Hydrostatic Testing

Pipe and joints shall sustain losses not exceeding 0.04 gallons per hour per inch diameter per 100 feet when field tested by exfiltration methods.

The hydrostatic head for test purposes shall exceed the maximum estimated ground water level in the section being tested by at least 72 inches and in no case shall be less than 72 inches above the inside top of the highest section of pipe in the test section, including service connections. The engineer shall make the final decisions regarding test

height for the water in the pipe section being tested. The length of pipe tested by exfiltration shall be limited so that the pressure on the invert of the lower end of the section shall not exceed 28 feet of water column.

The pipe test section may be filled 24 hours prior to time of exfiltration testing, if desired, to permit normal absorption into the pipe walls to take place.

All service connection footage shall be taken into account in computing allowable leakage.

303.3.09C Air Testing

303.3.09C1 General

The pressure gauge used in air testing shall have minimum divisions of 0.10 psi and have an accuracy of 0.0625 psi (one ounce per square inch). All air used shall pass through a single control panel.

303.3.09C2 Method

All air testing shall be by the Time Pressure Drop Method. The test procedures are described as follows.

a) The contractor may wet the lines prior to testing.

b) Determine the average height of the ground water over the line. The test pressures required shall be increased 0.433 psi for each foot of average water depth over the exterior crown of the pipe.

c) Add air slowly to the section of system being tested until the internal air pressure is raised to 4.0 psig greater than the average back pressure due to ground water.

d) After the test pressure is reached, allow at least two minutes for the air temperature to stabilize adding only the amount of air required to maintain pressure.

e) After the temperature stabilization period, disconnect the air supply.

f) Record the time in seconds that is required for the internal air pressure to drop from 3.5 psig to 2.5 psig greater than the average back pressure due to ground water.

g) Compare the time recorded in step f) with the time determined in subsection 303.3.09C3.

303.3.09C3 Acceptance

The tested section shall be considered acceptable if it does not lose air at a rate greater than 0.003 cfm per square foot of internal pipeline surface, or 2 cfm, whichever is greater.

This specification shall be satisfied if the time measured by the preceding described method is not less than the time as computed according to the following procedure.

a) Record the diameter in inches and the length in feet of all pipe in the section to be tested, including the service connections, in a table similar to the following.

Diameter Inches	Length Feet	K = $0.011d^2L$	C = $0.0003882dL$
		_____	_____

Total of "K" and "C" values:

Time Required by Specification = _____seconds.
Actual Time as Determined by Test = _____seconds.

b) Using the nomograph at the end of this section, place a straightedge from the "d" column (diameter in inches) to the "L" column (length in feet). Read the corresponding "K" and "C" values and record them in the table.

c) Add all values of "K" and all values of "C" for the section being tested.

d) If the total of all the "C" values is less than one, the time shall be the total of all the "K" values.

e) If the total of all the "C" values is more than one, the time shall be found by dividing the total of all the "K" values by the total of all the "C" values. The quotient is the maximum test time. To make this division with the nomograph, use the scales "C" and "K" and read the quotient (time) from the "t q" scale.

f) In the event that the "d" and "L" values for a particular section of the system do not fall within the limits of the nomograph, the values of "K" and "C" may be computed from the following equations: "K" = $0.011d^2L$; "C" = 0.0003882dL.

303.3.09D Individual Joint Testing

303.3.09D1 General

The contractor may test each individual joint for leakage using a pneumatic joint testing apparatus.

The method, equipment, and personnel used in individual joint testing shall be subject to the approval of the engineer. The engineer may, at any time, require a calibration check of the instrumentation used. The pressure gauge used shall have minimum divisions of 0.10 psi and have an accuracy of 0.0625 psi (one ounce per square inch). All air used shall pass through a single control panel.

303.3.09D2 Method

All air testing shall be by the Time Pressure Drop Method. The test procedures are described as follows.

a) Determine the average height of the ground water over the line. The test pressures required below shall be increased 0.433 psi for each foot of average water depth over the exterior crown of the pipe.

b) Add air slowly to the section of system being tested until the internal air pressure is raised to 4.0 psig greater than the average back pressure due to ground water.

303.3.09D3 Acceptance

The joint shall be considered acceptable if it does not lose air at a rate greater than 0.003 cfm per square foot of internal pipeline surface tested, or 2 cfm, whichever is greater.

303.3.10 Deflection Testing for Flexible Pipe

In addition to hydrostatic or air testing, the contractor shall conduct deflection tests of sanitary sewers constructed of flexible pipe. The testing shall be conducted by pulling an approved mandrel through the completed pipeline. The diameter of the mandrel shall be 95 percent of the pipe initial inside diameter.

Testing shall be conducted on a manhole to manhole basis and shall be done after the line has been completely flushed out with water. The tests shall be conducted not less than 30 days after the trench backfill and compaction has been completed and may be conducted concurrently with television inspection.

303.3.11 Television Inspection of Sanitary Sewers

Upon completion of all sewer construction, testing and repairs, the contractor shall conduct a color TV acceptance inspection of all installed lines 6 inches to 72 inches. Unless otherwise directed, the contractor shall also conduct a subsequent warranty TV inspection of all installed lines. Warranty TV inspections shall be in color and shall be conducted during the warranty period in a season of high groundwater conditions as defined by the engineer. The acceptance inspection and the warranty inspection shall be conducted by an approved technical service which is equipped to make audio-visual tape recordings of the televised inspections.

The audio-visual recordings shall be compatible with the owner's playback equipment. The contractor shall ensure that recording equipment is functioning properly and that a clear and usable record is made of all possible defects. The equipment used for recording shall be equipped with a footage meter which records a visual record on the tape. A voice accounting of suspected deficiencies shall be made on the sound track.

A written report shall be made at the time of each television inspection. This report shall be made on a form approved by the engineer. The video record and the written report of the acceptance inspection and the warranty inspection shall be submitted to the engineer and will become the property of the owner.

The audio and visual reports of the acceptance inspection and the warranty inspection shall include identification of individual groundwater infiltration sources such as sewer laterals, building sewer connections and construction defects.

303.3.12 Repairs

The contractor shall locate and repair any sections failing to pass the required tests and inspections and shall then repeat the specified tests and inspections on those sections at no expense to the owner.

Following a successful hydrostatic or air test, visible infiltration of ground water in any section shall be considered evidence that the original test was in error or that failure of the section has occurred. The contractor shall correct such failures, and retest the repaired sections, at no expense to the owner.

303.4.00 Measurement and Payment

303.4.01 Sewer Pipe

Sewer pipe will be measured and paid for on a lineal foot basis, to the nearest foot, for each size and type listed in the bid schedule. Measurement will be along the pipe from center to center of manholes and other structures, or to the end of the pipe where no structures exist, with no deduction for structures and fittings.

Payment shall constitute full compensation for the pipe in place, including hydrostatic and air testing. Payment will be made for pipe in place only after the pipe has successfully passed the air or hydrostatic, TV acceptance tests.

303.4.02 Tee and Wye Fittings

Tee and wye fittings will be paid for at the unit prices listed in the bid schedule. Payment for tee and wye fittings will be in addition to payment for sewer pipe.

303.4.03 Concrete Encasement of Tees and Wyes

Concrete tee and wye encasement will be paid for at the unit prices listed in the bid schedule.

303.4.04 Concrete Closure Collars

Concrete closure collars will be paid for at the unit prices listed in the bid schedule.

303.4.05 Television Inspection

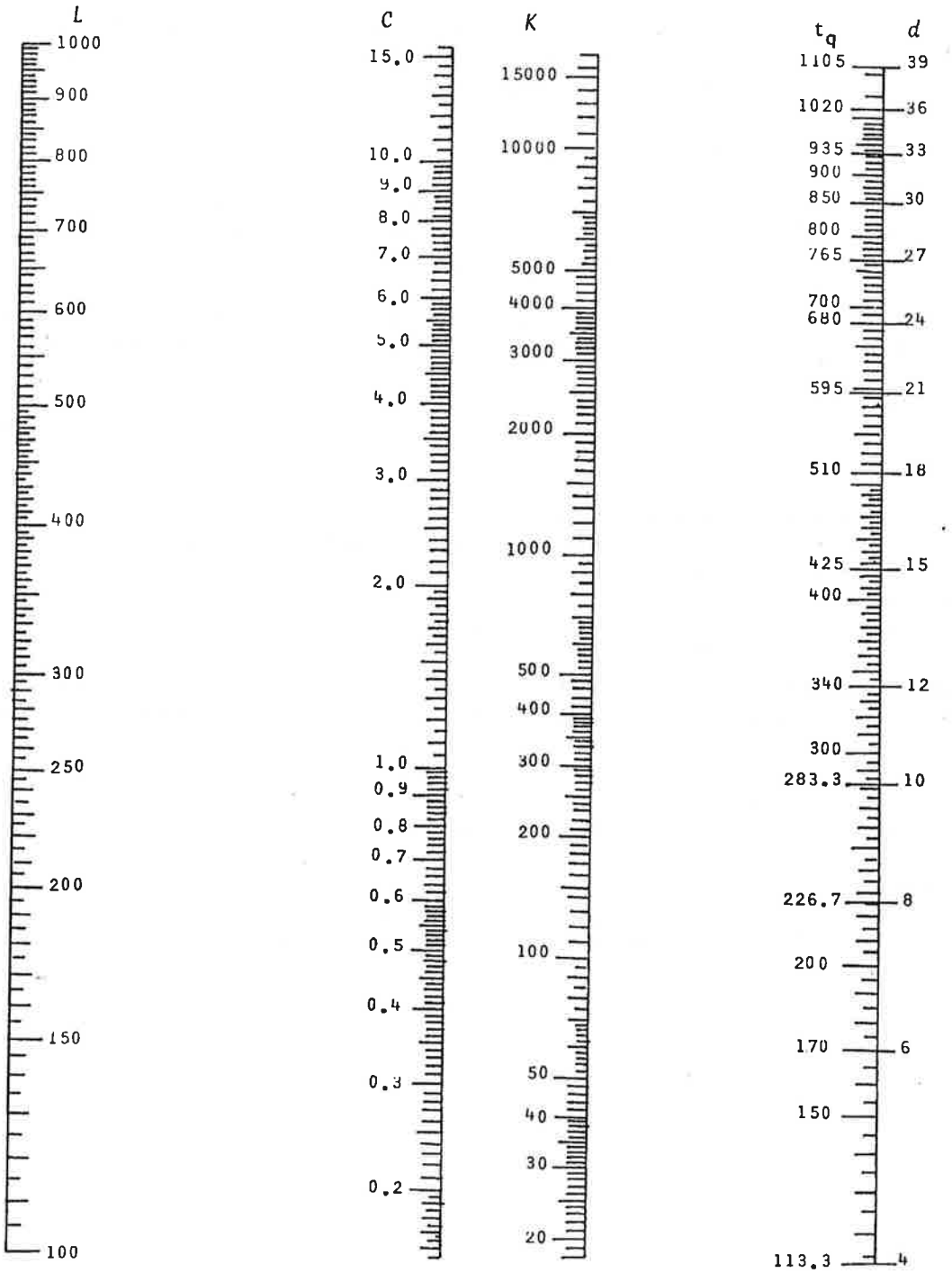
TV inspection will be measured and paid for on a lineal foot basis, to the nearest foot, for the length of pipe inspected and accepted by the engineer.

303.4.06 Deflection Testing

Deflection testing of flexible pipe shall be considered incidental work.

303.4.07 Incidental Basis

When not listed in the Bid Schedule, wye and tee fittings, concrete encasement of fittings, concrete closure collars, television inspection and deflection testing will be incidental to the work and no separate payment will be made for these items.



Nomograph for the solution of $K = .011d^2L$, $C = .0003882dL$, $t_q = K+C$

3

304 Service Line Sewers

304 Service Line Sewers

304.1.00 Description

This work consists of the installation of sewer service lines and connections.
Sewer service lines normally extend from the sewer main to the street, alley or easement right of way line.

304.2.00 Materials

304.2.01 Excavation and Backfill

The contractor shall conform to the applicable requirements of Section 301.

304.2.02 Rock Excavation

The contractor shall conform to the requirements of Section 301.

304.2.03 Pipe and Fittings for Service Lines and Cleanouts

304.2.03A General

Pipe and fittings for service lines shall be of one type of material throughout; no interchanging of pipe and fittings will be allowed.

304.2.03B Concrete Pipe

Concrete pipe shall conform to the requirements of ASTM C 14.

304.2.03C Cast Iron Pipe

Cast iron pipe shall conform to the requirements of ASTM A 74 Class 150.

304.2.03D Ductile Iron Pipe

Ductile iron pipe shall conform to the requirements of ANSI A21.51 or AWWA C 151, with push-on joint or mechanical joints as specified, conforming to AWWA C 111 or ANSI A21.11. Ductile iron pipe shall be lined with cement mortar and seal coated in accordance with ANSI A21.4 and AWWA C 104.

304.2.03E Polyvinyl Chloride (PVC) Pipe

PVC pipe shall conform to the requirements of ASTM D 3034 or F 794.

304.2.04 Pipe Joints

Pipe joint materials shall conform to the requirements of Section 303.

304.2.05 Cleanouts

Cleanouts shall be constructed of rigid pipe materials and fittings.

304.2.06 Imported Pipe Zone and Pipe Bedding Material

Imported pipe zone and pipe bedding material shall conform to the requirements of Section 301.

304.2.07 Service Connection Markers

Service connection markers shall be as specified in the standard details.

304.3.00 Construction

304.3.01 General

New construction shall conform to the applicable portions of Sections 301 and 303. Connection of service lines to existing sanitary sewers shall conform to the requirements of Section 308.

Service lines and grades shall be as shown on the City of Lowell Standard Details

The contractor shall install the pipe on a uniform grade between the tee or wye and the property line clean-out. Minimum slope shall be 1/4 inch per foot unless otherwise directed by the engineer. The sewer tee or wye shall be located so the service connection pipe will be within a horizontal distance of 1 foot of the staked location.

304.3.02 Imported Pipe Zone and Pipe Bedding

Imported pipe zone and pipe bedding material will be furnished and placed in accordance with Section 301.

304.3.03 Trench Backfill
Construction shall be in accordance with the requirements of Section 301.

304.3.04 Disposal of Excess Material
The contractor shall dispose of excess material in accordance with the requirements of Section 301.

304.3.05 Dewatering
Dewatering shall be in accordance with Section 301.

304.3.06 Installation of Pipe, Fittings, and Cleanouts
The service line pipe shall be installed upgrade from the connection to the lateral or main with bell or coupling ends upgrade. The maximum deflection permissible with any one fitting shall not exceed 45 degrees.

Service lines may be connected to manholes only when directed. When permitted, this type of connection shall be made so that a pipe joint is located not more than 1 foot from the manhole.

The ends of all service lines and fittings shall be capped with approved watertight plugs or caps which are capable of withstanding testing pressures.

The contractor shall install a cleanout at the termination of the service lines. Cleanouts shall include, but not be limited to, excavation and backfill, carrier pipes containing wyes, bends, riser pipes, mechanical plugs on carrier pipes, mechanical plugs on riser pipes, and cast iron rings and covers.

304.3.07 Deep Connections
When the slope of a service line is greater than 45 degrees, the connection shall be constructed in conformance with the standard drawing for deep connections.

304.3.08 Culverts
Removal and replacement of culverts shall conform to the requirements of Section 305.

304.3.09 Existing Service Lines
The contractor shall disconnect existing service lines from sewers to be abandoned and reconnect them to the new sewers. The contractor shall locate the existing service lines prior to installing tees or wyes in the new sewer line.

304.3.10 Markers
The contractor shall install markers at the ends of those service lines not scheduled for user connection under the contract.

The markers shall be installed so as to extend from the end of the service line to 30 inches above the ground surface.

304.3.11 Testing
Testing of the service lines shall be included in testing of the sewer lines and shall conform to the requirements of Section 303.

304.4.00 Measurement and Payment
304.4.01 Sanitary Sewer Service
Sanitary service laterals (long, short or deep), including wyes, tees, all other fittings required, clean-out, marker, pipe and testing as required by these specifications and as shown on the construction drawings and standard details will be paid for on a per each basis as listed in the bid schedule.

304.4.02 Reconnect Existing Sewer Service
Reconnection of existing sewer services shall be measured on a per each basis and payment shall be made for each sewer service disconnected, abandoned and reconnected to the new line as listed on the Bid Schedule

305 Storm Drain Pipe and Fittings

305 Storm Drain Pipe and Fittings

305.1.00 Description

This work consists of the construction of surface and subsurface drainage facilities.

305.2.00 Materials

305.2.01 Galvanized Corrugated Steel Pipe and Fittings

Galvanized corrugated steel pipe and fittings shall conform to the requirements of AASHTO M 36 or M 167.

When specified, the surfaces of corrugated steel pipe shall be completely coated with bituminous material conforming to AASHTO M 190, with a minimum thickness of 0.05 inch at the crest of the corrugations.

305.2.02 Corrugated Aluminum Alloy Pipe and Fittings

Corrugated aluminum alloy pipe and fittings shall conform to the requirements of AASHTO M 196, M 197, M 211, and M 219.

305.2.03 Reinforced Concrete Pipe and Fittings

Reinforced concrete pipe and fittings shall conform to the requirements of ASTM C 76 or ASTM C 655.

305.2.04 PVC Pipe and Fittings

PVC pipe and fittings shall conform to the requirements of ASTM D 3034, ASTM F 679 or F 794 and have a minimum wall stiffness of 46 psi or an SDR of 35.

305.2.05 Polyethylene (PE) Pipe and Fittings

Polyethylene pipe and fittings shall be made of polyethylene compounds which conform with the physical requirements of Type III, Category 3, 4, or 5, P23, P33, P34, Class C, with the applicable requirements defined in ASTM D 1248. PE pipe and fittings shall also conform to AASHTO M 294.

305.2.06 Galvanized Corrugated Steel Pipe Arches and Fittings

Galvanized corrugated steel pipe arches and fittings shall conform to the requirements of AASHTO M 36 and AASHTO M 136.

305.2.07 Corrugated Aluminum Alloy Pipe Arches and Fittings

Corrugated aluminum alloy pipe arches and fittings shall conform to the requirements of AASHTO M 196 and AASHTO M 197.

305.2.08 Galvanized Corrugated Steel Structural Plate Arches

Galvanized corrugated structural steel plate pipe, arches and pipe arches shall conform to the requirements of AASHTO M 167, except there shall be no limitation to the weight of a single plate. After galvanizing and corrugating, the base metal for structural plate shall also conform to the following mechanical requirements:

Tensile Strength	45,000 psi min.
Yield Point	33,000 psi min.
Elongation in 2 inches	20% min.

Tension test specimens shall be prepared and tested in accordance with ASTM A 446, except specimens shall be cut from the flat test portion of the roll with the specimen length parallel to the corrugation.

305.2.09 Aluminum Structural Plate Arches

Aluminum structural plate arches shall conform to the requirements of AASHTO M 219.

305.2.10 Perforated Galvanized Corrugated Steel Pipe and Fittings

Perforated galvanized corrugated steel pipe and fittings shall conform to the requirements of AASHTO M 36 or AASHTO M 167.

305.2.11 Perforated Corrugated Aluminum Alloy Pipe and Fittings

Perforated corrugated aluminum alloy pipe and fittings shall conform to the requirements of AASHTO M 197.

305.2.12 Perforated PVC Pipe and Fittings
Perforated PVC pipe and fittings shall conform to the requirements of ASTM 3034 and ASTM 2729.

305.2.13 Perforated Polyethylene Pipe and Fittings
Perforated polyethylene pipe and fittings shall conform to the requirements of ASTM F 405 and ASTM F 667.

305.2.14 Cement Mortar and Nonshrink Grout
Cement mortar and nonshrink grout shall conform to the applicable requirements of Section 306.

305.2.15 Jointing Materials
Jointing materials for concrete and PVC shall conform to the applicable requirements of Section 303.

305.2.16 End Sections

305.2.16A Galvanized Corrugated Steel Pipe
End sections shall conform to the requirements of AASHTO M 36.

305.2.16B Corrugated Aluminum Alloy Pipe
End sections shall conform to the requirements of AASHTO M 196 and AASHTO M 211.

305.2.16C Reinforced Concrete Pipe
End sections shall conform to the requirements of ASTM C 76.

305.2.17 Cleanouts
Cleanouts shall be constructed of rigid pipe materials and fittings.

305.2.18 Filter Material
Filter material shall be coarse sand, crushed or uncrushed gravel, rock or combinations thereof, and shall be 3/4"-0.

SIEVE ANALYSIS

Sieve Size Passing	Percent by Weight
3/4 inch	100
1/4 inch	30-60
No. 8	20-50
No. 30	8-30
No. 50	3-12
No. 200 (wet sieve)	0-1

305.2.19 Drainage Geotextile Fabric
The fabric shall be composed of a polymeric yarn or fiber oriented into a stable network which retains its relative structure during handling, placement, and design service life. The fabric shall be free of any chemical treatment or coating which might significantly reduce permeability. The selvage of fabric shall be such that the outer fibers are prevented from pulling away from the fabric.

305.2.19A Drainage Geotextile Fabric Requirements
Both woven and nonwoven fabrics are acceptable. Slit film or slit tape fabrics will not be permitted.

Geotextile Fabric Property	Test Method	
Grab tensile strength, lbs.	ASTM D 1682 Modified	80 min.
Grab elongation, percent	ASTM D 1682 Modified	15 min.
Burst strength (diaphragm method), psi.	ASTM D 3786 Modified	130 min.
Puncture strength, lbs.	ASTM D 3787 Modified	80 min.
AOS (Apparent Opening Size), ... U.S. Std. sieve	OSHD TM 815	50-100
Water permeability, cm./sec.	ASTM D 4491	0.01 min.

305.3.00 Construction

305.3.01 Installation

Pipe laying shall begin at the downstream end of the pipe line. The lower segment of the pipe shall be in contact with the shaped bedding 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. The lower segment of the pipe shall be in contact with the shaped bedding throughout the full length of the pipe.

Paved invert or partially lined pipe shall be laid so that the longitudinal centerline of the paved segment coincides with the flow line. Elliptical and elliptically reinforced pipe shall be placed with the major axis within 5 degrees of vertical.

All field joints made in the joining of sections of pipe to form culverts and sewers, and to connect to structures and special sections, shall be closely fitted, tight, and shall provide a smooth and uniform interior surface. The joints shall secure and hold adjoining sections to each other and shall fasten securely to adjoining structures and special sections.

Perforated pipe shall be placed with the perforations facing down. The pipe shall be inspected prior to lowering into the trench and cleaned of any material that may plug the perforations of the pipe. Pipe sections shall be securely fastened together with couplings, fittings or bands as specified by the manufacturer for the type of pipe used. Upgrade ends of all subsurface drain pipe shall be capped with approved plugs.

305.3.02 Granular Drain Rock

The granular drain rock shall provide a firm unyielding support along the entire pipe length.

305.3.03 Television Inspection

Television inspection shall conform with the requirements of Section 303.

305.3.04 Deflection Testing

Flexible pipe shall be deflection tested in accordance with the requirements of Section 303.

305.3.05 Repairs

The contractor shall locate and repair any sections failing to pass the required tests and inspections and shall then repeat the specified tests and inspections on those sections at no expense to the owner.

305.4.00 Measurement and Payment

305.4.01 Storm Drain Pipe

Storm drain pipe will be measured and paid for on a lineal foot basis, to the nearest foot, for each size and type listed in the bid schedule. Measurement will be horizontally from center to center of manholes, catch basins, or other structures, or to the end of the pipe where no structures exist, with no deduction for structures or fittings.

Payment shall constitute full compensation for the pipe in place, including deflection testing. Payment will be made for pipe in place only after the pipe has successfully passed the deflection and TV acceptance tests.

305.4.02 Perforated Drain Pipe

Perforated drain pipe will be measured and paid for on a lineal foot basis, to the nearest foot, for each size and type listed in the bid schedule. Filter material will be considered incidental to the construction of perforated drain pipe.

305.4.03 Pipe Arches and Plate Arches

Pipe arches and plate arches will be measured and paid for on a lineal foot basis, to the nearest foot, for each size and type listed in the bid schedule.

305.4.04 End Sections

End sections will be paid for at the unit price for each size and type listed in the bid schedule.

305.4.05 Tee and Wye Fittings

Tee and wye fittings will be paid for at the contract unit price for each size and type listed in the bid schedule. Payment for tee and wye fittings will be in addition to payment for pipe.

305.4.06 Drainage Geotextile Fabrics

Geotextile fabric used in trench applications will be measured horizontally and paid for on a lineal foot basis, to the nearest foot, for the length of trench the fabric is used in. No separate measurement will be made for construction of laps, seams, joints, or patches, unless the engineer orders more than the specified lap, in which case the added lap width will be included in the measurement.

305.4.07 Television Inspection

TV inspection will be measured and paid for in conformance with Section 303.

305.4.08 Deflection Testing

Deflection testing of flexible pipe shall be considered incidental work.

305.4.09 Incidental Work

When not listed on the Bid Schedule, end sections, fittings, television inspection and testing shall be considered incidental to the work and no separate payment shall be made for these items.

306 Manholes

306 Manholes

306.1.00 Description

This work consists of the construction and installation of manholes.

306.2.00 Materials

306.2.01 Cast-in-Place Concrete Manholes

306.2.01A Aggregates

Aggregates shall conform to the requirements of Section 212.

306.2.01B Portland Cement and Portland Cement Concrete (PCC)

Portland cement and PCC shall conform to the requirements of Section 212 and shall be Class 3000.

306.2.01C Metal Reinforcement

Metal reinforcement shall conform to the requirements of ASTM A 615, grade 60, deformed bars.

306.2.01D Forms

Exterior surfaces shall be formed with steel or plywood. Other surfaces shall be formed with matched boards, plywood, or other approved material. Trench walls, rock, or earth will not be acceptable form material.

306.2.02 Precast Concrete Manholes

Materials shall conform to the requirements of ASTM C 478 and the Standard Details of the City of Lowell. Minimum wall thickness shall be 4 inches. Cones shall have the same wall thickness and reinforcement as riser sections.

Prior to delivery of precast manhole sections to the job site, yard permeability tests may be required at the point of manufacture. The precast sections to be tested will be selected at random from the stockpiled material which is to be supplied to the project. All test specimens will be mat tested, and shall meet the permeability test requirements of ASTM C 14.

Precast manhole sections shall consist of circular sections in standard nominal inside diameters of 42, 48, 54, 60, 72, 84, or 96 inches. Heights of sections shall be multiples of 12 inches. Heights of manhole sections 72 inches through 96 inches in diameter shall be as required to fit site conditions. Other sections shall be 24-inch riser and flattop sections.

306.2.03 Precast Bases

Precast manhole bases may be used provided all the details of construction are approved prior to construction.

306.2.04 Metal Castings

306.2.04A General

Manhole covers shall be designed so they may be secured to the frames. Matching surfaces of covers and frames shall be flat to prevent any movement of covers within the frames. Covers and frames shall be interchangeable.

306.2.04B Cast Iron

Cast iron materials shall conform to the requirements of ASTM A 48, Class 30B. The foundry shall certify as to the tensile and transverse properties and the Brinell Hardness. The owner reserves the right to require a rough transverse bar (size of bar 1.2 inches in diameter by 20 inches long) and/or a tensile bar as per ASTM A 48 for each 20 castings or heat when less than 20 castings are made.

306.2.04C Aluminum

Aluminum materials shall be cast of an aluminum alloy meeting Federal Specification RR-F-621B for 20,000 lb loading. All frame castings shall be coated with a resin-type protective coating. The coating shall be sufficient thickness to protect the metal from outside elements.

306.2.05 Cap Screws

Cap screws and washers for watertight manhole covers shall be stainless steel with 60,000 psi minimum tensile strength conforming to the requirements of ASTM A 453.

306.2.06 Joint Materials

306.2.06A Mortar

Mortar shall conform to the requirements of ASTM C 387, or be proportioned one part Type II portland cement to two parts clean, well-graded sand which will pass a 1/8 inch screen. Admixtures may be used not exceeding the following percentages of weight of cement: hydrated lime, 10 per cent; diatomaceous earth or other inert materials, 5 percent. The consistency of the mortar shall be such that it will readily adhere to the precast concrete if using the standard tongue-and-groove type joint. Mortar mixed for longer than 30 minutes shall not be used.

306.2.06B Non-Shrink Grout

Non-shrink grout shall be Sika 212, Euco N-S, Five-Star, or approved non-metallic cementitious commercial grout exhibiting zero shrinkage per ASTM C-827 and CRD-C-621. Grout shall not be amended with cement or sand and shall not be reconditioned with water after initial mixing. Unused grout shall be discarded after 20 minutes and shall not be used.

Non-shrink grouts shall be placed or packed only with the use of an approved commercial concrete bonding agent applied to all cured concrete surfaces being grouted. The bonding agent shall be compatible with the brand of grout used. Water shall not be used as a substitute for the commercial bonding agent.

306.2.06C Preformed Plastic Gaskets

Preformed plastic gaskets shall meet all the requirements of ASTM C 990.

306.2.06D Rubber Gaskets

Materials shall conform to ASTM C 443.

306.2.07 Manhole Steps

Manhole steps shall conform to the requirements as listed below:

Structural Steel Galvanized	ASTM M 111 and A 123
Reinforcing Steel Galvanized	ASTM A 615 and A 123
Plastic with Reinforcing Steel	ASTM C 478 and A 615

306.2.08 Pipe Anchors

Anchor bolts and anchor straps for inside drop pipe connections shall be stainless steel.

306.2.09 Pipe and Fittings

Pipe and fittings shall conform to the applicable portions of Sections 303 and 305. Tees, ells and other fittings for drop manholes shall be of the same material as the pipe in the adjacent trench.

306.2.10 Pipe Stubouts for Service Connections

Pipe stubouts for service connections shall conform to the applicable portions of Section 304 and are to be of the same size and kind of material as the service connection pipes.

306.2.11 Pipe Stubouts for Future Sewer Connections

Pipe stubouts shall be the same type as approved for use in the lateral, main or trunk sewer construction. Strength classifications shall be the same class as in adjacent trenches. Where there are two different classes of pipe at a manhole, the higher strength pipe will govern strength classification. Watertight plugs shall be furnished with each stubout and shall be adequately braced against hydrostatic or air test pressures.

306.2.12 Manhole Carry-Through

All carry-through pipes and fittings shall be ductile iron conforming to Section 402.

306.3.00 Construction

306.3.01 General

306.3.01A Foundation Stabilization

If, in the opinion of the engineer, unstable material exists that will not support the manhole or other structure, the contractor shall excavate below grade and backfill with trench foundation stabilization material in accordance with Section 301.

306.3.01B Pipe Connections
Special care shall be taken to see that the openings through which pipes enter the structure are completely watertight. All pipe shall be connected to manholes according to the manufacturer's recommendations.

Concrete pipe connections to sanitary manholes shall be grouted watertight with non-shrink grout conforming with subsection 306.2.06B.

PVC pipe shall be connected to sanitary manholes using an approved adapter specifically manufactured for the intended service. PVC pipe adapters shall be Fernco CMA, Romac LCT, Tylox Manhole Adapters, Vassally Series 32850, Kor-N-Seal, Sealtite, Z-Lok-XP, or approved equal commercial products. Field-fabricated waterstops or improvised adapters shall not be used. Adapters requiring the use of grout for installation shall be anchored and finished using non-shrink grout conforming with subsection 306.2.06B.

306.3.02 Precast Concrete Manholes
Precast manhole components may be used to construct standard, drop, and carry-through manholes. Sanitary manholes less than 4 feet in depth measured from the springline of the pipe to the bottom of the lower riser ring shall be flat-top manholes.

306.3.02A Bases
If bases are cast in place, the concrete shall be consolidated by mechanical vibration. The concrete shall be screeded off in such a manner such that the first manhole section to be placed has a level uniform bearing for the full circumference.

If bases are precast, the base section shall be carefully placed on the prepared bedding so as to be fully and uniformly supported at true grade and alignment.

The invert shall be constructed to a section identical with that of the sewer pipe. Where the size of sewer pipe is changed at the manhole, the invert shall be constructed to form a smooth transition without abrupt breaks or unevenness of the invert surfaces. Where a full section of concrete sewer pipe is laid through the manhole, the top shall be broken out to the spring line of the pipe for the full width of the manhole, and the exposed edge of the pipe completely covered with mortar. During construction, the contractor shall divert existing flows of water or sewage from new concrete or mortar surfaces to prevent damage to the fresh concrete or mortar until the initial set has been achieved.

306.3.02B Precast Manhole Sections
All lift holes shall be thoroughly wetted, then completely filled with nonshrink grout, and smoothed and pointed both inside and out to ensure watertightness.

Preformed plastic or rubber gaskets shall be used on all sanitary manholes. Mortar will be allowed on storm manholes, and on 24-inch extension rings above the cone. All mortar joints between precast elements shall be thoroughly wetted, then completely filled with mortar. On proposed street grades, a minimum of one 24-inch precast riser will be required between the cone and manhole cover frame.

306.3.02C Grates, Frames, and Covers
Manhole frames, grates and covers shall be installed in such a manner as to prevent infiltration of surface or ground water between the frame and the concrete of the manhole section. All mortared sanitary sewer manhole necks and all riser ring joints made with mortar shall be constructed using an approved commercial concrete bonding agent applied to all cured concrete surfaces being mortared. No joints, necks or frames on sanitary manholes shall be mortared without an approved bonding agent.

306.3.03 Sanitary Manhole Testing
The contractor shall be responsible for process control testing of sanitary manholes and may conduct such tests as necessary during the construction process. The tests required in this subsection are for the information of the engineer. The results of the tests will not indemnify the contractor of responsibility for defects in the construction.

All sanitary sewer manholes shall be tested for acceptance by either hydrostatic or vacuum testing after completion of backfilling, compaction and surface restoration, including paving. If the manhole fails the test, necessary repairs shall be made by an approved method, and the manhole retested. The manhole shall be repaired and retested until a satisfactory test is obtained.

306.3.03A Hydrostatic Testing
The hydrostatic test shall consist of plugging all inlets and outlets and filling the manhole with water. Each manhole shall be filled to the rim at the start of the test. Leakage in each manhole shall not exceed 0.2 gallons per hour per foot of head above the invert. Leakage shall be determined by refilling to the rim using a calibrated known-volume container. Manholes may be filled 24 hours prior to the time of testing to permit normal absorption into the manhole walls.

306.3.03B Vacuum Testing
Vacuum testing shall be done in accordance with ASTM C 1244-93. All pipes entering the manhole shall be temporarily plugged, and plugs shall be braced. The test head shall be placed in or on top of the manhole ring. A vacuum of 10 inches of mercury shall

be drawn on the manhole, the valve on the vacuum line of the test head closed, and the vacuum pump shut off. The time shall be measured for the vacuum to drop to 9 inches of mercury. The manhole shall pass if the time for the vacuum reading to drop from 10 inches of mercury to 9 inches of mercury meets or exceeds the values indicated in the table below.

MINIMUM TEST TIMES FOR VARIOUS MANHOLE DIAMETERS

	Diameter In.								
	30 or less	33	35	42	48	54	60	66	72
*Depth (ft)	**Time, Seconds								
8 or less	11	12	14	17	20	23	26	29	33
10	14	15	18	21	25	29	33	36	41
12	17	18	21	25	30	35	39	43	49
14	20	21	25	30	35	41	46	51	57
16	22	24	29	34	40	46	52	58	67
18	25	27	32	38	45	52	59	65	73
20	28	30	35	42	50	53	65	72	81
22	31	33	39	46	55	64	72	79	89
24	33	36	42	51	59	64	78	87	97
26	35	39	46	55	64	75	85	94	105
28	39	42	49	59	69	81	91	101	113
30	42	45	53	63	74	87	98	108	121

*Depth is measured from the top of the manhole to the lowest invert.
**Test times for manhole depths between those shown in this table may be calculated by interpolation.

306.4.00 Measurement and Payment

Manholes will be paid for at unit price for each size and type listed in the bid schedule.

307 Catch Basins and Inlets

307 Catch Basins and Inlets

307.1.00 Description

This work consists of the construction of catch basins and inlets.

307.2.00 Materials

307.2.01 Concrete

Concrete shall conform to the requirements of Section 212 and shall be Class 3000-1 1/2.

307.2.02 Forms

Forms shall conform to the requirements of Section 306.

307.2.03 Metal Reinforcement

Metal reinforcement shall conform to the requirements of Section 306.

307.2.04 Mortar

Mortar shall conform to the requirements of Section 306.

307.2.05 Cast Iron Frames and Grates

Cast iron frames and grates shall conform to the requirements of Section 306.

307.2.06 Welded Frames and Grates

Welded frames and grates shall be fabricated of steel conforming to ASTM A 7, A 36, or A 373 in accordance with the details shown.

307.2.07 Precast Concrete Units

Precast units shall conform to the requirements of ASTM C 478.

307.3.00 Construction

307.3.01 Excavation and Backfill

Excavation and backfill shall conform to the requirements of Section 301.

307.3.02 Cast-in-Place Catch Basins and Inlets

Forms shall be tight and well braced. The corners shall be chamfered. All water and debris shall be removed.

Immediately after placement, the concrete shall be consolidated with an approved vibrator. Vibration time shall be limited to that necessary to produce satisfactory consolidation without causing segregation. The top surface shall be screeded and exposed surfaces trowelled to a smooth finish free from marks or irregularities. Exposed edges shall be radiused with a steel edging tool. After forms are removed, the contractor shall patch any defects in the concrete with approved mortar mix.

Immediately after removal of forms and final finishing, the concrete shall be treated with an approved curing compound.

307.3.03 Precast Concrete Units

Precast catch basins and inlets shall be installed at the specified line and grade.

307.4.00 Measurement and Payment

Catch basins and inlets will be paid for at unit price for each type and size listed in the bid schedule.

308 Work on Existing Sewers and Structures

308 Work on Existing Sewers and Structures

308.1.00 Description

This work consists of joining new work to existing, abandoning of sewer lines and structures, and adjustment of existing utility structures.

308.2.00 Materials

Materials shall conform to the requirements for the related work.

308.3.00 Construction

308.3.01 Excavation, Bedding and Backfill

Excavation, bedding and backfill shall conform to the requirements of Section 301.

308.3.02 Manholes Over Existing Sewers

308.3.02A General

Construction shall be in accordance with Section 306.

All sanitary sewer manholes shall be tested in accordance with Section 306.

The contractor shall prevent material or debris from entering the line.

Flow shall be maintained at all times. The engineer's approval shall be obtained prior to diverting flows.

308.3.02B Manholes Over Existing Rigid Sewers

Manholes shall be constructed over existing rigid sewers after first cleaning and applying approved commercial concrete bonding agent to all surfaces of the pipe that will be in contact with the manhole.

If the top of the existing rigid pipe is cut out, it shall be cut out to the spring line for the full width of the manhole. The exposed edge of pipe shall be smoothed and pointed with mortar.

308.3.02C Manholes in Existing Flexible Sewers

Manholes constructed in existing PVC and other flexible sewers shall be built with approved water stops or watertight fittings or boots at connections with the existing flexible sewer.

If approved by the engineer, manholes may be constructed over existing PVC sewers and sealed at the manhole wall using the following method: First apply a dense coating of clean mortar sand to all pipe surfaces that will be in contact with the manhole, using PVC solvent cement. After the cement has cured, commercial concrete bonding agent shall be applied to the sand prior to placement of concrete.

308.3.03 Service Line Connections to Existing Sewers

Connections of service lines to existing sewers shall be made watertight. Connection shall be made where possible to existing tees or wyes previously installed and plugged. The plug shall be removed and connection made in accordance with the requirements of Section 303. Transition couplings between dissimilar pipe materials shall be made using approved commercial adapters with stainless steel bands such as Fernco, Caulder, or approved equal.

No service line or building sewer shall be connected to an existing sewer without prior inspection and approval of the pipe for watertightness and proper construction in accordance with the state plumbing code. Previous use of the service line or building sewer for septic tank or other application, or absence of usable cleanouts for accessing the building sewer, shall not excuse the requirement for testing except as may be authorized by the state building codes inspector.

Where tees or wyes for connection are absent or unusable, connection of service lines shall be made with an approved tap such as Sealtite saddle, Fowler tap, Fowler tee, Tap-Tite tee, or approved equal commercial tap. All taps shall not be backfilled until inspected and approved by the engineer.

Taps shall be installed without protrusion into or damage to the existing sewer. The sewer shall be supported and bedding material replaced, as necessary, to prevent settlement of the sewer grade.

308.3.04 Manhole Connections

The contractor shall construct openings in the existing manhole base or barrel as required and construct connections that are watertight and that will provide a smooth flow into and through the manhole. All sanitary sewer pipe connections, including those at invert level as well as penetrations for drop connectors, conduits, and carry-throughs, shall conform to the requirements of Section 306.

The contractor shall provide all diversion facilities and perform all work necessary to maintain flow in existing lines during the connection to the manhole.

308.3.05 Pipe, Manhole, and Catch Basin Removal

Pipe, manholes, and catch basins scheduled for removal shall be removed and disposed of in accordance with Section 204.

308.3.06 Abandoning Pipe in Place

Abandoned pipes shall be cleaned and plugged watertight. Abandoned pipes shall be plugged with gasketed mechanical plugs or non-shrink grout seals as directed by the engineer. Abandoned pipes connected to sewer manholes shall have the plugs or seals installed from the inside of the manhole and the channel shall be reshaped to conform to the standard drawings.

308.3.07 Filling Abandoned Manholes and Catch Basins

Manholes and catch basins scheduled to be abandoned shall be cleaned and have all connecting pipes capped or plugged. Remove the manhole cone or flattop or the catch basin frame and fill the manhole barrel or catch basin with granular material meeting the requirements of Section 301.

308.3.08 Salvaging Frames, Covers and Grates

Frames, covers and grates scheduled for salvage shall be removed by the contractor and stored in an approved location for pickup by the owner. Frames, grates and covers meeting specifications may be salvaged from structures to be adjusted and may be reused in the work if of suitable size and condition. Any items damaged or unfit for reuse shall be replaced with similar items which are comparable in all respects with those which they are to replace and which are adequate for the intended purpose.

Salvaged components to be reused shall be cleaned of foreign material by methods that will not harm the components.

308.3.09 Manhole Adjustment

308.3.09A Concrete and Masonry Manholes

Manholes may be raised or lowered as specified below.

Minor adjustments of manholes shall be defined as adding or removing precast risers.

Major adjustments of manholes shall be defined as adjustments that infringe into the cone section. The cone shall be removed, manhole sections added or removed, and the cone replaced. Risers shall then be used to attain desired grade.

Precast sections removed in the adjusting work may be reused in other adjusting work or in new construction provided they are in good condition and otherwise conform to the specifications. Precast items that are not used in the work will become the property of the contractor.

308.3.09A1 Raising Tops of Manholes

The top of the manhole may be raised by the use of riser rings or reconstructing the neck. Fabricated metal rings or plates may be furnished and used in the adjustment work, provided the metal and its fabrication design is at least equal to the characteristics of strength and support required of the covers or grates to be placed, that a uniform bearing surface is assured, and that positive provisions are made to prevent displacement when in service.

The neck of the manhole shall be recontructed as follows. After existing frames, covers and grates have been removed, the exposed top surface, on which new mortar or concrete is to be placed, shall be chipped away to a depth of 1 1/2 inches to expose or until firm concrete is exposed. The new surface shall be cleaned by brushing and shall be moistened with water at the time of placing new concrete. New concrete shall be placed to the required

grade and cured at least three days, after which the frame shall be seated in fresh mortar and brought to the proper grade.

Masonry manholes of bricks or concrete blocks shall be raised with new bricks, blocks, mortar or combinations thereof or with concrete, as conditions may require or permit. Mortar for building up existing masonry shall not be placed to a depth of more than 3 inches. Concrete shall not be placed to a depth of less than 3 inches. To conform to these requirements, the existing shells or walls of structures to be adjusted shall be cut down as necessary to provide space for the new construction.

The total distance from the top of the metal frame at its new adjusted grade to the top of the cone shall not exceed 18 inches. Riser rings and repairs shall conform with the requirements of Section 306. Manhole barrels of brick, block, or concrete shall be extended in kind.

308.3.09A2 Lowering Tops of Manholes
Where the top of an existing manhole is to be lowered, the top of the structure shall be exposed to the required depth, cut off or removed to an elevation below that established for the bottom of the metal frame or cover, and then be built up with mortar, concrete, or brick or concrete blocks to the required elevation. The joining of new material to old, the minimum thicknesses of new mortar and concrete, the limitations, the curing and other details shall be as specified in "Raising Tops of Manholes."

308.3.09B Metal Manholes
Metal manholes shall be adjusted to grade by resetting the entire structure on a firm foundation, by adding extensions of like design and material or by severing the barrel in an acceptable manner. Salvaged structures not reused on the project shall become the property of the contractor.

308.3.10 Catch Basin and Inlet Adjustment
Catch basins and inlets will be adjusted in accordance with subsection 308.3.09.

308.3.11 Manhole Base Reconstruction
Manhole base reconstruction shall be in accordance with Section 306.

308.3.12 Catch Basin Connections
Catch basin connections shall be constructed in conformance with the pipe manufacturer's recommended practice for the type of piping and catch basin combination under consideration.

308.4.00 Measurement and Payment

308.4.01 Manholes Over Existing Sewers
Manholes over existing sewers will be paid for at the unit price for each type and size listed in the bid schedule.

308.4.02 Manhole Connections
Connections to existing manholes will be paid for at the unit price listed in the bid schedule.

308.4.03 Filling Abandoned Manholes and Catch Basins
Filling of manholes and catch basins will be paid for at the unit price listed in the bid schedule.

308.4.04 Abandoning Pipe in Place
Abandoning pipes in place will be considered incidental work.

308.4.05 Catch Basin and Inlet Adjustment
Adjustment of catch basins and inlets will be paid for at the unit price for each type and size listed in the bid schedule.

308.4.06 Manhole Base Reconstruction
Reconstruction of manhole bases will be paid for at the unit price listed in the bid schedule.

308.4.07 Catch Basin Connections
Catch basin connections will be paid for at the unit price listed in the bid schedule.

308.4.08 Manhole Adjustment
Adjustment of manholes will be paid for at the unit price for each type listed in the bid schedule.

308.4.09 Removal and Disposal of Existing Structures and Pipe
Removal and disposal of existing structures and pipe shall be paid for at the unit prices for each type listed in the bid schedule, except that removal and disposal shall be considered incidental if the pipe or structures are located within the limits of other excavation work, or removal is not listed on the bid schedule.

plans for the bottoms of footings or bases for the structure.

The upper limit shall be the ground surface at the site of the work immediately prior to the beginning of the work; except that where the excavation for the structure comes within the limits of roadway or channel change excavation areas, the upper limit shall be the planes of the bottom and side slope of those areas. When the excavation for the structure comes within the limits of embankment, the upper limit shall be the plane of the new embankment at the elevation specified or established by the engineer for the embankment construction.

In the event of excavation occurring below the elevations shown, the area will be backfilled to the proper grade, as directed by the engineer, at no cost to the owner.

501.3.03 Disposal of Excavated Material
Disposal of excavated material shall conform to the requirements of Section 204.

501.3.04 Shoring and Cribbing
When open excavations may be detrimental to adjacent structures, roadways, etc., they shall be shored, braced or protected by cofferdams in accordance with approved methods.

Shoring and cribbing shall be designed and constructed for the proper performance of the work. The interior dimensions of cofferdams and cribs shall provide sufficient clearance for the placement and inspection of forms.

Cofferdams or cribs shall be constructed so as to protect uncured concrete from damage. No timber or bracing shall be left in cofferdams or cribs in such a way as to extend into the substructure concrete.

Cofferdams or cribs, including all sheeting and bracing shall be removed after the completion of the substructure.

501.3.05 Dewatering
The contractor shall provide adequate means to remove and dispose of all water that would otherwise be detrimental to the work. Ground water shall be controlled so as to prevent softening of the bottom of excavations or formation of quick conditions or boils.

Dewatering systems shall be designed and operated to prevent removal of the natural soils and so that the ground water level outside the excavation is not reduced to the extent that would damage or endanger adjacent structures or property. The contractor shall dispose of the water in a suitable manner without damage to adjacent property.

501.3.06 Backfill
All spaces excavated and not occupied by structures or other permanent work shall be backfilled with excavated native material. The top surface shall be neatly graded.

Backfill which becomes a part of a roadway embankment or supports a roadway, rock slope protection, or slope paving shall be in conformance to the requirements of Section 204.

501.3.06A Backfill Around Structures
Backfill around concrete structures shall be placed only after the concrete has attained 2/3 of its specified compressive strength. All form materials and trash shall be removed from the excavation before placing any backfill.

Backfill placed around piers and columns shall be deposited evenly. The backfill in front of abutments and walls shall be placed first to prevent the possibility of forward movement. Special precautions shall be taken to prevent any wedging action against the concrete. Slopes bounding the excavation shall be altered by stepping or roughening to prevent wedge action.

Backfill material shall be deposited in lifts not exceeding 12 inches. Each lift shall be compacted to at least 90 percent of maximum density. Jetting or puddling will not be permitted.

Adequate provision shall be made for thorough drainage of all backfill. Selected granular, free-draining material shall be placed behind weep holes.

Where excavations are made in paved areas, pavement replacement shall be done in accordance with Division 2.

501 Earthwork

501.1.00 Description

This work consists of excavation, backfilling, embankment construction and disposal of materials in connection with the construction of structures.

501.2.00 Materials

501.2.01 Material Approval

The contractor shall submit manufacturer's certifications for the materials proposed for use in the work. If certifications are not available, the contractor shall submit samples of all proposed materials to the engineer for qualifying tests. Samples shall be representative and clearly marked to indicate the source of the material and the intended use.

501.2.02 General Backfill

General backfill shall be excavated material free from roots, debris and other deleterious materials.

501.2.03 Special Backfill

501.2.03A Granular Backfill

Granular backfill shall be river run or pit run gravel free from organic material, having a maximum particle size as shown on the plans or approved by the engineer. Granular backfill shall be reasonably well graded from coarse to fine and contain sufficient fines for required compaction.

501.2.03B Crushed Granular Backfill

Crushed granular backfill shall conform to the requirements of Section 207 and shall be 2 1/2"-0.

501.2.03C Sand Backfill

Sand backfill shall conform to the requirements for fine aggregates of Section 301.

501.2.03D Impervious Backfill

Impervious backfill material shall be composed of particles at least 95 percent of which pass the No. 200 sieve, and shall have a Plasticity Index not less than 20.

501.2.04 Foundation Stabilization

Foundation stabilization material shall be dense rock resistant to action of air and water, reasonably well graded from a maximum size that can be incorporated in the work. Sampling and testing for weight and for conformance to grading requirements may be done in the field.

501.2.05 Topsoil

Topsoil shall conform to the requirements of Section 221.

501.2.06 Water

Water shall conform to the requirements of Section 205.

501.3.00 Construction

501.3.01 Excavation for Structures

Excavation for structures shall include the removal of all material necessary to allow construction of footings, foundations, slabs, retaining walls, cribbing, culverts, and other similar structures as specified or as directed by the engineer. The work shall include the furnishing of all necessary equipment and the construction of all cribs, cofferdams, caissons, and all dewatering necessary for the execution of the work. The work shall also include the subsequent removal of cofferdams and cribs, the placement of backfill and the disposal of excess excavated material.

501.3.02 Limits of Excavation

The limits of excavation shall be as shown. When the limits are not shown, the limits will be lines parallel with and 1 foot outside the neat lines of the footings or bases of the structure. The lower limit shall be the elevation shown on the

501 Earthwork

Division 5 - Structures

404 Fire Hydrants

404.1.00 Description

This work consists of furnishing and installing fire hydrants complete with tee, lead, isolation valve, riser and joint restraint..

404.2.00 Materials

404.2.01 General

Fire hydrants shall be "Waterous 5-1/4" Pacer" model. All other materials shall conform with AWWA specifications. The contractor shall furnish materials certifications in accordance with Section 106.

404.2.02 Hydrants

Hydrants shall be of the dry-barrel type and shall conform with AWWA C 502. The bury length shall be a minimum of 3 1/2 feet. Outlet nozzle threads shall conform with NFPA 194, Appendix A, National Standard Thread.

Hydrants shall be furnished with two 2 1/2-inch hose nozzles and one 4 1/2-inch pumper nozzle. The nominal diameter of the main valve opening shall be 5 1/4 inches.

The base of the hydrant shall be provided with a flange-type joint connection. Gaskets, nuts and bolts for this connection shall be furnished by the contractor.

The drain outlet shall be tapped to receive a drain pipe.

404.3.00 Construction

Hydrant installation shall conform with AWWA Manual M 17 and AWWA C 600. Extensions required for hydrant adjustment shall be installed to the manufacturer's specifications.

404.4.00 Measurement and Payment

Fire hydrants will be paid for at the unit price listed in the bid schedule.

404 Fire Hydrants

403.4.00 Measurement and Payment

403.4.01 Valves and Valve Boxes

Valves will be paid for at the unit price for each size and type listed in the bid schedule. Valve boxes shall be considered incidental to the work and no separate payment will be made for installation of valve boxes.

403.4.02 Backflow Prevention Devices

Backflow prevention devices will be paid for at the unit price for each size and type listed in the bid schedule.

403.4.03 Meters

Meters will be paid for at the unit price for each size and type listed in the bid schedule.

403.4.04 Remote Registration Systems

Remote registration systems will be paid for at the unit price for each size and type listed in the bid schedule.

403.4.05 Sluice Gates

Sluice gates will be paid for at the unit price for each size and type listed in the bid schedule.

403.2.08A Displacement Meters
Displacement meters shall conform with AWWA C 700.

403.2.08B Turbine Meters
Turbine meters shall conform with AWWA C 701.

403.2.08C Compound Meters
Compound meters shall conform with AWWA C 702.

403.2.08D Fire Service Meters
Fire service meters shall conform with AWWA C 703.

403.2.08E Propeller Meters
Propeller meters shall conform with AWWA C 704.

403.2.08F Multi-Jet Meters
Multi-jet meters shall conform with AWWA C 708.

403.2.09 Remote Registration Systems
403.2.09A Direct Reading Type
Direct reading remote registration systems for meters shall conform with AWWA C 706.

403.2.09B Encoder Type
Encoder type remote registration systems for meters shall conform with AWWA C 707.

403.2.10 Sluice Gates
Sluice gates shall conform with AWWA C 501.

403.2.11 Valve Boxes
Valve boxes shall consist of a top section, cover, and extension section. The top section shall be 6 1/2 inch inside diameter ductile iron pipe 15 inches long with bell end. The cover shall be of cast iron and have the word "water" cast in its top. The cover shall be circular and designed so as to prohibit debris from entering the enclosure. The extension stem shall be PVC pipe or cast iron with a nominal outside diameter of 6 inches. The length shall be that necessary to properly enclose the valve shaft at each particular location.

403.3.00 Construction

403.3.01 Valves
Valves shall be installed so that the shafts are vertical. Jointing procedures shall conform with the applicable AWWA specification.

403.3.02 Meters
Meters shall be installed in conformance with the manufacturer's recommendations.

403.3.03 Remote Registration Systems
Remote registration systems shall be installed in conformance with the manufacturer's recommendations.

403.3.04 Sluice Gates
Sluice gates shall be installed in conformance with AWWA C 501 or the manufacturer's recommendations.

403.3.05 Backflow Prevention Devices
Backflow prevention devices conforming with Oregon State Health Division and UPC requirements shall be installed according to the manufacturer's recommendations.

403.3.06 Valve Boxes
Valve boxes shall be centered on the valve shaft. Construction shall conform with Section 402.

403 Valves and Meters

403.1.00 Description

403.1.01 General
This work consists of furnishing and installing valves and meters.

403.1.02 Certification
The contractor shall furnish materials certifications in accordance with Section 106.

403.2.00 Materials

403.2.01 Gate Valves
Gate valves 3 inches through 48 inches in diameter shall conform with AWWA C 500 or C 509-80. Valves shall open when the stem is rotated counterclockwise. Resilient seated gate valves shall conform with AWWA C 509.

403.2.02 Butterfly Valves
Butterfly valves shall conform with AWWA C 504. Valves shall be Class 150B.

403.2.03 Ball Valves
Ball valves shall conform with AWWA C 507.

403.2.04 Check Valves
403.2.04A Swing Check Valves
Swing check valves 2 inches through 24 inches in diameter shall be bronze mounted with cast or ductile iron body with outside lever and spring.

403.2.04B Spring-Loaded Plug or Disc Valves
Spring-loaded plug or disc check valves shall be bronze mounted with bronze, cast or ductile iron body, bronze plug or disc, stainless steel spring and resilient seating suitable for clear cold water service. The plug or disc of the check valves shall be easily replaceable.

403.2.04C Hydraulic Cushion Valves
Hydraulic cushion check valves shall be of bronze, cast or ductile iron, with bronze disc and disc faces, seat rings, and pivot pins. The valve shall provide drop-tight sealing. The valve shall be provided with an adjustable-speed integrally-mounted oil dashpot mechanical snubber system.

403.2.05 Hydraulically Operated Valves
Hydraulically operated valves shall be pilot controlled and diaphragm operated. Valves shall be suitable for 175 psi operation and shall be globe or angle valves. Closing speed shall be adjustable on all valves. Self-cleaning strainers for pilot water supply and valve position indicators shall be provided.

403.2.06 Combination Air and Vacuum Release Valves
Combination air and vacuum release valves shall be constructed to permit the escape of large volumes of air when the pipeline is being filled with water, so that smaller amounts of accumulated air will be released under normal operating conditions, and so that air may reenter the line to break any vacuum caused by the water leaving the pipeline rapidly. Valves shall have cast iron bodies and covers and stainless steel floats. Float guides, bushings, and lever pins shall be stainless steel or bronze. Valves shall be designed for operating service to 300 psi.

403.2.07 Backflow Prevention Devices
Backflow prevention devices shall conform with AWWA C 506, Accepted Procedure and Practice in Cross Connection Control Manual (8-80), Pacific Northwest Section AWWA and the requirements of the Oregon Adminstrative Rules..

403.2.08 Meters
The units of measure shall be gallons.

403 Valves and Meters

402.3.03E Valve Boxes and Vaults

Valve boxes and vaults shall be installed so as not to transmit shock or stress to the valve. The box cover shall be flush with the surface of the area in which installed. The valve operating nut shall be readily accessible for operation through the opening in the box or vault.

402.3.04 Testing

Testing shall be by the hydrostatic method and shall conform with AWWA C 600, Section 4.

Test pressure shall not exceed 150 percent of the rated operating pressure of the lowest rated component in the system. Normal test pressure shall be 150 psi at the upper most portion of the line tested.

Prior to testing, the pipeline shall be backfilled or anchored to prevent movement during the test.

402.3.05 Disinfection

Disinfection shall conform with AWWA C 601.

402.4.00 Measurement and Payment

402.4.01 Pipe

Pipe will be measured and paid for on a lineal foot basis, to the nearest foot, for the types and sizes listed in the bid schedule. No reduction in length will be made for valves and fittings.

402.4.02 Fittings

When listed in the Bid Schedule, fittings will be paid for at the unit price for each size and type listed in the bid schedule.

402.4.03 Tensile Restraint Systems

When listed in the Bid Schedule, thrust blocks and tensile restraint systems will be measured and paid for at the unit price listed in the bid schedule.

402.4.04 Incidental Work

When not listed in the bid schedule, thrust blocks, tensile restriant systems, fittings and fitting-related hardware or supplies such as couplings, joint lubricant, nuts, bolts, washers will be considered incidental work.

402.2.11 Nuts, Bolts and Washers

Nuts, bolts and washers shall be ductile iron or zinc coated steel. Zinc coating shall be by the hot-dip process and shall conform with ASTM B 6.

402.2.12 Pipe Restraint Systems

402.2.12A Thrust Blocks.

Portland cement concrete shall be Class 2400-1 1/2 and shall conform with Section 212. Metal reinforcement shall be Grade 40 and shall conform with Section 504.

402.2.12B Tensile Restraint Systems

Tensile restraint systems shall be "Mega-Lug" or approved and the Engineer shall identify the number of joints requiring restraint on the construction drawings.

402.2.13 Valve Boxes and Vaults

402.2.13A Cast Iron

Cast iron boxes and box components shall conform with ASTM A 48.

402.2.15B Portland Cement Concrete

Portland cement concrete shall be Class 3000-1 1/2 and shall conform with Section 212.

402.3.00 Construction

402.3.01 Handling and Storage

All material shall be handled with care to avoid damage. Material shall not be dropped, bumped, or allowed to impact on itself.

The contractor shall provide safe storage for material until it has been incorporated into the work. The interior of all pipe, couplings, rings, fittings, and other accessories shall be kept free from dirt and other foreign matter at all times. Valves and hydrants shall be drained and stored in a manner that will protect them from damage by freezing. Damaged materials shall be replaced by the contractor at no expense to the owner.

402.3.02 Alignment and Grade

All pipe shall be laid to and maintained at the lines and grades required by the engineer. Fittings, valves, air vents, and hydrants shall be installed at the required locations with joints centered, spigots home, and valve and hydrant stems plumb.

402.3.03 Installation

402.3.03A Ductile Iron Pipe

Installation of ductile iron pipe shall conform with AWWA C 600.

402.3.03B Concrete Steel Cylinder Pipe

Installation of concrete steel cylinder pipe shall be in accordance with the manufacturer's recommendations.

402.3.03C Reinforced Concrete Pipe

Installation of reinforced concrete pipe shall be in accordance with the manufacturer's recommendations.

402.3.03D Valves, Fittings, Plugs and Caps

Valves, fittings, plugs, and caps shall be set and joined to the pipe in the manner specified. Valves 12 inches and larger shall be provided with special support such as crushed rock or concrete pads so that the pipe will does not support the weight of the valve. Adjacent pipe shall be supported so as to prevent stress on the valve.

Valves shall not be used to bring misaligned pipe into alignment during installation.

All dead ends on new mains shall be equipped with blowoff assemblies and shall be closed with plugs or caps suitably restrained to withstand test pressure. Blowoff assemblies preceding the plugs or caps shall be restrained.

402 Water Pipe and Fittings

402.1.00 Description

This work consists of furnishing and installing water pipe and fittings normally used for water distribution systems.

402.2.00 Materials

402.2.01 Certification

The contractor shall furnish materials certifications in accordance with Section 106.

402.2.02 Ductile Iron Pipe

Ductile iron pipe shall be cement-mortar lined and seal-coated and shall conform with ASTM 536, AWWA C 151, AWWA C 104, and AWWA C 111.

402.2.03 Reinforced Concrete Steel Cylinder Pipe

Reinforced concrete steel cylinder pipe shall conform with AWWA C 300.

Before starting fabrication, the contractor shall furnish the engineer with two sets of shop drawings conforming with Section 104. The drawings shall include a laying plan and details of a standard pipe section, special fittings, and bends. Dimensions, coating and lining, and other pertinent information shall be shown. The laying plan shall show the location of each pipe section and each special length with each piece numbered or otherwise designated in sequence.

402.2.04 Prestressed Concrete Steel Cylinder Pipe

Prestressed concrete steel cylinder pipe shall conform with AWWA C 301.

Shop drawings shall be furnished in accordance with Section 104.

402.2.05 Reinforced Concrete Pipe

Reinforced concrete pipe shall conform with AWWA C 302

402.2.06 Pretensioned Reinforced Concrete Steel Cylinder Pipe

Pretensioned reinforced concrete steel cylinder pipe shall conform with AWWA C 303.

The contractor shall furnish the engineer with working drawings in accordance with Section 104.

402.2.07 Service Line Pipe

Service line pipe shall be Type K copper line with no breaks or splices between the main and the meter.

402.2.08 Pipe Fittings

Pipe fittings shall be at least equal in class to the pipe on which they are used. Joint materials shall be compatible with the adjacent pipe.

All tees, crosses, elbows, reducers, and other miscellaneous iron fittings shall be cement-lined gray or ductile cast iron conforming with AWWA C 110. Cement lining shall conform with AWWA C 104. All fittings shall have minimum pressure ratings of 150 psi.

Cast bronze fittings for making threaded joint connections shall conform with ANSI B16.15. Fittings for making connections with flared copper tubing shall conform with ANSI B16.26.

Pipe fittings shall conform with AWWA C 800 excluding lead pipe.

402.2.10 Joint Lubricant

Joint lubricant, when required, shall be in accordance with the pipe or joint manufacturer's recommendations and shall be water soluble and non-toxic.

402 Water Pipe and Fittings

401 Water Line Trench Excavation, Bedding, and Backfill

The work necessary in excavating, bedding, and backfilling water pipelines shall conform with the requirements of Section 301.

Division 4 - Water Distribution

309 Resurfacing

The work necessary in replacement of pavement, curbs, sidewalks, rock surfacing, topsoil, landscaping and other features removed or damaged in the operations related to the work shall be done in accordance with the requirements of Division 2.

501.3.06B Granular Backfill Around Structures
Granular backfill around structures shall be placed in lifts not exceeding 12 inches. Each lift shall be compacted to 90 percent of maximum density.

501.3.06C Granular Backfill Under Footings and Slabs
Granular backfill under footings and slabs shall be placed in lifts not exceeding 6 inches. Each lift shall be compacted to 95 percent of maximum density.

501.3.06D Granular Backfill Under Facilities
Granular backfill shall be placed in excavated areas under piping, sidewalks, curbs, and similar structures and facilities. The material shall be placed in lifts not exceeding 6 inches. Each lift shall be compacted to 95 percent of maximum density.

501.3.06E Sand Backfill
Sand backfill shall be placed in lifts not exceeding 12 inches. Each lift shall be compacted to 90 percent of maximum density.

501.3.06F Impervious Backfill
Impervious backfill shall be placed in lifts not exceeding 12 inches. Each lift shall be compacted to at least 95 percent of maximum density.

501.3.07 Compaction Testing
The in-place density of materials will be determined in compliance with AASHTO T 191, AASHTO T 205, or AASHTO T 238.

The relative maximum density of granular materials will be determined in compliance with OSHD TM 104 or TM 109. The in-place density of reused native materials and impervious materials will be determined in compliance with AASHTO T 99.

If the specified compaction is not obtained, the contractor shall notify the engineer. The contractor may be required to use a modified compaction procedure or apply additional compactive effort. If approved materials meeting the specifications cannot be compacted to the required density regardless of compactive method and effort, the engineer may reduce the required density or direct that alternate materials be used. In no case shall backfilling operations proceed until the contractor is able to compact the material to the satisfaction of the engineer.

501.3.08 Foundation Stabilization
When the material in the bottom of an excavation is unsuitable for supporting foundations, piers, retaining walls, cribbing, culverts or similar structures, the contractor shall overexcavate as directed and backfill to the required grade with foundation stabilization material. The foundation stabilization material and the method of placement shall be as approved by the engineer.

501.3.09 Embankment Construction
Embankment construction shall conform to the requirements of Section 204. Where the excavation for the structure comes within the limits of an embankment, the embankment shall be completed prior to construction of the structure.

501.4.00 Measurement and Payment

501.4.01 Shoring and Cribbing
Shoring and cribbing will be paid for on a lump sum basis for all required.

501.4.02 Excavation for Structures
Excavation for structures will be measured on a cubic yard basis, to the nearest 0.1 yard, in original position prior to excavation. The quantity measured for payment will include only the material excavated from within the limits defined in subsection 501.3.02.

No measurement or payment will be considered for material forced up between foundation piles during driving nor of material used in backfilling around piles should compaction occur during driving.

501.4.03 Excavation Below Elevations Shown
Excavation below elevations shown will be measured the same as set forth under excavation for structures, except that the upper pay limit will be the elevation shown for the bottoms of footings or bases of the structure, and the lower pay limit will be the limit of excavation directed by the engineer.

501.4.04 Backfill
Backfill will be measured and paid for on a cubic yard basis to the nearest 0.1 yard. The horizontal and upper limits shall be measured in conformance with subsection 501.4.02 for the material placed between the outside surface of the structure and the limits specified. Any backfill outside of these limits will be considered incidental work.

501.4.05 Foundation Stabilization
Foundation stabilization will be measured and paid for on a cubic yard basis to the nearest 0.1 yard. The volume for payment will be based on field measurement of the actual compacted volume placed within the neat lines and grades specified.

501.4.06 Topsoil
Topsoil will be measured and paid for in conformance with Section 221.

501.4.07 Embankment
Embankment will be measured and paid for on a cubic yard basis, to the nearest 0.1 yard, for the compacted volume placed within the lines and grades specified.

501.4.08 Incidental Work
When not listed in the bid schedule, shoring and cribbing, backfill, dewatering, special material placed at weep holes, pavement replacement, and other anticipated items will be considered incidental work.

502 Piling

502 Piling

502.1.00 Description

This work consists of furnishing and driving piles of the kind and dimension shown, in the manner and to the elevation, penetration and bearing specified.

502.2.00 Materials

502.2.01 Steel H Piling

Steel H piling shall consist of rolled steel pile sections. Steel shall conform to the requirements of ASTM A 36, except that the manufacturer's name, brand or trademark may be shown by die stamping in the web at intervals not exceeding 20 feet along the length of the pile.

502.2.02 Tubular Steel Piling

502.2.02A Unfilled Tubular Steel Piling

Unfilled tubular steel piles shall conform to the requirements of welded and seamless steel pipe piles ASTM A 252, Grade 2, with chemical requirements meeting ASTM A 53, Grade B. The wall thickness shall not be less than 3/16 inch.

502.2.02B Filled Tubular Steel Piling

Filled tubular steel piling shall conform to the requirements of ASTM A 252, Grade 2. Closure plates for closed end piles shall conform to the requirements of ASTM A 36.

502.2.03 Sheet Piling

Steel sheet piling shall conform to the requirements of ASTM A 328 or ASTM A 572. All other sheet piling shall meet the requirements prescribed above for the particular material specified.

502.2.04 Shells for Cast-in-Place Piling

Shells driven without a mandrel shall have a minimum 12-inch diameter at cutoff and a minimum 8 inches diameter tip made from not less than 7 gauge (0.1792 inches in thickness) plate stock conforming to ASTM A 36. Shells may be either spirally welded or longitudinally welded and may be either tapered or constant in section. Tips shall be sealed as noted on the plans.

Shells driven with a mandrel shall be of sufficient strength and thickness to withstand driving without injury and to resist harmful distortion and/or buckling due to soil pressure after the piles are driven and the mandrel removed. Butt and tip dimensions shall be as specified.

502.2.05 Prestressed Concrete Piling

Prestressed concrete piling shall conform to the requirements of Section 505.

502.2.06 Precast Concrete Piling

Precast concrete piling shall conform to the requirements of Sections 503 and 504. Type II or Type III portland cement concrete conforming to the requirements of Section 212 shall be used in all precast concrete piles.

502.2.07 Timber Piling

Timber piling shall conform to the requirements of AASHTO M 168.

502.2.08 Treated Timber Piling

Treated timber piling shall conform to the requirements of AASHTO M 168. Piling shall be treated with creosote or creosote solution in conformance with AWPA Standards C1 and C3 except that marine piling, as identified in the contract documents, shall be treated in conformance with the AWPA Standard MP-2.

Treated timber piles shall be strapped with three straps: one approximately 18 inches from the butt; one approximately 24 inches from the butt; and, one approximately 12 inches from the tip. Straps shall be approximately 1 1/4 inches wide, 0.03 inches thick, and manufactured from cold-rolled, heat-treated steel and shall have an ultimate tensile strength of 5,100 pounds. The straps shall encircle the pile once and shall be fastened with a clip so crimped that the joint will

have a minimum tensile strength of 80 percent of the tensile strength of the strap. The strap shall be installed after pressure treating of the pile.

502.2.09 Composite Timber Piling
Composite timber piling shall be made up of two sections of timber pile and a section of steel pipe. Timber treatment, if specified, shall conform to the requirements of subsection 502.2.08.

502.3.00 Construction

502.3.01 Ordering Piling

502.3.01A Timber, Precast and Prestressed Concrete Piles
The contractor shall furnish piles in accordance with an itemized order list, furnished by the engineer, showing the number and length of all piles. The lengths specified in the order list will be based on the lengths which are assumed to remain in the completed structure plus an allowance for variation in the final driven lengths.

The contractor may, at no expense to the owner, use longer lengths to provide for the contractor's method of operation.

502.3.01B Steel Piles and Shells for Cast-in-place Concrete Piles
The contractor shall be responsible for determining the pile lengths required and for ordering and furnishing piling of sufficient length to obtain the penetration and bearing value specified and to extend into the cap or footing as shown. For the purpose of determining the lengths of piles required, the contractor may, with the approval of the engineer, drive test piles, make borings or make other investigations the contractor considers necessary. Such work shall be performed at no expense to the owner.

Piling purchased in accordance with an engineer's itemized list, but not incorporated in the finished structure, shall be delivered to an approved site and become the property of the owner. The purchase of additional piles or piles of a greater length than those shown on the engineer's list shall not obligate the owner for additional cost. All pile cutoffs not incorporated in the finished structure shall become the property of the contractor.

502.3.02 Methods of Driving

502.3.02A General
Piles shall be driven with a steam, air or diesel hammer, or a combination of water jets and hammer. A single acting hammer shall be used in driving prestressed concrete piling.

Other types of hammers may be used only with the written approval of the engineer.

502.3.02B Hammers
The hammer used shall be capable of developing consistently effective dynamic energy suitable for the piles being driven and for the depths and material into which they are being driven. Underwater hammers will not be permitted. All hammers shall have a power source equal to or greater than that required by the hammer manufacturer.

The hammer used shall deliver a minimum total energy per blow in accordance with the following table.

Minimum Hammer Energy

Required Pile Bearing Value	Steam and Air Hammers	Diesel Hammers
50 tons and under	14,500 ft. lb.	18,000 ft. lb.
51 to 70 tons	19,000 ft. lb.	24,000 ft. lb.
71 to 90 tons	26,500 ft. lb.	33,000 ft. lb.
91 to 100 tons	30,000 ft. lb.	37,500 ft. lb.
Over 100 tons	As called for by contract documents	

The weight of the striking part of the hammer used shall be not less than 1/3 the weight being driven and in no case shall the striking part weight be less than 2,750 pounds.

Alternatively, the minimum hammer energy may be determined by approved dynamic methods of analysis to compute internal pile forces for evaluating driving stresses.

The contractor shall furnish the engineer with the manufacturer's specifications and catalog for all diesel, steam or air hammers used, showing all the data necessary for computing the bearing value of the piles driven.

Hammers shall be equipped with all appurtenances necessary for safe, efficient driving and provided with a suitable head which does not damage the pile. All driving equipment shall be maintained and operated in accordance with the manufacturer's instructions.

When directed, a pressure gauge shall be installed at the inboard end of the hose for measuring the air or steam pressure at the hammer.

502.3.02C Cushion Blocks
For steel and concrete piling, a cushion device suited to the pile and hammer employed shall be used to prevent damage to the piles. Cushion blocks shall be inspected periodically during driving and shall be replaced when they become worn and compacted.

502.3.02D Leads
Fixed-lead pile drivers shall be used. Leads shall be of sufficient length so that the use of a follower will not be necessary except as specified for timber piles. Leads adapted to the driving of battered piles shall be employed for driving battered piles.

502.3.02E Followers
The driving of piling with followers shall be done only with written approval. Followers, made of steel, with driving head and cap made to fit snugly over the head of the pile, may be used when driving timber piles. The use of wood followers will not be permitted. When followers are used, one pile from each group of ten shall be a long pile driven without a follower, and shall be used to determine the bearing value of the group.

502.3.02F Water Jets
Water jets shall not be used without the approval of the engineer. When used, the number of jets and the volume and pressure of the water at the jet nozzles shall be sufficient to freely erode the material adjacent to the pile. Before the desired penetration is reached, the jets shall be withdrawn and the piles shall be driven with the hammer to the final penetration and required bearing value.

5O2.3.03 Preparation for Driving

502.3.03A Excavation
Foundation pits, including cofferdams or cribs, shall be completely excavated before the driving of foundation piles is begun. Allowance shall be made for upheaval of the pit bottom due to the pile driving operation. Any material forced up above the base of the foundation pit shall be removed to the correct elevation, before the concrete is placed, at no additional expense to the owner.

502.3.03B Caps
The heads of all piles shall be cut or cast normal to the axis of the piles. A driving cap of an approved design shall be employed to hold the axis of the pile in line with the axis of the hammer. The cap shall be designed to distribute the blow of the hammer throughout the cross section of the pile and shall support a timber or other approved shock block.

Timber piles, treated and untreated, shall be freshly cut on the butt end immediately prior to driving. Approved caps, collars or bands shall be placed on the butt end of the pile to avoid crushing or brooming the pile head. The butt end shall be so beveled to ensure a tight fit with the collar, cap or band and to avoid splitting of the sapwood from the body of the pile during driving.

For precast concrete piles, the diameter of the inside of the cap shall be determined before the pile is cast and the pile head formed to make a loose fit inside the cap.

The top of the steel casing for cast-in-place concrete piles shall be protected with a combination driving head and pilot, of proper size for the hammer, to ensure a properly distributed blow and to prevent damage to the casing during

driving.

502.3.03C Shoes
Piles shall be driven with square ends. In the event the engineer determine that soil conditions require shoes, the piles shall be carefully fitted with steel shoes of an approved design.

502.3.03D Welding
Welding of pile splices and welding of attachments such as pile tips and pile anchors to steel piles and steel shells shall be done by the shielded metal arc process, the submerged arc process, or the gas shielded metal arc process. All welds, welding procedure, welding materials and preparation of welded surfaces for painting shall conform to the AWS Standard Specifications for Welded Highway and Railway Bridges.

502.3.04 Determination of Bearing Values
The minimum bearing values of piles should be determined by loading tests, as specified. Analysis of pile resistance by dynamic and/or static methods, as approved, shall be the second order of preference. In the absence of loading tests or substantiated pile analysis, the minimum bearing values shall be determined from the following formulas:

$$P = 2WH/(S+0.1) \quad \text{for single-acting air or steam hammers}$$

$$P = [2H\,(W+Ap)]/(S+0.1) \quad \text{for double-acting air or steam hammers}$$

$$P = [2\,(0.8E)]/(S+0.1) \quad \text{for diesel hammers}$$

Where:

P = bearing value 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 = air or steam pressure in pounds per square inch at the hammer
S = the average penetration in inches per blow for the last 10 to 20 blows
E = Energy for all open-end diesel hammers shall be considered to be E = WH. If the diesel hammer is equipped with a compression or bounce chamber above the ram or piston, the hammer energy shall be considered to be the Equivalent Energy, E = WH + (energy in compression chamber).

The foregoing formulas are applicable only when:

a) The hammer has a free fall;
b) The head of the pile is not broomed or crushed;
c) The penetration is reasonably quick and uniform;
d) There is no appreciable bounce after the blow. If there is appreciable bounce, twice the height of the bounce shall be deducted from "H" to determine the value of "H" in the formula;
e) A follower is not used; and,
f) The hammer is in good condition and operating in a satisfactory manner.

Timber piling shall be driven to the bearing value shown. If bearing values are not shown, timber piling shall be driven to a minimum value of 20 tons.

502.3.05 Casting, Placement and Curing
Before casting precast piling, the contractor shall obtain the engineer's approval of design calculations and shop drawings outlining the method and sequence of stressing, prestressing tendons and steel reinforcement details, proposed anchoring devices, anchoring stresses and any additional data pertaining to the prestressing operations.

As soon as the forms are removed, concrete piles shall be carefully pointed with a 1:2 mortar, filling all cavities or irregularities. Piling exposed to view shall be finished above the ground line in accordance with the requirements of Section 503. That portion which will be below ground or low water surface or piles in salt water or alkali soils need not

be finished except by pointing.

Precast piling shall be cured in conformance with the requirements of Section 503. Precast, prestressed piles shall be cured in conformance with the requirements of Section 505.

502.3.06 Storage and Handling

502.3.06A Timber Piling

Timber piling shall be stored and handled so as to avoid damage or abrasion. Special care shall be taken to avoid breaking the surface of treated piles. The use of tools or lead equipment which dig into the wood will not be permitted.

Cuts or breaks in the surface of treated piles shall be given three brush coats of hot creosote oil of approved quality. Hot creosote oil shall be poured into all bolt holes, splits or cuts. Any unfilled holes shall be plugged with creosoted plugs after being treated with creosote oil. When the treatment is damaged so that the integrity of the pile is in jeopardy, the pile will be rejected and a replacement pile shall be furnished by the contractor at no expense to the owner. Treated piling shall be close stacked and piled to prevent warping.

502.3.06B Steel Piling

Steel piling shall be stored and handled so as to avoid damage to or rusting of the piles. Bent or kinked piles which, in the opinion of the engineer, cannot be straightened without damage to the metal shall not be used in the work.

502.3.06C Precast Concrete Piling

Precast concrete piling shall be stored and handled so that the piling will not be subject to fracture by impact, bending stresses or other forces. The contractor shall indicate the pile pickup points on the shop drawings.

The maximum length of pile per number of pickup points shall be in accordance with the recommendations of the PCI. The piles shall be lifted only at the points shown on the approved shop drawings. Piles shall be lifted by means of approved bridles or slings attached to the pile at the marked pickup points.

In no case shall the method of handling be such as to induce stresses in the reinforcement in excess of 12,000 pounds per square inch, allowing 100 percent of the calculated load for impact and shock effects. In handling piles for use in sea water or alkali soils, special care shall be exercised to avoid surface abrasions or other injuries exposing the interior concrete.

502.3.07 Driving Piling

502.3.07A General

Piles shall be driven continuously, without voluntary interruption, to the minimum penetration and/or bearing specified.

All timber piles shall preferably be driven by striking directly on the head of the pile without the use of cushions or blocks. Uniform section and uniform taper section steel casings or shells may be driven without a mandrel. Step taper shells shall be driven using a mandrel of a length equal to the full length of the pile.

502.3.07B Minimum Penetration

When piles are to be driven to a minimum penetration, they shall be driven continuously to the specified penetration, or to refusal. If the penetration at refusal is less than the minimum specified, and the engineer determines that the required penetration cannot be obtained without exceeding the maximum driving resistance of the pile, jetting while driving or pre-boring may be approved. If directed, the contractor shall remove and redrive the pile at another location.

502.3.07C Driving Restrictions

No pile shall be driven within 20 feet of structural concrete which has set less than seven days.

Steel casing for cast-in-place concrete piling shall not be driven within 15 feet of a pile when reinforced concrete has set for less than seven days or unreinforced concrete has set for less than 48 hours.

502.3.07D Locations for Driving

Pile locations shall be laid out from information shown on the plans. The method used to determine pile locations

shall be as approved by the engineer.

502.3.07E Accuracy of Driving
Piling shall be driven in true alignment at the locations shown.

Templates or other approved methods shall be used to obtain the required degree of accuracy. The centers of foundation piles shall not vary from vertical or the specified batter by more than 6 inches at cutoff elevation. Manipulation of the piles into alignment or position will not be permitted. The contractor will be required to redrive or use other satisfactory methods to avoid such manipulation. Piles for trestle or dock bents shall be driven so that the cap may be placed in its proper location without inducing excessive stresses in the piles.

502.3.07F Driving Through Embankments
Piling in embankments shall not be driven until the embankment is in place. Piles shall be driven completely through embankment fills to the specified bearing and/or penetration in the underlying material. If penetration of the fill cannot be accomplished with usual driving methods, the contractor shall, at no expense to the owner, use pre-boring or other approved methods. Pre-bored or spudded holes shall be of a size and depth necessary to allow frictionless penetration of the fill by the pile. After piles are driven to the required bearing and/or penetration, the space between the pile and the pre-bored or spudded hole shall be tightly filled with approved granular material.

502.3.07G Minimum Age
Precast concrete piles shall not be driven until test cylinders made from the same concrete pour, and cured with the piles, reach design strength. Prestressed concrete piles shall not be driven within three days of detensioning the prestressing strands.

502.3.08 Test Piles
The contractor shall drive test piles to determine the lengths of piling required to obtain the necessary load carrying capacity and/or penetration. These piles shall be driven at the locations designated and shall be of sufficient length to provide for any variation in soil conditions. Test piles shall be driven to specified bearing and/or penetration without interruption in the driving. Interruption in the driving shall be cause for rejection of the pile as a test pile and it shall be replaced with a properly driven pile at no expense to the owner.

Test piles shall be the same as the permanent piles. Test piles for treated timber piles may be either treated or untreated.

Driving equipment and methods used to drive test piles shall be the same as that to be used for driving the permanent piles.

Test piles for foundations and trestles shall be driven to a minimum bearing value of 15 tons more than the bearing value specified for the permanent piles. When a pile tip elevation is specified, the test piles shall penetrate at least to the specified tip elevation. If a pile tip elevation is not specified, the test piles shall penetrate at least 10 feet below the bottom of the concrete footing and 15 feet below the bottom of the concrete seal.

If a test pile driven in place of a permanent pile is damaged by handling or driving to the extent that it is unfit for use, the pile shall be removed and replaced at no expense to the owner. If the engineer specifically directs the contractor to drive the test pile to more than 15 tons over the minimum bearing capacity specified for permanent piling, the contractor shall overdrive the test pile as directed. The contractor will not be required to bear the expense of removal and replacement of the test pile if it is damaged as a result of overdriving at the direction of the engineer. Timber piles or precast concrete piles, when used as test piles, shall not be used in place of permanent piles and shall be driven outside of the footing.

When steel piles or cast-in-place concrete piles are used for test piles, they shall be driven in place of permanent piles. The number of steel piles called for on the plans shall be reduced by the number of test piles driven in place of permanent steel piles. The number of cast-in-place concrete piles called for on the plans shall be reduced by the number of test piles driven in place of permanent cast-in-place concrete piles.

Test piles that are not to be incorporated in the completed structure shall be removed to at least 2 feet below the surface of the ground and the remaining hole backfilled with earth or other acceptable material.

502.3.09 Loading Tests

The size and number of piles shall be determined by loading tests. Loading tests shall conform to the requirements of ASTM D 1143.

502.3.10 Splicing

502.3.10A Timber, Precast Concrete and Prestressed Concrete Piles

Timber, precast concrete and prestressed concrete piles shall be furnished in lengths required in final position. Splicing will not be permitted.

502.3.10B Tubular Steel and H Piling

Tubular steel and H piling may be spliced when required. Splice welding shall be by the shielded metal arc, submerged arc, or gas shielded metal arc process. Splicing shall be by a full penetration butt weld which will develop the section of the pile and shall have a full and even bearing at the joint. A maximum of two splices per pile will be allowed.

502.3.10C Composite Timber Piling

Composite timber piling shall be spliced by shaping the upper end of the lower section and the lower end of the upper section to form a tight driving fit into the steel splice.

The lower pile shall be driven to approximately the ground or water line before splicing.

The pipe section shall be drilled to accommodate spikes or bolts. The number and arrangement of the holes shall be as specified.

502.3.11 Cutoffs

502.3.11A General

Piles driven below the cutoff elevation without approval shall be withdrawn and replaced by new piles, or spliced as specified.

502.3.11B Timber Piles

The tops of all piling shall be true to a horizontal plane at the elevation shown or established by the engineer. Piles which support timber caps or grillage shall be cut to conform to the plane of the bottom of the superimposed structure. Cutting shall be done with approved tools that will not fracture or damage the pile.

In general, the length of pile above the elevation of cut-off shall be sufficient to permit the complete removal of all material injured by driving. Piles driven to the cut-off elevation shall be free from all broomed, splintered, or damaged material.

Immediately after making final cutoff, the cut surface of treated and untreated piles, except those encased with concrete, shall be thoroughly coated with hot creosote followed by two applications of a hot sealing compound mixture of creosote and asphalt pitch, mixed to a thick consistency and thoroughly brushed into the wood. The contractor shall allow time for each application to soak in before applying the next coat.

Timber pile heads not encased in concrete shall be further protected by one of the following waterproofing methods.

1) Zinc Covering - The cut surface shall be covered with three applications of a mixture of 60 percent creosote and 40 percent asphalt or thoroughly brush coated with three applications of hot creosote and covered with hot asphalt. Before placing the cap, a sheet of 12 gauge (.028 inch) zinc shall be placed on each pile head. The sheet zinc shall be of sufficient size to project at least 4 inches outside of the pile and it shall be bent down, neatly trimmed and securely fastened to the faces of the pile with large-headed galvanized roofing nails.

2) Fabric Covering - The heads of all piles shall be covered with alternate layers of hot asphalt pitch and waterproofing fabric, similar to membrane waterproofing, using four applications of asphalt pitch and three layers of fabric. The covering 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 seven complete turns of galvanized wire securely held in place by large-headed galvanized nails or staples. Galvanized or stainless steel straps and clips conforming to the specifications may be used in lieu of galvanized wire. The edges of the fabric projecting below the wrapping shall be trimmed.

All timber pile cutoffs shall become the property of the contractor and shall be removed from the project.

502.3.11C Steel Piles or Casings for Cast-in-Place Concrete Piles
The tops of the piles shall be cut square at the required elevation and shall be ground smooth after cutoff.

All cutoffs from steel piles and shells shall remain the property of the contractor. Undamaged cutoffs may be used as pile extensions or welded together to form full-length piles.

502.3.11D Precast Concrete Piles
Precast concrete piles shall be cut off at the required elevation using approved equipment which will not fracture or damage the pile.

The contractor shall repair any spalling of the concrete below the area of the pile covered by the footing or pile cap as approved by the engineer.

Pile cutoffs designated to be used in construction of pile extensions or buildups shall remain the property of the owner. All precast concrete pile cutoffs not used in extensions or buildups shall become the property of the contractor and shall be removed from the project.

For cutoffs of prestressed piles, the projecting prestressing strands shall be thoroughly cleaned of all concrete.

502.3.12 Extensions or Build-Ups
Extensions, splices or build-ups on concrete piles shall be made only with approval and after driving is completed. If additional driving to obtain the specified bearing is required after build-ups or extensions are made, no additional driving shall be performed until the concrete in the build-ups or extensions have reached design strength.

Splices of prestressed concrete piles to prestressed concrete piles shall be made as designated. Any spalled concrete shall be removed and the pile fresh-headed to provide a top surface that is perpendicular to the pile axis.

For other precast piles the concrete at the head of the pile shall be cut away, leaving the reinforcement steel exposed for a length equal to 40 diameters of the reinforcing steel members. The final cut of the concrete shall be perpendicular to the axis of the pile. Reinforcement similar to that used in the pile shall be securely fastened to the projecting steel and the necessary form work shall be placed. Care shall be taken to prevent leakage along the pile.

Concrete used in extensions shall conform to the same requirements 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 cement or other suitable bonding material. Forms for the buildup shall conform to the requirements of Section 503. The forms shall remain in place not less than seven days and shall then be carefully removed and the entire exposed surface of the pile finished as specified.

Where piles with steel casings are used, and a portion of the pile is exposed to view above the finish ground line or the low water line in water crossings, the steel casings shall not extend above an elevation 2 feet below the finish ground line or the low water line. Above the finish ground line or low water line, piles may be either round or octagonal. The reinforcement for the section of pile above the cut-off elevation for the steel casing shall extend a minimum of 4 feet into the lower section to tie the two sections together.

502.3.13 Damaged or Defective Piles
The handling and driving of piles shall not subject them to excessive or undue abuse which may produce crushing or spalling of concrete, injurious splitting, splintering and brooming of wood, or deforming of steel. Piles shall not be subjected to excessive manipulation to force them into proper position.

Any pile which is split, broomed, cracked, crushed, broken, or damaged so as to impair its intended purpose, due to internal defects or as some consequence of storage, handling or driving, shall be corrected at no expense to the owner by one of the following methods:

a) The pile shall be withdrawn and replaced;
b) A replacement pile shall be driven adjacent to the damaged or defective pile; or,
c) The pile shall be spliced or built up as specified or a portion of the footing extended to properly embed the pile.

502.3.14 Inspection
The contractor shall collect and record the following data:

a) Elevation of the ground surface at the pile when located on land;
b) Elevation of the water surface at the pile when located in water and the time and date the water surface elevation was recorded;
c) Overall pile length;
d) Depth pile is driven;
e) Number of hammer blows per foot of penetration for the entire driving sequence;
f) Length of any cutoff; and,
g) Elevation of any splice or repair.

502.4.00 Measurement and Payment

502.4.01 Furnishing Piling

502.4.01A Timber and Precast Concrete
Timber and precast concrete piling will be measured and paid for on a lineal foot basis, to the nearest foot, and will be the total footage computed from the order list. Composite piling made with timber sections spliced together will be considered as one pile.

Payment shall constitute full compensation for the work include splicing, shoeing, extensions, and buildups.

502.4.01B Steel Piles and Steel Shells for Cast-in-Place Concrete Piles
Steel piles and steel shells for cast-in-place piles will be measured and paid for on a lineal foot basis, to the nearest foot. Measurement shall be from the tip of the pile to the plane of the cutoff.

Payment shall constitute full compensation for the work including splicing, tip reinforcement, attachments, casings, concrete, and reinforcement.

502.4.01C Test Piles
Test piles will be measured and paid for on a lineal foot basis, to the nearest foot, for the total footage specified or directed to be placed.

Test piles driven by the contractor, for the contractor's information or convenience, which are later incorporated into the completed work will be measured and paid for in accordance with the applicable provisions. No measurement and payment will be made for test piles, or driving test piles, that are not shown or directed to be placed and which are not incorporated in the completed work.

502.4.02 Driving Piling
Except for dock or trestle piles, driving piling will be measured and paid for on a lineal foot basis, to the nearest foot, for the size and type of piling listed in the bid schedule. Measurement shall be from the tip of the pile to the plane of the cutoff. Measurement shall not be less than 75 percent of the individual pile lengths shown in the engineer's estimated length or order list, whichever is applicable.

Driving of dock or trestle piles will be measured and paid for on a lineal foot basis, to the nearest foot, for the length of the pile measured from the tip of the pile to the ground or water surface.

Payment shall constitute full compensation for the work including cutting off piles, treatment and capping of pile heads, finishing concrete piles and for all jetting, drilling, blasting, or other work necessary to obtain the required penetration or bearing values of piles.

502.4.03 Load Tests
Load tests will be paid for at the unit price listed in the bid schedule.

503 Concrete Structures

503 Concrete Structures

503.1.00 Description

This work consists of construction of portland cement concrete (PCC), reinforced or unreinforced, precast, or cast-in-place, which is used in bridges, box culverts, retaining walls and other concrete structures.

Process control sampling and testing shall be the responsibility of the contractor. Testing shall be by a laboratory approved by the engineer. The contractor will provide certification of all test results to the engineer.

503.2.00 Materials

503.2.01 Portland Cement

Portland cement shall conform to the requirements of Section 212.

503.2.02 Aggregates

503.2.02A Fine Aggregates

Fine aggregate shall conform to the requirements of Section 212.

503.2.02B Coarse Aggregate

Coarse aggregate shall conform to the requirements of Section 212.

503.2.02C Sand for Mortar

Sand for mortar shall conform to the requirements of Section 212.

503.2.03 Water

Water used in mixing PCC shall conform to the requirements of Section 212.

503.2.04 Admixtures

503.2.04A Air-Entraining Admixtures

Air-entraining admixtures shall conform to the requirements of Section 212.

503.2.04B Water-reducing, Retarding and Accelerating Admixtures

Water-reducing, retarding and accelerating admixtures shall conform to the requirements of Section 212.

503.2.05 Curing Materials

Curing materials shall conform to the requirements of Section 212.

503.2.06 Joint Materials

All joint materials shall conform to the requirements of Section 212.

503.2.07 Water Stop

503.2.07A Plastic

Plastic water stops shall be fabricated with a uniform cross section, free from porosity or other defects, to the nominal dimensions shown on the plans. An equivalent standard shape may be furnished if approved by the engineer.

The material from which the water stop is fabricated shall be a homogeneous, elastomeric, plastic compound of basic polyvinyl chloride and other material. No reclaimed material shall be used. The contractor shall furnish a certificate from the producer showing values for the designated properties. The contractor shall furnish samples, in lengths adequate for testing, as ordered by the engineer.

The water stop shall have the following properties.

	ASTM Test Method	Specification
Tensile Strength (psi)	D 412	1800
Elongation %	D 412	350
100% Modulus (psi)	D 412	760
Low Brittle Temperature	D 746	-50° F
Cold Bend Test*	No Failures	

* Samples maintained at -70° F for two hours, then bent quickly around a 1/4-inch mandrel to 180°.

503.2.07B Rubber

Rubber water stop shall be manufactured to the dimensions shown on the plans in such a manner that the finished product shall have an integral cross section which will be dense, homogeneous, and free from porosity and other imperfections. The water stop shall have the following properties.

1) Hardness: The Shore A Durometer hardness shall be 60 to 70 when tested in accordance with ASTM D 2240.

2) Elongation: Minimum of 450 percent.

3) Tensile strength: Minimum of 3000 pounds per square inch.

4) Water absorption: Maximum of 5 percent by weight after immersion in water for two days at 158° F.

5) Tensile strength after aging: The test specimen, after accelerated aging of 7 days at 158 F, shall retain not less than 80 percent of the original tensile strength. The tensile strength of the test specimen, after accelerated aging of 48 hours in oxygen at 158° F and tensile stress of 300 pounds per square inch, shall be not less than 80 percent of the original tensile strength.

6) Compression set: After 22 hours at 158° F, compression set shall be not more than 30 percent when tested in accordance with ASTM D 395, Method B.

7) Specific gravity: 1.17 +/- 0.03.

8) Defects: Minor surface defects such as surface peel covering less than 1 square inch, surface cavities or bumps less than 1/4 inch in longest lateral dimensions and less than 1/16 inch deep will be acceptable.

503.2.07C Copper

Sheet copper for water stops or flashings shall meet the requirements of ASTM B 152 for type ETP light cold-rolled, soft-anneal.

503.3.00 Construction

503.3.01 Mix Design

The contractor shall provide an approved mix design in conformance with the requirements of Section 212.

503.3.01A Classes of Concrete

If the maximum size of aggregate is not included as a part of the class of concrete shown, the contractor shall use 1 inch maximum size aggregate in all precast pre-stressed concrete members, in the stems of post-tensioned box girders and in members where reinforcement spacing is closer than 2 inches.

503.3.01B Sampling and Testing

The sampling and testing of PCC shall conform to the requirements of Section 212. Field-cured cylinders shall be cured under the same conditions as the most unfavorable conditions for the portions of the concrete which the cylinders represent.

503.3.02 Falsework

Working drawings and calculations for falsework shall be prepared and submitted in accordance with Section 104 and shall be stamped by an engineer registered to practice in the State of Oregon.

503.3.03 Forms

Forms shall be set and maintained until the concrete is sufficiently hardened. Forms shall be mortar-tight and of sufficient rigidity to prevent distortion due to the pressure of the concrete and other loads incidental to the construction operations. Forms shall be designed and constructed to prevent warping and the opening of joints and so the finished concrete will conform to the proper final dimensions and contours.

Deck forms for concrete box girder spans shall be supported by the girder stems. Posts or other supports for deck forms will not be permitted to come in contact with the bottom slab of the box girder.

Wood forms for concrete surfaces not subject to backfill shall be made of dressed lumber of uniform thickness, with a form liner of an approved type, and mortar-tight. Wood forms for the interior of cells of box girders may be made with or without a form liner. Shiplap or S4S boards are acceptable provided the forms are mortar-tight. Plywood will be acceptable as a form liner if supported in an approved manner.

Metal ties or anchorages within the forms shall be constructed to permit their removal to a depth of at least 1 inch from the face without injury to the concrete. When ordinary wire ties are permitted, all wires shall be cut back at least 1/4 inch from the face of the concrete upon removal of the form. The cavities shall be filled with cement mortar and the surface left sound, smooth, even, and uniform in color.

For narrow walls and columns, where the bottom of the form is inaccessible, openings near the bottom shall be provided for cleaning out extraneous material before placing the concrete.

All forms shall be treated with an approved release agent before placing the concrete. Material which will adhere to or discolor the concrete shall not be used.

503.3.04 Removal of Falsework and Forms

When field operations are controlled by cylinder tests, forms and shoring for structural slabs or beams shall remain in place until the concrete has reached 75 percent of the specified 28-day compressive strength. Until that time, the contractor shall not place earth backfill against walls below grade.

When field operations are not controlled by cylinder tests, the following intervals, exclusive of days when the temperature is below 40 F, may be used as a guide for removal of forms and supports.

Part of Structures	Interval
Supports under beams	14 days
Floor slabs	7-14 days
Walls	12-24 hours
Columns	1-7 days
Sides of beams and all other parts	12-24 hours

Methods of form removal likely to cause over-stressing of the concrete shall not be used. Supports shall be removed in a manner that will permit the concrete to uniformly and gradually carry the stresses due to the structure's own weight.

All formwork shall be removed from the cells of concrete box girders to which access is provided, and all formwork except that necessary to support the deck slab shall be removed from the remaining cells of the box girder. All wood formwork and all form supports and braces shall be removed from the interior of structural steel box girders.

The design of the post-tensioned structures is such that the structure is not self-supporting until post-tensioning is complete. The contractor shall consider this in the design, maintenance, and protection of falsework.

503.3.05 Adverse weather

503.3.05A Hot Weather

During hot weather the contractor shall make all reasonable efforts to maintain the temperature of the concrete below the specified minimum temperature. When concrete temperatures approach 90° F, the engineer may require the use

of ice or ice water for mixing the concrete and/or require pre-cooling aggregate stockpiles by sprinkling. Mix proportions shall be adjusted so cooling ice or water does not adversely affect the water/cement ratio of the concrete. No concrete with temperatures over 90° F shall be placed.

503.3.05B Cold Weather

No concrete shall be placed when the ambient temperature is below 35° F. When directed, the contractor shall enclose the structure in such a way that the concrete and air within the enclosure can be kept above 60° F for a period of seven days after placing the concrete. When enclosures are used to maintain specified temperatures, the contractor shall furnish a 24-hour temperature-recording thermometer to record air temperature within the enclosure.

The contractor shall supply heating equipment and the necessary fuel. When dry heat is used, the contractor shall provide means to maintain the appropriate atmospheric moisture content.

The temperature of the concrete shall be not less than 60° F at the time of placing in the forms. In case of extremely low temperatures, the engineer may raise the minimum limiting temperatures for water, aggregates and mixed concrete.

Insulated forms capable of maintaining the surface of the concrete at no less than 50° F may be used in lieu of other protection of concrete involving housing and heating. Exposed horizontal surfaces shall be protected and insulated. If the forms do not maintain the proper temperature at the surface of the concrete, auxiliary protection and heat shall be used.

503.3.06 Handling and Placing

503.3.06A General

The interior of forms shall be cleaned of all sawdust, chips, and other debris. Struts, stays and braces, serving temporarily to hold the forms in correct shape and alignment prior to the placing of concrete, shall be removed when the concrete placing has reached that elevation.

Concrete shall be placed in horizontal layers not more than 12 inches thick. When less than a complete layer is placed in one operation the pour shall be terminated in a vertical bulkhead. Each layer shall be placed and consolidated before the preceding layer has taken initial set to avoid surfaces of separation between the layers. Concrete shall not be permitted to free-fall through reinforcing steel or from a height of more than 5 feet.

When the placing of concrete is temporarily discontinued, the top surface of the concrete adjacent to forms shall be smoothed with a trowel. After becoming firm enough to retain its form, the concrete shall be cleaned of laitance and other objectionable material to expose sound concrete. Where a feathered edge might be produced at a construction joint, as in the sloped top surface of a wing wall, inset formwork 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, in which case a construction joint shall be made at the underside of the coping.

503.3.06B Culverts

The base slab or footings of box culverts shall be placed and allowed to set before the remainder of the culvert is constructed. Suitable provision shall be made for bonding the sidewalls to the culvert base.

Before concrete is placed in the sidewalls, the culvert footings shall be thoroughly cleaned of all laitance, shavings, sticks, sawdust, or other extraneous material and the surface carefully chipped and roughened.

In the construction of box culverts 4 feet or less in height, the sidewalls and top slab may be constructed monolithically. When this method of construction is used, 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. Keys shall be constructed in the sidewalls for anchoring the cover slab.

Each wing wall shall be constructed monolithically.

503.3.06C Girders, Slabs and Columns

Concrete in girders shall be deposited uniformly for the full length of the girder and brought up evenly in horizontal layers, with no lift lines or cold joints.

Concrete pours in columns and abutments or walls shall be stopped at the bottoms of caps, cross beams, girders or any widened portion of the column or wall, and the concrete allowed to obtain its initial shrinkage and settlement before the pour is continued. This delay shall not be less than 12 hours for pours over 4 feet in height.

Mechanical shear keys shall be formed in all construction joints in columns. Shear keys shall be approximately 2 inches in depth, and shall be approximately 1/3 the width of the column in both directions, centered in the column.

Concrete pours in T-beams and box girders shall be stopped at the bottom of the deck or deck fillet and the concrete allowed to obtain full shrinkage and settlement before the pour is continued. The delay shall be not less than 12 hours when the beams or girders are over 4 feet in height. Similar delays shall be incorporated into concrete pours at the intersection of any structural members where concrete settlement could cause cracking at the intersection. Mechanical shear keys shall be formed between girder stems and slabs, and in vertical construction joints where permitted. The keys shall be spaced along the girder stem as required, but the spacing shall not exceed 1 foot center to center.

Concrete in the bottom slab of box girder structures shall be poured to the bottoms of beam stems or stem fillets. Before the stems are poured, the bottom slab concrete shall be allowed to cure a minimum of three days at ambient temperatures of 40 F or above, or for at least five days at ambient temperatures below 40 F.

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 achieved specified strength.

503.3.06D Pumping

Concrete may be placed by pumping provided the contractor and uses equipment capable of placing the concrete as specified. The operation of the pump shall produce a continuous stream of concrete without air pockets. When pumping is completed, the concrete remaining in the pipeline, if it is to be used, shall be ejected in a manner that will not cause contamination of the concrete or segregation of the ingredients.

Any additional costs involved in placing concrete by this method shall be at no expense to the owner.

503.3.06E Placing Concrete Under Water

Concrete shall be placed under water only with the approval of the engineer.

Concrete placed under water shall be carefully placed in a consolidated mass, in its final position, by means of a tremie or by pumping and shall not be disturbed after being deposited. Still water shall be maintained at the point of placement.

Concrete seals shall be maintained continuously from start to finish and the surface of the concrete shall be kept horizontal at all times. To ensure thorough bonding, each succeeding layer of a seal shall be placed before the preceding layer has taken initial set. The concrete in seals shall be poured at a minimum rate of 50 cubic yards per hour.

A tremie shall consist of a tube, having a minimum diameter of 10 inches, of sufficient length to reach from the bottom of the excavation to the concrete placing elevation above the water line. The tremie shall have an attached receptacle or hopper for receiving concrete. A jointed tremie will be permitted, provided the joints are flanged and gasketed and are watertight. The tremie shall be supported to permit free movement of the discharge end over the entire top surface of the work and to permit rapid lowering when necessary to retard or stop the flow of concrete.

At the start of the work and on any withdrawal of the pipe for moving to a new location, the discharge end shall be closed to prevent water from entering the pipe. During the progress of the work the pipe shall be entirely sealed at all times and kept full of concrete to the bottom of the hopper. 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 placing of concrete shall be continuous until the work is completed.

503.3.07 Construction Joints

503.3.07A General

At construction joints, shear keys or inclined reinforcement shall be used where necessary to transmit shear or to bond the two sections together.

503.3.07B Bonding

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 in a manner that will not leave loosened particles of aggregate or damaged concrete at the surface. The surface shall be thoroughly cleaned of foreign matter and laitance and saturated with water. The cleaned and saturated surfaces shall be thoroughly covered with a coating of mortar or cement grout. The new concrete shall be placed before the grout coating has attained an initial set.

The placing of concrete shall be continuous from joint to joint.

503.3.08 Expansion and Fixed Joints and Bearings

503.3.08A Open Joints

Open joints shall be constructed with the use of a removable template of approved material. The template shall be removed without chipping or breaking the corners of the concrete. Reinforcement shall not extend across an open joint.

503.3.08B Filled Joints

Poured expansion joints shall be constructed similar to open joints. Pre-molded filler shall be placed in position inside the form as the concrete on the first side of the joint is placed. When the form is removed, the concrete on the other side of the pre-molded filler shall be placed.

503.3.08C Steel Joints

The plates, angles or other structural shapes shall be shop fabricated to conform to the section of the concrete deck. Care shall be taken to ensure that the surface of the steel joint in the finished plane is true and free of warping. The joints shall be secured in a manner to keep them in the correct position during the placing of the concrete. The opening at expansion joints at normal temperature shall be as shown, and care shall be taken to avoid impairment of the clearance in any manner.

503.3.08D Water Stops

Water stops shall be spliced, welded or soldered to form continuous watertight joints. Where movement at the joint is provided for, the water stops shall be designed to permit such movement without damage to the water stop or the joint.

503.3.08E Bearing Devices

Bearing devices shall be set in plastic concrete or grout to ensure uniform bearing. Rockers and other expansion devices shall be set in the proper position for the temperature at the time of erection.

503.3.08F Preformed Elastomeric Joint Seals

Preformed elastomeric joint seals shall be in the longest practicable lengths for longitudinal joints. In transverse joints, one factory splice will be permitted where the required length of material in any one joint exceeds manufacturers' standard lengths. Splices shall be true and smooth on the outside surfaces with no offsets of abutting sections and with complete bond on all abutting surfaces. Joints shall be clean, dry and free of spalls and irregularities which would impair a tight seal in service. Seals shall be placed in the joint under compression, as recommended by the manufacturer, using a lubricant-adhesive applied to both sides of the seal just prior to installation.

The seal shall contact the walls of the joint throughout the length of the seal. The seal shall be removed and reinstalled when the longitudinal elongation of the seal is 3 percent or more from the original length.

All lubricant-adhesive which comes upon the top of an installed seal shall be removed before it dries. Seals with twists, curls, nicks or other malformations shall be removed and replaced. Prior to installation, the ends of seals shall be plugged with a watertight plug. The plug shall be foam rubber or other acceptable closed cell cellular material that is compressible to 15 percent of the uncompressed thickness. The plug shall be a minimum of 2 inches in length and shall be secured in the elastomeric joint seal with an adhesive that will ensure a watertight plug.

503.3.09 Surface Finishing

503.3.09A Formed Surfaces

All concrete surfaces, except for roadways and sidewalks, shall receive a general surface finish. The finish shall extend to a point 1 foot below any adjoining ground surface. Class 1, 2, or 3 finishes, if required, shall be applied to all exposed concrete surfaces except the underside of decks and between girders.

Surface finishes shall meet the following requirements.

1) General surface finish - General surface finish shall consist of filling all depressions resulting from removal of form ties and repairing all rock pockets. All form bolts and any metal placed for the convenience of the contractor shall be removed to a depth of 1 inch below the surface of the concrete. All rock pockets and other unsound concrete shall be removed and the resulting holes or depressions filled with mortar. When rock pockets affect the strength of the structure or endanger the life of the reinforcement, the concrete shall be removed and replaced. For exterior surfaces where only a Class 1 finish is required, white cement shall be added to the mortar to tint the mortar to match the concrete being repaired.

2) Class 1 surface finish (unpainted) - Class 1 surface finish shall consist of all work required for general surface finish, plus removal of bulges, fins, depressions, stains, discolorations, and other imperfections to produce a smooth, even surface of uniform texture and appearance.

3) Class 2 surface finish (ground and painted) - After completion of the General and Class 1 surface finish the surface shall be ground with a power grinder, or other approved method, to remove laitance and surface film which may impair adherence of the paint. The unpainted surface shall then be thoroughly saturated with water and painted while damp with a latex emulsion paint. A minimum of two coats of paint shall be applied, with additional coats as necessary to provide uniformity in coverage and appearance.

4) Class 3 surface finish (ground, floated, and painted) - After completion of the General and Class 1 surface finish, the surface shall be thoroughly ground with a power grinder or other approved method to remove all laitance and surface film resulting from form treatment. The surface shall then be finished by floating with a suitable float using a paste of fine sand and cement to fill all air holes and voids and to bring the surface to a smooth and uniform texture. The surface shall be kept damp until the finish has set so that dusting will not occur when the surface is rubbed. After the paste has set for at least 24 hours, the surface shall be thoroughly saturated with water and, while damp, painted with a latex emulsion paint. A minimum of two coats of paint shall be applied with additional coats as necessary to provide uniform coverage and appearance.

503.3.09B Unformed Surfaces

Unformed surfaces shall be finished in conformance with Section 212 and Section 215.

503.3.10 Curing

Concrete surfaces shall be cured by covering with burlap, canvas, sand, or other satisfactory material. The covering shall be placed as soon as the concrete has hardened sufficiently to support the covering without damage to the concrete surface. The cover shall be kept continuously moist for a minimum of seven days. The type of covering provided shall be that which is best suited to the conditions.

When coverings are not necessary, the surfaces shall be kept continuously moist by flushing or sprinkling. The sprinkling system shall be arranged to keep the outside of all forms damp for a period of seven days after the placing of concrete.

Slab concrete exposed to conditions causing premature drying during pouring operations shall be protected by providing wind breaks, fog spray, or by other methods approved by the engineer.

503.4.00 Measurement and Payment

503.4.01 PCC Structures

503.4.01A Lump Sum Basis

PCC structures will be paid for on a lump sum basis for all work required.

503.4.01B Cubic Yard Basis

PCC structures will be measured and paid for on a cubic yard basis, to the nearest 0.1 yard, for the classes of PCC listed in the bid schedule.

503.4.02 Incidental Work

When not listed in the bid schedule, joint and bearing construction, sampling and testing, and other anticipated items will be considered incidental work.

504 Reinforcement

504 Reinforcement

504.1.00 Description

This work consists of furnishing and placing of metal reinforcement and accessories.

504.2.00 Materials

504.2.01 Bars

Bars shall be deformed and fabricated from billet steel conforming to the requirements of ASTM A 615, rail steel conforming to the requirements of ASTM A 616, or axle steel conforming to the requirements of ASTM A 617. All bars in reinforced concrete pavement shall be Grade 60.

504.2.02 Mats

Steel for bar or rod mats shall conform to the requirements of ASTM A 184.

504.2.03 Welded Wire Fabric

Welded wire fabric shall conform to the requirements of AASHTO M 55.

504.2.04 Dowels

Dowels shall conform to the requirements of AASHTO M 227, Grade 70.

504.2.05 Wire

Wire shall conform to the requirements of AASHTO M 32.

504.2.06 Epoxy Coated Reinforcement

Epoxy coated reinforcement shall conform to the requirements of AASHTO M 284 and the following.

a) Visible voids in the coating, regardless of cause, shall be patched if the total area of voids exceeds 0.25 percent of the surface area of the bar. Bars which require patching in excess of 5 percent of the total surface area of the bar will be rejected.

b) Systems for handling coated bars shall have padded contact areas for the bars. All bundling bands shall be padded and all bundles shall be lifted with strong back multiple supports or a platform bridge to prevent bar-to-bar abrasion from sags in the bar bundle.

c) Coated steel shall be tied and supported with nonmetallic coated ties and supports.

504.2.07 Supports

Bar supports and their placement shall conform to Chapter 3 of the CRSI Manual of Standard Practice. Bar supports in areas exposed to view after stripping shall be of galvanized or plastic coated steel, or of concrete, as approved by the engineer.

504.2.08 Certification

Certification of bar reinforcement will identify the reinforcement by heat number.

The certification shall also contain the weight, number of pieces and dimensions of each size of material of each heat number shipped, the project identification, and the date of shipment. If a color code is used for identification, the heat number and color combinations shall also be shown.

504.2.09 Identification

Each piece of bar reinforcement shall be identified the engineer can determine the heat number prior to use in the work. Reinforcement shall be tagged and marked in accordance with the CRSI Manual of Standard Practice.

504.3.00 Construction

504.3.01 Shop Drawings

Shop drawings shall be submitted in accordance with the requirements of Section 104. Shop drawing details for bar reinforcement shall conform to Chapter 6 of the CRSI Manual of Standard Practice. Shop drawing details for welded wire fabric shall conform to Chapter 2 of the same manual.

504.3.02 Fabrication

Fabrication shall conform to Chapter 7 of the CRSI Manual of Standard Practice.

504.3.03 Placing

Reinforcement shall be accurately placed in the positions shown on the plans and maintained in position during the placing of concrete. Bars in top mats of footings and deck slabs shall be tied at all intersections. All other bars shall be tied at all intersections except where spacing is less than 1 foot in each direction when alternate intersections shall be tied.

Distance from the forms shall be maintained by means of stays, blocks, ties, hangers, or other approved supports. Blocks for holding reinforcement from contact with the forms shall be precast mortar blocks of approved shape and dimensions and shall have the same compressive strength as the concrete in which they are placed.

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.

The placing of bar reinforcement shall conform to the requirements of Chapter 8 of the CRSI Manual of Standard Practice.

Reinforcement in any member shall be inspected and approved by the engineer before the placing of concrete begins. Concrete placed in violation of this provision may be rejected.

504.3.04 Splicing

Splicing shall conform to the requirements of the CRSI Manual of Standard Practice.

504.4.00 Measurement and Payment

504.4.01 Lump Sum Basis

Reinforcement will be paid for on a lump sum basis for all required.

504.4.02 Unit Price Basis

Reinforcement will be measured and paid for on a unit price per pound basis.

Reinforcement will be measured based on the total computed weight for the sizes and lengths of bars as shown on the plans or authorized.

The weight of mesh will be computed from the theoretical weight of plain wire. If the weight per square foot is given on the plan, that weight will be used.

For the purpose of computing weights of bar reinforcement, CRSI standards shall apply.

The weight of reinforcement for prestressed beams, slabs, piles, and other items where the reinforcement is included in the contract price for the item will not be included in the pay quantities for reinforcement.

No allowance will be made for clips, wire, separators, supports and other material used in fastening the reinforcing in place. When bars are substituted upon the contractor's request and as a result, more steel is used than specified, only the amount specified will be included in the pay quantities.

When laps are made for splices for the convenience of the contractor, the additional reinforcement will not be included

506 Steel Structures

The work necessary for furnishing and erecting steel structures including all hardware and protective coatings shall conform to the requirements of the OSHD Standard Specifications.

507 Timber Structures

The work necessary for furnishing and erecting timber structures including all hardware and preservative treatments shall conform to the requirements of the OSHD Standard Specifications.

508 Metal Retaining Walls

The work necessary for furnishing and erecting metal retaining walls including all hardware and protective coatings shall conform to the requirements of the OSHD Standard Specifications.

509 Miscellaneous Metals

The work necessary for furnishing, fabricating, assembling, and erecting miscellaneous metal items incidental to structures shall conform to the requirements of the OSHD Standard Specifications.

510 Bearing and Expansion Devices

The work necessary to furnish and place metal bearing and expansion devices shall conform to the requirements of the OSHD Standard Specifications.

511 Railing, Fencing, Gates, and Cattle Guards

The work necessary to furnish and place railing, fencing, gates, and cattle guards shall conform to the requirements of the OSHD Standard Specifications.

512 Painting of Structures

The work necessary for painting of structures shall conform to the requirements of the OSHD Standard Specifications.

513 Slope Protection

The work necessary for slope paving, riprap, and other slope protection shall conform to the requirements of the OSHD Standard Specifications.