

500 STRUCTURES

ITEM 501 STRUCTURES-GENERAL

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501.01 Description. Structures shall be built as indicated on the plans, in accordance with the specifications for the various items which constitute the completed structure, and in reasonably close conformity with the lines, grades, and dimensions shown on the plans or established by the Engineer.

The Contractor shall so plan and carry on his work, including fabrication, erection, and construction, that the structure as a whole and all its component parts will function as contemplated in the design.

501.02 Verification of Dimensions. The Contractor shall verify all dimensions established by the Engineer and satisfy himself as to the correctness thereof and the mutual agreement of parts.

501.03 Foundation Information. The City assumes no responsibility for the accuracy of soundings, test borings or rock elevation shown on the plans, even though this information is the result of field investigations.

501.04 Approval of Fabricator. Before any steel, other metal, or prestressed concrete members requiring fabrication are ordered by the Contractor, the fabricator or fabricators shall be approved by the Engineer. Request for such approvals shall be made by the Contractor in writing on or before the date of the preconstruction conference.

Fabricators of structural steel for structures furnished under 513, exclusive of bridge bearings, roadway expansion joints, and secondary and detail material as defined in 513.02, shall be certified in accordance with the requirements of the American Institute of Steel Construction (AISC) Quality Certification Program in the appropriate category.

501.05

Certification under AISC Category I is limited to simple and multiple span rolled beam bridges which require no heat curving or butt welded sections.

Approval will be given only to those Fabricators who will perform all fabrication in plants located within the continental limits of the United States.

501.05 Shop Drawings. Structural steel and other metal items, prestressed concrete members, precast concrete structural elements which are to be assembled, laminated elastomeric bearings, joint sealing devices and other similar items requiring either shop or field fabrication shall be detailed on shop drawings by the Contractor in accordance with AASHTO "Standard Specifications for Highway Bridges" and the Ohio "Supplement" to the AASHTO specifications in effect on the date of advertisement for bids.

The Contractor shall submit to the Engineer, for review and approval, three copies of these drawings, unless additional copies are requested. All drawings shall show detailer's and checker's initials as an indication that details have been checked for accuracy. Fabrication shall not begin until written approval of the submitted drawings has been received from the Engineer. Following approval of the drawings, four complete sets shall be submitted to the Engineer unless additional copies are requested.

The prints shall be made from tracings, neatly and accurately drawn on sheets 22 or 24 inches wide and 36 inches long.

Drawings used for fabrication shall indicate the date of approval by the City. After all fabrication is completed, the Fabricator shall furnish a 35 millimeter microfilm copy of each shop drawing mounted in a 3-1/4 by 4-3/8 inch aperture card. The card shall be imprinted along the top edge with the City bridge and project number, details shown on the drawing, and drawing number in the order listed.

501.06 Approval of Construction Plans. The following plans shall be approved by the Engineer and by any involved railway companies before the work may begin. For such approval, three copies of the plans, plus an additional five copies for each involved railway company, shall be submitted. The plans shall be prepared by a registered professional engineer and shall bear his signature and P.E. number or his P.E. seal. Two copies of the design computations shall be submitted with the plans.

(a) Plans for sheeting and bracing of excavation adjacent to railroad tracks.

(b) Plans of falsework for cast-in-place concrete bridges over 20 feet in span. These plans shall be submitted at least 15 days before the construction of the falsework, and approval must be obtained prior to placing superstructure material.

(c) Plans for the proposed erection and handling procedure for (1) multiple span plate girder bridges, (2) rolled beam bridges where the length of any fabricated beam

exceeds 80 feet, where fabricated sections contain bend point or horizontal curvature where cross girders are involved or where there is a field splice on each span, (3) trusses, (4) arches, and (5) structures carrying railway traffic. These plans shall be submitted at least 30 days before material handling is to begin, and handling or erecting shall not begin before approval is obtained. The drawings for the proposed procedure shall include the complete framing plan showing each girder or beam section by "piece mark," sequence of erection, load capacity of erection equipment to be utilized, method of lifting members, splicing procedures and methods for obtaining structure stability in the initial piece or pieces erected and the partially completed structure.

Equipment used for erection shall also be used for unloading and any interim handling.

(d) Plans for permanent or temporary attachments other than those shown or permitted by Contract Plans made by welding to main structural members.

Approval of the above construction plans does not relieve the Contractor of responsibility for the behavior of the temporary structures and procedures proposed.

501.07 Test Reports. Certified test data for all structural steel, except bar stock enumerated in 513.03, steel piles, cast steel, aluminum, bronze and sheet lead to be supplied shall be furnished the Engineer showing compliance with the requirements of 711. Certified test data shall be furnished for new sheet piling. Acceptance of used sheet piling shall be governed by the requirements of 504.02. All test data shall be accompanied by copies of mill shipping notices or invoices showing the quantity and size of material being certified. Materials will not be accepted for erection until the test data have been approved by the Engineer.

Structural steel and other metals produced in countries other than the United States may be used providing each heat is sampled and tested prior to use by an approved domestic U.S.A. laboratory and shown to comply with the requirements of 711. Such testing shall be performed at no additional cost to the City.

Certified test data showing compliance with 711.08 shall be submitted to the Engineer.

The certified test data required above shall be submitted in single copy for each structure, except where the structure carries railway traffic and then one additional copy shall be submitted for each railway company involved.

501.08 Utilities. When appurtenances for gas, steam, water or electric lines, car tracks or other utilities are to be installed on a new structure, the Contractor shall cooperate with the utility company or agency, in their installation of these utilities, after the installation and method of installation have been approved by the Engineer.

501.09

501.09 Erection Stresses. No part of the structure shall be subjected to unit stresses that exceed by more than one-third the allowable unit stresses, as given in AASHTO "Standard Specifications for Highway Bridges" due to erection and construction methods, or to the use or movement of erection or construction equipment onto or across the uncompleted or completed structure.

When equipment having a gross weight in excess of 40,000 pounds is to be placed on the structure and used for erection purposes, structural analysis calculations showing the stresses produced by the equipment and associated erection loads shall be submitted to the Engineer for review and approval.

501.10 Traffic. Traffic, including the movement of construction equipment, shall be restricted on concrete structures according to 511.14.

ITEM 502 TEMPORARY STRUCTURE

502.01 Description

502.02 General

502.03 Maintenance

502.04 Removal

502.05 Basis of Payment

502.01 Description. This item shall consist of preparing plans, providing, maintaining and subsequently removing one or more temporary structures in reasonably close conformity with the plans, special provisions and proposal and with the requirements hereinafter set forth.

502.02 General. The temporary structure shall have an adequate waterway opening, but generally not less than 75 percent of the effective waterway opening of the proposed structure may be designed to provide for a five-year frequency flood as a minimum. The Contractor shall be responsible, however, for any damages caused by upstream flooding due to insufficient temporary structure size or the accumulation of debris or sediment in the channel. A clear roadway width of at least 23 feet face to face of guardrails shall be provided. Provisions shall be made for pedestrian traffic where the existing structure or approaches or both have sidewalks. Such provision shall consist of at least one sidewalk not less than 4 feet wide and shall include adequate connections to existing walks.

The temporary structure shall be designed for a loading of HS20-44 at unit stresses not to exceed 136.5 percent of those specified by pertinent sections of AASHTO "Standard Specifications for Highway Bridges."

Three copies of the Contractor's plans for the proposed temporary structure shall be submitted to the Engineer at least 15 days before its scheduled construction and such construction shall not begin until after approval has been received. The plans

shall be prepared by a registered Professional Engineer and shall bear his signature and registration number.

Piling, when required, shall be driven to sufficient penetration to carry the superimposed loads in accordance with 507, but not less than 12 tons per pile.

If the plans state that the existing superstructure may be used in lieu of new construction, it need not be altered to meet either the above width or strength requirements, but it shall be moved or dismantled and re-erected with sufficient care to avoid any reduction of capacity. If such superstructure has been restricted by posting to loads less than permitted by statute, the posting signs shall be moved to the temporary road, unless the superstructure is strengthened to a legal load capacity. If the Contractor plans to use the existing superstructure on the temporary road, he shall notify the Engineer at least 3 days in advance of the time when it will be moved in order to permit the City to establish a detour. The bridge shall be completed in not more than 48 hours after traffic has been routed over the detour.

502.03 Maintenance. The Contractor shall maintain all portions of the temporary structure including lighting in good condition with respect to both safety and smoothness for travel as long as it is needed for maintenance of traffic. The channel and waterway opening shall also be satisfactorily maintained. The lump sum temporary structure item shall be considered as including maintenance.

502.04 Removal. When the temporary structure is no longer needed, it shall become the property of the Contractor and shall be removed from the site by him according to 202.

502.05 Basis of Payment. The erection, maintenance and subsequent removal of the temporary structure will be paid for at the contract price for:

<u>Item</u>	<u>Unit</u>	<u>Description</u>
502	Lump Sum	Temporary structure

ITEM 503 EXCAVATION FOR STRUCTURES

- 503.01 Description**
- 503.02 Classification**
- 503.03 Cofferdams, Cribs and Sheeting**
- 503.04 Protection of Excavation**
- 503.05 Footings in Rock**
- 503.06 Approval of Foundations**
- 503.07 Culvert Foundations**
- 503.08 Additional Excavation**
- 503.09 Disposal of Excavated Material**
- 503.10 Backfill**

503.01

503.11 Method of Measurement

503.12 Basis of Payment

503.01 Description. This item shall consist of designing cofferdams and shoring, excavating all materials not removed under other items that must be removed to enable construction of bridges, foundations for box culverts and other structures. Included in this item are (a) constructing, maintaining and subsequently removing cofferdams and shoring, (b) dewatering and backfilling the excavation, (c) protecting the excavation against collapse, and (d) disposing of materials not required or suitable for backfill.

503.02 Classification. Excavation is classified as (a) unclassified excavation, (b) unclassified excavation including rock (or shale), and (c) rock (or shale) excavation.

503.03 Cofferdams, Cribs and Sheeting. This item shall include the preparation of a plan, construction, maintenance and subsequent removal of all cofferdams, cribs, sheeting, shoring, bracing or other materials necessary to safely support the sides of excavations, trenches, embankments, adjacent buildings, tracks or other premises, and all dewatering necessary to complete required construction.

Wales and crossbraces shall, if practicable, clear the top of the footings by at least 1 foot. If this is not practicable, such bracing shall be of structural steel and shall be left in place. The ends of such structural members shall be burned off flush with the surface of the concrete unless the ends would be exposed to view when the structure is completed. Ends so exposed shall be boxed back at least 6 inches from the face of the concrete and shall be burned off at least 3 inches back of the concrete face. The resulting holes shall be completely filled with concrete.

Where water is not encountered, sheeting may be placed at plan dimension of footing and used as forms for footing concrete. This sheeting shall be left in place at least to top of footing or shall be properly separated from the footing concrete so that it may be removed without damage to the concrete.

Where water is encountered and cofferdams are necessary, they shall be practically watertight before any excavation is made below water level. Provisions shall be made outside the footing or trench to drain, collect and remove water. When concrete is being placed, the excavation shall be kept dewatered until concrete is above prevailing water level. Footing concrete shall be effectively protected from erosion. If a concrete seal is used to stop the flow upward from the bottom of a cofferdam, it shall be placed below the planned footing and it shall be considered as a part of the cofferdam. No concrete yardage will be allowed for a seal unless it is specifically called for on the plans.

503.04 Protection of Excavation. The sides of all excavations shall be cut so as to prevent caving or the excavation shall be protected from caving and the material below the bottom of footings shall not be disturbed. Blasting shall be done

in a manner that will avoid damage to the material which supports the structure vertically or laterally and subsequent slides that will damage the structure, road or adjacent property. Blasting shall conform to Section 203.04(c). Where the material below the bottom of footings not supported by piles has been disturbed, it shall be removed and the entire space filled with concrete at the Contractor's expense. Under footings supported on piles, the over-excavated or disturbed volumes shall be replaced and compacted as directed. If backfilling is necessary to correct caving or slides, it shall be according to 503.10.

All excavation adjacent to railroad tracks shall be subject to the supervision of the involved railway company. Sufficient bracing shall be provided to insure the proper support of roadbed and tracks.

503.05 Footings in Rock. Where rock or shale excavation is a separate pay item, the portion of the excavation into rock or shale below the top of footing shall be filled with concrete. Where rock or shale is removed as part of unclassified excavation, and the footing is designed to be keyed into the bedrock, the excavation into bedrock the minimum specified depth of keying shall be confined within the area bounded by the outer edge of the footing. Excavation outside these limits and within and below the keyed depth shall be filled with concrete.

503.06 Approval of Foundations. The Contractor shall notify the Engineer when the excavation will be completed to the depth shown on the plans, and no footings shall be placed until the Engineer has approved the subfoundation.

503.07 Culvert Foundations. Box culverts may be placed directly on solid rock, if rock exists for the full length of the culvert; but boulders, unstable material, and rock over a portion of the length shall be removed and replaced with suitable compacted material for a depth determined by the Engineer, but in no case less than 6 inches below the bottom of the culvert. Rock and boulders shall be removed for a width sufficient for placing and proper compaction of the backfill. Unstable material shall be removed on each side of the culvert for a width generally equal to the span of the culvert, but not less than 2 feet. Payment for this work shall be made according to 503.08.

503.08 Additional Excavation. The elevations shown on the plans for the bottoms of footings shall be considered as approximate. When excavation below plan elevation for footings is required, the 3 feet immediately below the plan elevation within the lateral limits defined by 503.11 (3) shall be paid for at the unit price bid for the class of excavation.

Where cofferdams are a separate pay item, the lump sum price shall be considered as including any extra cost involved for cofferdams for additional depth up to 3 feet below plan elevation. Excavation deeper than 3 feet below plan elevation and the additional cofferdams necessitated by this excavation may be provided for as extra work, as described in 109.04.

503.09

503.09 Disposal of Excavated Material. Excavated material shall be disposed of in accordance with 202.03. Other suitable excavation material shall be used for backfill. Material which is not needed or not suitable for backfill shall be disposed of in accordance with 203.05.

503.10 Backfill. Backfill under this item shall be considered as all replaced excavation and new embankment adjacent to structures. Backfill shall be of materials meeting the requirements of 203.08, and shall be constructed according to 203 except as modified in this section.

No backfill shall be placed against any structural elements until they have been approved by the Engineer.

Soil backfill in bridge abutment areas and around culverts shall be compacted according to 203.12. Elsewhere, the required compaction of soil shall be 95 percent of the maximum laboratory dry weight.

Backfill in front of abutments and around piers shall be carried to ground lines shown on the plans.

All structural foundation units shall be backfilled as soon as practicable after the required conditions of 503.10 are met to avoid the ponding of surface water and the accumulation of debris. Backfill in front of abutments, piers, wing walls and retaining walls shall be made simultaneously with the backfill behind them.

Backfill against a waterproofed surface shall be placed carefully to avoid damage to the waterproofing material.

Mechanical tampers or approved compactors shall be used to compact all backfill and embankment within four feet of each side of a culvert, and heavy compaction equipment shall not be operated in this area or over the culvert until it is covered to the greater depth of 2 feet or one-fourth the span of the culvert with compacted fill. The backfill shall be placed in 4 inch lifts (loose depth). For multiple span culverts the span shall be assumed to be the longer individual span.

Lightweight dozers and graders may be operated over culverts having 1 foot of compacted cover, but heavy earth moving equipment shall require 2 feet of cover. Any additional fill and subsequent excavation required to provide this minimum cover shall be made at no additional cost to the City.

If the Contractor elects to construct an embankment in accordance with 203 before placing the culvert, the additional excavation and backfill shall be performed at no cost to the City.

503.11 Method of Measurement. After the requirements of 201, 202 and 203 have been met, the cubic yards of excavation shall be measured as a solid:

(1) Bounded on the bottom, by the bottom plane of the footing, crossbeam, or wall.

(2) Bounded on the top:

(a) In cut sections, by the surface of the remaining ground.

(b) In fill sections:

Where excavation is performed prior to embankment, by the surface of the original ground. Where excavation is performed after embankment, by the surface of the embankment.

(3) Bounded on the sides:

(a) For unclassified excavation, 1 foot outside the outer edge of the footing, crossbeam, or wall.

(b) For rock or shale excavation when "rock excavation" is a contract item, by the outer edge of the footing or wall.

(c) For rock or shale excavation when the rock or shale is removed as part of unclassified excavation including rock or shale, above the minimum specified depth of keying the same as (a) above; for the remainder of the excavation, the same as (b) above.

(d) For unstable material under culverts, the limits of removal as specified.

Abutment excavation quantities include removal of material above the bench (if any), in front of the vertical plane described in (3) (a) above, and by the finished slope of the cut or embankment.

For keys below footings, the number of cubic yards shall be the volume of key as shown on the plans.

Culvert excavation and backfill between the surface of the original ground, the flow line of the culvert, and 1:1 slopes from the outer face of the culvert shall be included with 203 quantities. The remaining culvert excavation and backfill shall be governed by this item.

503.12 Basis of Payment. Payment for accepted quantities will be made at the contract price for:

<u>Item</u>	<u>Unit</u>	<u>Description</u>
503	Lump Sum	Cofferdams, cribs and sheeting

504.01

503	Cubic Yard	Unclassified excavation
503	Cubic Yard	Unclassified excavation including rock
503	Cubic Yard	Unclassified excavation including shale
503	Cubic Yard	Unclassified excavation including rock and/or shale
503	Cubic Yard	Rock excavation
503	Cubic Yard	Shale excavation

Unless cofferdams, cribs and sheeting are separately itemized, they are included with the contract unit price for excavation.

ITEM 504 SHEET PILING

504.01 Description

504.02 Materials

504.03 Driving

504.04 Method of Measurement

504.05 Basis of Payment

504.01 Description. This item shall consist of furnishing and driving steel or wood sheet piling to be left in place, or temporary steel or wood sheet piling driven and subsequently removed, including the furnishing and installing of all necessary anchors, braces, walers, headers or other attachments to structures.

504.02 Materials. Sheet piling shall conform to the requirements of 711.03 or 711.26. Used steel sheet piling in good condition which meets project requirements may be used if inspected and approved by the Engineer.

504.03 Driving. Sheet piling left in place shall be driven to the penetration or tip elevation called for on the plans, or as directed by the Engineer. Temporary sheet piling, when specified, shall be driven to the depth or penetration as deemed necessary by the contractor for the protection of the work.

504.04 Method of Measurement. The quantity of sheet piling left in place shall be the number of square feet complete in place measured in the plane of the face of the sheeting bounded by A-1, B-1 and C as follows:

- (A) Bounded on the top:
 - (1) By the elevations or dimensions shown on the plan or ordered or approved by the Engineer.
 - (2) When specified for protection of the work by a line 2 feet below proposed finish grade if not under pavement, or 2 feet below bottom of proposed or existing pavement.
- (B) Bounded on the bottom:

- (1) By the elevations, dimensions or penetration shown on the plan or ordered or approved by the Engineer.
 - (2) By the elevation of the bottom of the trench or excavation.
- (C) Length shall be the actual length installed or as shown on the plan, whichever is less.

The quantity of Temporary sheet piling shall be the number of square feet, installed and removed, measured in the plane of the face of the sheeting bounded by A-2, B-2 and C above. The quantity of temporary sheet piling below the bottom of the trench or excavation will not be measured for payment.

When temporary sheet piling is not a separate pay item the work shall be performed but the cost thereof shall be included in the item requiring the sheet piling.

If two sets of sheet piling are used on one wall no payment shall be made for the overlap.

504.05 Basis of Payment. Payment for accepted quantities will be made at the contract price for:

<u>Item</u>	<u>Unit</u>	<u>Description</u>
504	Square Foot	Steel sheet piling left in place (minimum section modulus of ____in. ³ per foot of wall)
504	Square Foot	Temporary sheet piling
504	Square Foot	Wood sheet piling left in place

ITEM 505 TEST PILE

505.01 Description

505.02 Materials

505.03 General Procedure

505.04 Basis of Payment

505.01 Description. This item shall consist of furnishing and driving a test pile at a structure to obtain information for the Contractor's use in determining the approximate length of piles necessary to meet the requirements for specified bearing capacity.

This item shall include moving the pile driving equipment to and from the site.

505.02

505.02 Materials. The test pile shall be of the type and size specified by the plans for the bearing piles.

505.03 General Procedure. The test pile shall be driven in accordance with the provisions of 507, and if practicable it shall be driven at a location which will permit it to be used as a bearing pile. If it is not used as a bearing pile, it shall be cut off or removed at the option of the Contractor.

If cut off, it shall be at least 3 feet below the finished ground line or 2 feet below the bottom of footing.

Any pile driven subsequently to the test pile for the purpose of determining the probable lengths of bearing piles shall be driven as a bearing pile and will be paid for at the contract unit price bid per linear foot for Item 507.

505.04 Basis of Payment. Payment for accepted quantities will be made at the contract price for:

<u>Item</u>	<u>Unit</u>	<u>Description</u>
505	Lump Sum	Test pile

ITEM 506 STATIC LOAD TEST

506.01 Description

506.02 General

506.03 Application of Load

506.04 Basis of Payment

506.01 Description. This item shall consist of the application of a test load to a driven pile and the furnishing of instruments and facilities for obtaining load-settlement data of the pile.

506.02 General. The use of the first pile load test and its location shall be determined by the Engineer. One or more subsequent test loads, if provided in the proposal, shall be applied if and where directed by the Engineer.

The hammer selected for driving the test loaded pile shall be used for driving all piles represented by the load test pile. If the Contractor subsequently finds it necessary to use a different size and type of hammer, the Engineer will determine if an additional test load is necessary; any such additional test load shall be completed at no additional cost to the City.

When anchor piles are used in the test procedures, they shall be located not closer than 4 feet center to center from the load test pile. If possible, the anchor piles should be parallel to the axis of the load test pile. Battered piles may be used as

anchor piles provided the horizontal forces in the anchor system are balanced and primary bending stresses are not induced in the piles by the test load. Bearing piles meeting these requirements may be used as anchor piles. After the test has been completed, anchor piles other than bearing piles shall be removed or cut off at least 2 feet below the bottom of the footing or 3 feet below the finished surface of the ground.

The Contractor shall furnish dependable gages and devices for determining the load applied. He shall also furnish the Engineer with a recent verification of the calibration of the gages or devices by a reliable agency equipped to do the testing.

The Contractor shall supply adequate facilities for making load and settlement readings 24 hours per day.

The tested pile shall be substantially vertical and the load should be applied to the pile at a point as near the ground surface as possible to avoid column buckling of the pile.

If a cast-in-place reinforced concrete pile is to be tested and the shell provides all the steel required by 507.06, the shell shall be tested without concrete filling, unless otherwise directed by the Engineer. The test-loading will not be considered satisfactory if the pile fails internally during the test-loading due to improper installation or procedure by the Contractor.

506.03 Application of Load. The load shall be applied not earlier than 72 hours after both the pile to be tested and the anchor piles have been driven.

The test load shall be concentrically applied by such a method that the test load acting on the pile at any time may be definitely determined and controlled.

The initial loading shall be approximately 4/5 of the capacity R determined according to the pertinent capacity formula in 507.05 or as directed. Subsequent loading shall be increments approximately 1/5 R, and the first of these increments shall be applied 1 hour after all measurable settlement due to the initial loading has ceased. The second such increment shall be applied 2 hours after the measurable settlement due to the first increment has ceased. Subsequent load increments shall be applied after measurable settlement due to the previous increment has ceased and after a time lapse in hours corresponding to the sequence number of the load increment. "Measurable settlement," is defined as 0.01 inch or more in a 20 minute time interval.

All settlement readings will be recorded by the Engineer or as noted on the plans.

The application of load will be considered complete when the "yield point" is reached. The "yield point" is defined as where the additional amount of settlement exceeds 0.02 inch per ton for the load increment applied.

506.04

If the yield point is reached before the total applied load exceeds 3 times the plan design load, an additional increment of load shall be applied to assure that the failure has been established. If the amount of settlement per increment is repeated or increased, the application of load will be considered completed, but if not, the application of load increments will be continued until the yield point is reached or until a total load of 4 times the plan design load is applied. The safe bearing value Q shall be considered as 50 percent of the yield capacity.

When the yield point has not been reached after the last required increment of load has been applied, the application of the total load shall be continued for not less than 1 hour after all measurable settlement has ceased.

All instrumentation shall remain in place for three hours after the pile is unloaded in order to obtain settlement recovery measurements.

If it is necessary to remove and reapply the load, it shall be reapplied utilizing the same procedures used to apply the initial loads except that the load increments shall be applied 15 minutes after all measurable settlement has ceased.

506.04 Basis of Payment. Payment for accepted quantities will be made at the contract price for:

<u>Item</u>	<u>Unit</u>	<u>Description</u>
506	Lump Sum	Static load test
506	Each	Subsequent static load test

ITEM 507 BEARING PILES

- 507.01 Description
- 507.02 General
- 507.03 Materials
- 507.04 Driving of Piles
- 507.05 Determination of Capacity
- 507.06 Cast-in-Place Reinforced Concrete Piles
- 507.07 Steel Piles
- 507.08 Timber Piles
- 507.09 Splices
- 507.10 Defective Piles
- 507.11 Painting of Piles
- 507.12 Prebored Holes
- 507.13 Method of Measurement
- 507.14 Basis of Payment

507.01 Description. This item shall consist of furnishing and driving bearing piles of the type and size specified. The piles shall be driven at the locations and to the elevations shown on the plans or as otherwise approved by the Engineer.

507.02 General. The Contractor shall be responsible for the selection of the piles and the pile lengths which will meet all requirements of the plans and specifications. Estimated pile lengths shown on the plans are approximate, having been determined from the subsurface investigation.

507.03 Materials. Materials shall conform to the following:

Concrete (Class C)	511
Reinforcing steel	509
Chemical admixture for concrete	705.12, Type F
Steel piles	711.01 or 711.03
Timber	711.26
Steel pile points	711.01 or 711.07
Prime paint	708.15
Finish paint.....	708.08

507.04 Driving of Piles. The piles shall be driven until they have at least the bearing capacity called for on the plans. The bearing capacity furnished should preferably not exceed the required capacity by more than 15 percent unless a greater capacity is attained in meeting the requirement for minimum penetration.

The penetration of each pile generally shall be at least 80 percent of the penetration as determined from the estimated average length indicated on the plans. If it appears that appreciable overdriving will be necessary to attain this minimum length of penetration, this situation shall be promptly reported to the Engineer. In such cases, the final penetration, driving requirements, right of substitution of another pile type for the specified type, and the use of prebored holes will be determined by the Engineer after further study of the conditions. Any additional costs due to such adjustments shall be borne by the Contractor.

If embankment material makes it difficult to obtain adequate penetration for the abutment piles, the use of prebored holes at the Contractor's expense will be permitted.

All piles raised during the process of driving adjacent piles shall be driven down again.

The size or type of hammer shall be selected to suit the conditions that will be encountered and shall be submitted to the Engineer for approval prior to use. If the size of hammer used is found to be unsatisfactory, corrective measures shall be used as required to produce satisfactory results. When a pile test load is performed, the provisions of the second paragraph of 506.02 shall apply.

507.05

The energy of the hammer shall not be less than 7000 foot-pounds per blow. The ram of the steam, air-operated or diesel hammer shall weigh not less than 1500 pounds.

The ram of a drop hammer shall have a minimum weight of 3000 pounds, except for driving temporary piles a 2000 pound minimum weight is acceptable provided that the constant used in the capacity formula of 507.05 is 0.5 instead of 0.3 as indicated. The height of fall for drop hammers shall not exceed 7 feet.

When the outside rows of bearing piles are not driven accurately, the size of the footing shall, if necessary, be increased at the Contractor's expense so that the minimum thickness of concrete between any pile and the edge of the footing will be at least 75 percent of that shown on the plan.

Driving leads shall be used and shall be securely anchored. A cap device with sliding jaws shall be used to engage the leads to guide the pile and maintain its alignment with the stroke of the hammer. The travel of the hammer shall be accurately aligned with the axis of the pile.

The cap shall be adequately cushioned to avoid damage from driving to the top of the pile. The cap and pile top shall be shaped to distribute the hammer blow uniformly to the top surface of the pile.

A follower shall not be used without the permission of the Engineer, but when approved for use, an allowance shall be made for the increased energy loss.

When a pile test load is required, piles other than the load test pile and anchor piles shall not be driven until after the test loading has been completed and the required depth of penetration has been determined.

Water jets shall not be used without the permission of the Engineer. When water jets are authorized, the number and placement of the jets, the volume and pressure of the water, the depth of penetration without jetting, and any other factor that has a significant effect on the bearing capacity of the driven pile will be subject to such authorization.

Piles which become damaged during driving shall be replaced or repaired before driving is continued.

After being driven, the piles shall be cut off at the elevation and angle specified on the plans.

507.05 Determination of Capacity. The bearing capacity (R) of a driven pile (considered as a single isolated pile) shall be determined by means of the following capacity formula, unless this formula is modified as a result of a test load:

For a drop hammer: $R = \underline{2DWH}$

S+0.3

For a single-acting, differential-acting or double-acting steam (or air-operated) hammer, or a diesel hammer:

$$R = \frac{2DF}{S+0.1} \qquad B = \frac{12}{\frac{2DF}{R} - 0.1}$$

In which:

R = Safe bearing value, in pounds (corresponding with the design load capacity per pile called for on the plans). The above formulas contain a safety factor of 2. The piles will be driven to a yield capacity that is two times the design load capacity. When a 506 or 523 test is performed, the yield load capacity that is found will be divided by 2 to determine the design load capacity.

$D^2 = \frac{(1 - UG)^2}{1 + G^2}$ (applies only in case of battered piles)

B = Blows per foot

W = Weight of striking parts of hammer, in pounds

H = Height of fall of striking parts, in feet

F = WH for single-acting steam hammer, in ft-lbs.

F = Approved rated energy of hammer for a differential- acting or double-acting steam or air-operated hammer, or a diesel hammer, in ft-lbs.

S = Penetration, in inches per blow (generally determined from the rate of penetration for the last several inches of penetration)

U = Coefficient of friction, which is estimated at 0.05 for double acting, differential-acting and diesel, 0.1 for single-acting, and 0.2 for drop hammers.

G = Rate of batter (1/3, 1/4, etc.)

Q = Safe bearing capacity as determined by test load in pounds (1/2 the yield capacity).

When pile driving is resumed after an interruption and the rate of penetration is appreciably less than before the interruption, the value of "S" shall not be considered satisfactory for use in the capacity formula until after several feet of

507.06

penetration. When driving has been interrupted for an appreciable length of time, the required additional length of penetration after driving is resumed shall preferably be determined from the penetration of adjacent piles for which no such interruption occurred.

If the bearing capacity of a driven pile is checked by test-loading according to 506 or 523 and is found to be different than the formula capacity, the formula shall be multiplied by the ratio Q/R. The formula thus modified shall then be used for determining the bearing capacity of the bearing piles of the same type and size which penetrate for nearly the same depth into substantially the same kind of soils. Further formula adjustment may be necessary if pile driving conditions change from those which were found at the test pile.

507.06 Cast-in-Place Reinforced Concrete Piles. Cast-in- place reinforced concrete piles shall conform to one of the types described below. The diameter shall be measured as follows:

- (a) Plain cylindrical casing, the outside diameter.
- (b) Cylindrical casings with vertical fluting, the diameter of a circle circumscribing the outermost points or ridges.
- (c) Cylindrical casing with circumferential corrugations, the average of the outside diameters measured at the bottom and top of the corrugations or continuously welded helical corrugations with diameters measured at tops of the corrugations.
- (d) Tapered piles, the top diameter as determined in (a), (b), or (c), but the point shall not be less than 8 inches.
- (e) Step-tapered piles, the top diameter as determined by (a), (b), or (c) and the diameter of any section shall be not less than that of a pile tapered uniformly from 8 inches diameter at point to the top.

Pile casings described in (1) or (2) below shall be water tight after being driven and shall have shoes or points which do not project more than 1/4 inch outside the vertical surface of the casing.

(1) Cast-in-place reinforced concrete piles having casings that remain in the ground, but which are not designed to resist axial and bending stresses, shall have vertical and lateral reinforcing steel as follows:

(a) When the piles are in an embankment or within the embankment height distance from the toe of the slope, the amount of longitudinal (vertical) reinforcement for the upper segment shall be determined from the formula:

$$A = 0.05d (1+.04L)$$

In which A = minimum cross-sectional area, in square inches of steel required.

L = length of pile in feet (based on the expected length as per test pile).

d = diameter in inches as called for on the plans.

The reinforcement specified for the upper segment of the pile shall extend not less than 10 feet below the existing or finished ground surface, whichever is lower, except that the reinforced portion shall never be less than one half the pile length. The lower half or remainder of the pile shall have not less than one-half the formula amount.

The longitudinal steel shall be uniformly spaced around the perimeter and not less than 4 nor more than 8 bars of equal size shall be used.

Lateral reinforcing, consisting of hoops or spirals, shall surround the vertical reinforcement. The total weight of lateral steel shall be not less than one-fourth the required weight of longitudinal steel and it shall be uniformly spaced along the pile not farther apart than the top diameter. The lateral steel shall be securely fastened to the vertical bars and shall be placed and secured to maintain a clear distance of between 1-3/4 and 2 inches from the surface of the concrete.

(b) When the piles are not in an embankment, or not within the embankment height distance from the toe of the slope, only the upper segment shall be reinforced and the amount shall be as specified in (a).

(2) Cast-in-place piles having casings that remain in the ground and which are designed to resist axial and bending stresses shall have a net cross-sectional area of metal equal to or greater than "A" according to the above formula. The cross-sectional area of the casing shall be determined at the one-fourth point nearest the butt and 1/16 inch of wall thickness shall be deducted for anticipated corrosion loss. Any deficiency in area shall be supplied as longitudinal and lateral reinforcing which shall be placed as directed in (1) above.

The Contractor shall have available a suitable light for the inspection of the interior of a driven casing for its entire length.

The tops of driven casings shall be covered until the concrete is placed. Any accumulated water or other foreign matter in a driven casing shall be removed before placing the concrete. No concrete shall be placed until all piles within a radius of 15 feet have been driven, or the driving within a 15 foot radius shall be discontinued until the concrete has been placed and has set at least seven days. Concrete for cast-in- place piles need not be vibrated, but care shall be taken in placing concrete to prevent the formation of voids. Concrete for cast-in-place piles shall contain a superplasticizing admixture meeting the requirements of 705.12, Type F. After the superplasticizer has been added the slump range shall be 6 to 8 inches.

507.07 Steel Piles. Steel piles will consist of structural steel shapes of the kind and size specified.

507.08 Timber Piles. Timber piles shall be of sufficient length to permit the removal of broomed or split portions caused by driving, and they shall be symmetrically trimmed to a right truncated cone at the tip. When steel shoes or points are specified, the tip of the pile shall be carefully shaped so that the steel shoe or point will fit snugly and symmetrically.

Timber piles shall be handled and stored in a manner as to avoid warping.

When creosoted piles are specified, they shall comply with 521.03 and 712.06.

507.09 Splices. Splices in steel casings and structural shapes shall be avoided to the fullest practicable extent, especially where exposed to view. Splices in timber piles will not be permitted.

Pile casings and structural shapes may be spliced to obtain the required length either before driving or after a segment has been driven, but if the latter procedure is used, the splice shall be made at least three feet above the ground to permit observation of the splice while subject to the forces of driving. The segments shall be aligned to make the axes of all segments common.

Structural shapes shall be spliced by butt welds made in accordance with 513.17, except that temporary extension bars are not required. If a steel casing is to remain in the ground and is to be considered as pile reinforcement, the section shall be spliced by welding in a manner that will provide sufficient strength to conform with reinforcing requirements.

507.10 Defective Piles. A pile will be considered defective if it is damaged to an extent that the strength of its section is reduced by more than 20 percent, or if its location differs from the specified location by more than the top diameter for piles that will be entirely underground or by more than one-fourth the top diameter for piles which project above the ground. Piles which project above the ground will also be considered defective if the top cannot be drawn to the specified location.

Defective piles shall be replaced or if practicable they shall be either repaired or a substitute pile shall be driven beside the damaged one. The off-location limits do not apply to the substitute pile.

If a defective pile is withdrawn, the hole remaining in the ground shall be filled with sand. If a defective pile is left in place under a footing and a replacement is driven beside it, the defective pile shall be cut off slightly above the bottom of the footing. A defective pile that is left in place but not under a footing, shall be cut off at least 3 feet below ground level. Defective casings left in place shall be completely filled with concrete.

507.11 Painting of Piles. The exposed portion of steel piles and casing of cast-in-place concrete piles shall be thoroughly cleaned and painted with two prime coats and one finish coat applied according to 514.

507.12 Prebored Holes. Prebored holes shall be as shown on the plans. The diameter of auger may vary as follows: (1) for round piles, from 2 inches less to 4 inches more than the diameter of piles, (2) for steel H-piles, from 6 inches less to 2 inches more than the diagonal dimension of piles, but shall be such as to produce satisfactory pile driving results.

Voids between the pile and the prebored material shall be backfilled with granular material satisfactory to the Engineer.

507.13 Method of Measurement. The total length of all non-defective bearing piles accepted for payment shall be the lengths in feet measured along the axis of each pile from the bottom of each pile to the elevation of cutoff. Steel points (or shoes) shall not be included with the measured length of piles for payment.

If the test pile is used as a bearing pile payment will be made according to 505, lump sum only.

The length of prebored holes shall be measured in feet from the surface of ground at the time of boring to the bottom of the hole.

507.14 Basis of Payment. Payment for accepted quantities will be made at the contract price for:

<u>Item</u>	<u>Unit</u>	<u>Description</u>
507	Linear Foot	Steel piles, HP ____ x
507	Linear Foot	____ inch Cast-in-place reinforced concrete piles
507	Linear Foot	Timber piles, creosoted
507	Linear Foot	Timber piles, untreated
507	Linear Foot	Prebored holes
507	Each	Steel shoes (or points)

ITEM 508 FALSEWORK AND FORMS

508.01 Description

508.02 Forms

508.03 Oiling Forms

508.04 Payment

508.01 Description. Falsework shall be substantial and rigid and shall not unduly obstruct any waterway, highway or railway. Intermediate supports shall be

508.01

arranged to produce in the completed structure the camber necessary for conformance with the plan profile of the roadway. The maximum deflection "d", in inches, in the longitudinal falsework members at the edges of the concrete deck shall not exceed 1/2 inch or the amount obtained by the following formula, whichever is greater.

$d = (S+100) / 1000$, in which S is the distance between supports in inches.

For transverse falsework members, and for longitudinal falsework members other than those near the edges of the deck, the permissible deflection obtained from the above formula may be increased 75 percent. If unusual requirements for spanning an existing road or channel or restrictions due to vertical clearance exist, a falsework with an excessive deflection may be approved by the Engineer.

Camber shall be built into the falsework to compensate for falsework deflection, dead load deflection, and deck surface profile.

The Contractor shall remove and replace, at his own expense, any part of the structure made unsatisfactory by settlement or form deformation.

Falsework for arches shall be so constructed that it may be released gradually.

Falsework construction shall be removed before final acceptance of the structure. Falsework piling shall be cut off or pulled. If piles are cut off, they shall be cut at least 3 feet below the slope line, riprap line or bed of stream.

For all bridges over 20 foot span whose main supporting members are cast-in-place concrete, falsework plans must be submitted and approved according to 501.06.

When a thickened edge is shown on the plans, it may be developed by sloping the bottom of the slab for a minimum of 9 feet from the edge, in lieu of the section shown. This modification is at the Contractor's option and additional concrete required shall be furnished at no cost to the City.

Falsework for structures shall remain in place until the concrete has met the requirements of 511.14.

Spandrel walls, decks or arches, sidewalks and curbs, or any superimposed concrete to be completed after the main supporting member or the deck is constructed shall not be placed until the falsework for the main supporting member has been removed or released.

For continuous concrete slab or beam superstructures, the concrete shall not be placed on any span until the falsework and forms are complete for the adjacent spans.

The falsework shall not be released or removed from any span until the concrete in adjacent spans has been placed a sufficient length of time to meet all requirements for the removal of falsework as set forth above.

508.02 Forms. All concrete shall be placed in proper forms. The use of the unprotected side of the excavation, instead of forms, will not be permitted, except as indicated in 503.05 for rock or hard shale excavation. For dry excavation described under 503.03, the sheeting may be used as forms for footings.

The forms shall be substantial, unyielding and mortar tight, and shall be so designed that the finished concrete will conform to the proper dimensions and contours. Forms for exposed surfaces shall be made of approved material requiring a minimum number of joints or dressed lumber of uniform thickness using a form liner of an approved type. Forms and form liners are to be used in a manner to reduce to a minimum the joints showing on the finished surface. Joints shall be arranged to coincide with any rustication grooves shown on the plans. Forms shall be properly braced or tied together with approved form ties so arranged that when forms are removed, no metal will be within 2 inches of an exposed surface of the finished structure. An approved insert shall be used in connection with all ties in the region of exposed surfaces. No material except metal, and precast mortar blocks placed in accordance with 509.09, shall be permitted to remain in the concrete.

For concrete decks separated by an open median, the falsework and forms for each deck shall be independent of the adjacent structure.

Temporary openings shall be provided at the base of column and wall forms and in the bottom of all narrow, deep members where necessary to facilitate cleaning or inspection immediately before depositing concrete.

All exposed edges shall be beveled 3/4 inch with a triangular strip built into the forms.

Where rustication is used, the molding shall be fastened to the forms in such a manner that the molding will remain in the concrete when the forms are removed. Molding for rustication shall be surfaced on all sides. This molding shall not be removed until the concrete has set sufficiently so that the edges of the concrete will not be damaged.

If weep holes through abutments or retaining walls are called for on the plans or are required to provide outlets for backfill drainage, they shall be formed in such a manner as to obtain a smooth circular opening and straight gradient through the wall. They shall be not less than 3 nor more than 4 inches in diameter, with a gradient of 1 inch per foot, spaced not closer than 6 foot nor more than 10 foot centers and placed so that the bottom of weep holes, at face of wall, is approximately 6 inches above ground line or low water elevation.

508.03

508.03 Oiling Forms. The inside of forms shall be coated with non-staining mineral oil or other approved material, prior to placing the reinforcing steel.

508.04 Payment. Falsework and forms will not be paid for separately, but their cost shall be included for payment in the price bid for the item for which they are used.

ITEM 509 REINFORCING STEEL

509.01 Description

509.02 Materials

509.03 Care of Materials

509.04 Method of Placing

509.05 Bending

509.06 Shop Assembled Units

509.07 Approval of Placing

509.08 Splicing

509.09 Supports

509.10 Method of Measurement

509.11 Basis of Payment

509.01 Description. This item shall consist of furnishing and placing in concrete, reinforcing steel of the quality, type, size and quantity designated, including steel dowels.

509.02 Materials. Reinforcing steel shall be deformed bars conforming to 709.01, 709.03, or 709.05. Spiral reinforcing steel shall conform to 709.01 or 709.08. Bar mats and wire fabric shall conform to 709.09, 709.10 or 709.12. Epoxy coated reinforcing steel shall conform to 709.13.

509.03 Care of Materials. All reinforcing steel when received on the work, prior to its use shall be stacked off the ground and shall be kept free from dirt, oil, grease, or avoidable rust. When placed in the concrete, it shall be clean and free from loose rust. All epoxy coated bars shall be handled per ASTM A775.

509.04 Method of Placing. Reinforcing steel shall be placed in the position shown on the plans and shall be securely held in this position during the concreting operation. At the Contractor's option, a portion not to exceed 25 percent of the upper longitudinal bars in a bridge deck slab may be placed beneath the upper transverse bars for support of the top mat. In no case shall reinforcing steel be driven or forced into the concrete after it has taken its initial set.

Welding on main reinforcing is prohibited. Fabrication of reinforcing bar cages for prestressed beams is permitted when done in a manner satisfactory to the Engineer.

The clearance between the reinforcing steel and the surface of the concrete shall be not less than:

- (a) 2-1/2 inches at the top surfaces of cast-in-place deck slabs and sidewalks.
- (b) 3 inches at the faces of footings placed against rock or earth rather than forms.
- (c) 1 inch at the bottom surface of a cast-in-place deck slab
- (d) 2 inches at all other surfaces
- (e) or as specified on the plan.

For epoxy coated reinforcing bars, plastic coated or epoxy coated bar supports and tie wires shall be employed to protect the coating from physical damage during placement and to prevent electrical coupling between mats.

Bars shall be carefully handled and installed so that patching at the job site will be kept to a minimum. It is not expected that the coated bars, when in final position ready for concrete placement, will be completely free of damaged areas. However, numerous nicks and scrapes which expose the steel will not be allowed, regardless of the stage when they occur subsequent to coating in the plant. All damage defined as significant damage shall be patched. At the discretion of the Engineer, numerous areas of damage not defined as significant damage shall also be patched. The latter type of patching can be avoided by careful observance of the requirements of Section 509.03.

Significant damage is defined as any opening in the coating which exposes the steel and which exceeds the following sizes:

An area of 0.05 square inch (approximately 1/4" square or 1/4" diameter or equivalent).

An area of 0.012 square inch (approximately 1/8" square or 1/8" diameter) if the opening is within 1/4" of another opening of the same or larger size.

6 inches in length, regardless of area.

An aggregate area of 0.07 square inch in any one foot length. For example, three areas each 3/16" diameter equals 0.08 square inch would require patching.

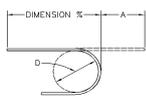
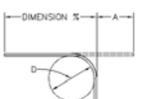
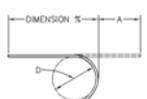
509.04

Where repair is required, the damaged areas shall be cleaned, repaired and adequate cure time allowed before placing concrete. The installation shall be considered approved when patching has been done as outlined above.

Where reinforcing bar cages for prestressed concrete beams are fabricated by tack welding, the areas damaged by the tack welding shall be patched as outlined above.

509.05 Bending. Reinforcing steel shall be carefully shaped to the pertinent dimensions shown on the plans and in the Standard Bends table. Reinforcing steel showing transverse cracks shall not be used.

STANDARD BENDS

BAR				 180° Bend		 90° Bend		 135° Stirrup Bend	
				Bar No.	Nom. Diam. In.	Area Sq. In.	Wgt. lb/LF	D	A
3	.375	0.11	0.376	2-1/4	5	2-1/4	6	1-1/2	5
4	.500	0.20	0.668	3	6	3	8	2	6-1/2
5	.625	0.31	1.043	3-3/4	7	3-3/4	10	2-1/2	8
6	.750	0.44	1.502	4-1/2	8	4-1/2	12	4-1/2	11
7	.875	0.60	2.044	5-1/4	10	5-1/4	14	5-1/4	12-1/2
8	1.000	0.79	2.670	6	11	6	16	6	14-1/2
9	1.128	1.00	3.400	9-1/2	15	9-1/2	19		
10	1.270	1.27	4.303	10-3/4	17	10-3/4	22		
11	1.410	1.56	5.313	12	19	12	24		
14	1.693	2.25	7.65	18-1/4	27	18-1/4	31		
18	2.257	4.00	13.60	24	36	24	41		

Tolerances:

For diameter of bends, "D", the tolerance is plus or minus the diameter of the bar.

For straight bars the tolerance is plus or minus one inch.

For out to out dimensions of bent bars the tolerance is plus or minus 1/2 inch for No. 7 bars or smaller and one inch plus or minus for No. 8 bars or larger.

For truss bars the tolerance for height is minus 1/2 inch, with no allowance for increased height.

No weight allowances will be made for tolerances.

509.06 Shop Assembled Units. The use of unit frames or shop assembled reinforcing steel where practicable is recommended.

509.07 Approval of Placing. Reinforcing steel shall be in place and approved by the Engineer before any concrete is placed.

509.08 Splicing. Splices of reinforcement shall be made only as specified or determined by the Engineer.

Welded wire fabric shall be spliced by lapping 12".

Spiral reinforcement shall be spliced by lapping 1-1/2 turns. A material sample of spirals up to 30 inches long, if taken from an end of the spiral, need not be replaced. Welded wire fabric shall be spliced 12".

Number 14 and 18 bars shall be spliced with approved mechanical connectors. Mechanical connectors shall be capable of developing 125 percent of the yield strength of the bars connected.

Bars used to replace random samples shall be lapped as follows:

<u>Bar Size</u>	<u>Lap Length</u>
4	1'-4"
5	1'-8"
6	2'-0"
7	2'-6"
8	3'-3"
9	4'-2"
10	5'-3"
11	6'-5"

509.09 Supports. Precast mortar blocks or metal supports, of adequate strength, of the proper depth and in sufficient number shall be used for supporting the bars in slabs, beams or girders. Where metal supports are used, the portion at and near the surface of the concrete shall be stainless steel, plastic tipped galvanized steel, or epoxy coated or plastic coated steel. Metal supports shall have a shape that is easily enveloped by the concrete.

If mortar blocks are used, they shall be made from the same materials and of the same proportions of sand and cement as that of the concrete in which they are to be embedded. They shall not be used where they will be exposed to view. They shall be cast and properly cured for at least seven days before use and shall have a wire or other device cast into each block for the purpose of attaching them securely to the reinforcing steel.

509.10 Method of Measurement. The number of pounds of reinforcing steel shall be the actual number of pounds of the various sizes incorporated in the

509.11

concrete as shown on the plans, completed and accepted. The number of pounds shall be determined from the number, length and weight of the bars as shown on the steel list of the plans, based on the weight per linear foot shown in the table, with deductions for bars not used and additions for extra bars used as directed by the Engineer. The weight of coated reinforcing steel shall be based on the weight of uncoated steel.

509.11 Basis of Payment. Payment for accepted quantities will be made at the contract price for:

<u>Item</u>	<u>Unit</u>	<u>Description</u>
509	Pound	Reinforcing steel
509	Pound	Epoxy coated reinforcing steel

Where epoxy coated reinforcing steel is specified for prestressed concrete members, the cost of epoxy coating shall be included with Item 515 for payment.

ITEM 510 DOWEL HOLES

510.01 Description

510.02 Method of Construction

510.03 Basis of Payment

510.01 Description. This item shall consist of the drilling of holes into concrete or masonry and the furnishing and placing of grout into the holes. The furnishing and placing of steel for dowels is included with 509 Reinforcing Steel.

510.02 Method of Construction. The holes shall be drilled at the location and to the depth shown on the plans and shall be approximately 1/2 inch larger in diameter than the dowel bars. The holes shall be partially filled with an approved non-shrink grout 701.11 and the bars shall be forced into the holes the specified depth, spreading the grout mortar around the bar and solidly filling the hole. The bar and the filler shall be held in place until the filler has taken its initial set.

510.03 Basis of Payment. Payment for accepted quantities will be made at the contract price for:

<u>Item</u>	<u>Unit</u>	<u>Description</u>
510	Each or Linear Foot	Dowel holes

ITEM 511 CONCRETE FOR STRUCTURES

511.01 Description

511.02 Materials

- 511.03 Proportions**
- 511.04 Concrete Test Specimens**
- 511.05 High-Early-Strength Concrete**
- 511.06 Mixing of Concrete**
- 511.07 Slump**
- 511.08 Placing Concrete**
- 511.09 Construction Joints**
- 511.10 Emergency**
- 511.11 Depositing Concrete Under Water**
- 511.12 Depositing, Protecting and Curing Concrete During Cold Weather**
- 511.13 Removal of Forms**
- 511.14 Curing and Loading**
- 511.15 Surface Finish**
- 511.16 Roadway Finish**
- 511.17 Sidewalk Finish**
- 511.18 ODOT Class HP Concrete Testing**
- 511.19 Method of Measurement**
- 511.20 Basis of Payment**

511.01 Description. This item shall consist of furnishing and placing portland cement concrete in accordance with these specifications and in reasonably close conformity with the lines, grades and dimensions shown on the plans. Falsework and forms shall be in accordance with 508.

For prestressed concrete see 515.

511.02 Materials. Materials shall conform to 499.02 except as follows:

Aggregate; all concrete above the ground line in a given substructure unit or all concrete for any given superstructure shall be made of aggregates of the same kinds and colors, except upon the written permission of the Engineer. Gravel for coarse aggregate may only be used where specifically noted on the plans or with written permission of the Engineer.

Portland Cement; only one brand, grade or kind shall be used in any given substructure unit above the ground line or given superstructure except by written permission of the Engineer.

Curing materials; 705.05, 705.06 (White Opaque), 705.07 Type 1 or ID, or 705.08 Type I or II, Class 2.

Joint filler; 1/4 inch gray sponge 711.28, or preformed filler 705.03.

Seals; preformed elastomeric compression joints seals, 705.11.

Chemical admixture; 705.12 Type A, B, or D.

511.03

511.03 Proportions. Concrete for structures shall be proportioned according to 499.03, using Class C or Class S as specified.

The proportioning is based on developing a minimum compressive strength at 28 days of 4000 pounds per square inch for Class C and 4500 pounds per square inch for Class S concrete.

511.04 Concrete Test Specimens. On structures over 20 foot span, test cylinders will be made from each 200 cubic yards, or fraction thereof, of concrete that is incorporated each day in the work. On structures of 20 foot span or less, cylinders will be made for each 50 cubic yards of concrete.

511.05 High-Early-Strength Concrete. The use of high- early-strength concrete shall be in accordance with 499.03. Curing and loading shall be in accordance with 511.14.

511.06 Mixing of Concrete. Mixing shall be according to 499.06 except that the discharge time for placing superstructure concrete shall be limited to 60 minutes, after the combining of cement and water.

When mixed, all concrete shall have a temperature of not more than 90°F, and the concrete shall be maintained below this temperature until deposited in the work.

When an air temperature at 60°F or higher prevails at the time of placing concrete in a bridge superstructure (over 20 foot span), the Contractor shall add an approved chemical admixture (705.12 Type B or D) to the concrete.

511.07 Slump. Concrete shall have a slump such that it will be workable in the required position. It shall be of such a consistency that it will flow around reinforcing steel, but individual particles of coarse aggregate when isolated shall show a coating of mortar containing its proportionate amount of sand.

The slump of concrete shall be in accordance with 499.03. The slump shall be determined according to ASTM C 143.

511.08 Placing Concrete. Submit to the Engineer a description of proposed placing procedures and notify the Engineer at least 24 hours in advance of placing concrete.

Place superstructure concrete when the ambient air temperature is 85 °F (30 °C) or less and not predicted to go above 85 °F (30 °C) during the concrete placement; and when evaporation rates, determined according to Figure 1 in ACI 308, do not exceed the following:

<u>Class</u>	<u>Evaporation Rate</u>
S.	0.2 pound per square foot per hour (1.0 kg/m ² /hour).

Determine and document the ambient air temperature, concrete temperature, deck surface temperature, relative humidity, and wind velocity, subject to verification by the Engineer. Measure data required in Figure 1 from within 10 feet (3 m) of the area where the superstructure concrete is placed.

Figure 1 does not apply to substructure items and poured parapets. Figure 1 applies to slip-formed parapets.

To meet favorable atmospheric conditions, may require the Contractor to place concrete at night. At least 24 hours before placing concrete at night, submit a lighting plan for the work area to the Engineer. Obtain the Engineer's approval of the lighting plan before placing the concrete. Direct lights so that approaching traffic is not affected or distracted.

Before placing a concrete deck on continuous steel beams or girders, complete all of the main beam or girder splices at least two piers beyond the pier or piers supporting the concrete.

Before placing concrete for backwalls above the approach slab seat with steel expansion joints, backfill the abutments to within 2-foot (0.6 m) of the bridge seat elevation, place superstructure concrete in the adjacent span, and either erect structural steel or prestressed concrete beams. Use the steel expansion joint as a template for the top of the backwall. If temporary bolts are used to support the backwall portion of an expansion device during the placing of the backwall concrete, remove the bolts after the concrete has taken its initial set and before a change in temperature causes superstructure movement sufficient to damage the backwall.

Before placing concrete, assure the Engineer of an adequate and uniform source of supply of concrete to allow proper placing and finishing, and of the availability of coverings to protect the concrete from rain.

Do not add or apply water to the concrete after it has left the truck and before applying curing materials according to 511.14.

Before placing concrete, thoroughly clean all forms and structural steel that contact the concrete and ensure that the space to be occupied by the concrete is free of laitance, silt, dirt, shavings, sawdust, loose and built-up rust, and other debris.

Deposit concrete using methods that ensure reinforcing steel is completely enveloped in concrete mortar and that allow inspection of concrete enveloping the reinforcing steel. Use a method or device to convey the concrete from the mixer to the work that prevents coarse aggregate separating from the mortar. If depositing concrete in shallow members, such as slabs, place it with as short a vertical drop as possible. Place the concrete over a section to maintain a practically horizontal surface. If using a chute, slope the chute to allow concrete to flow without segregation. Place concrete as near as possible to its final position.

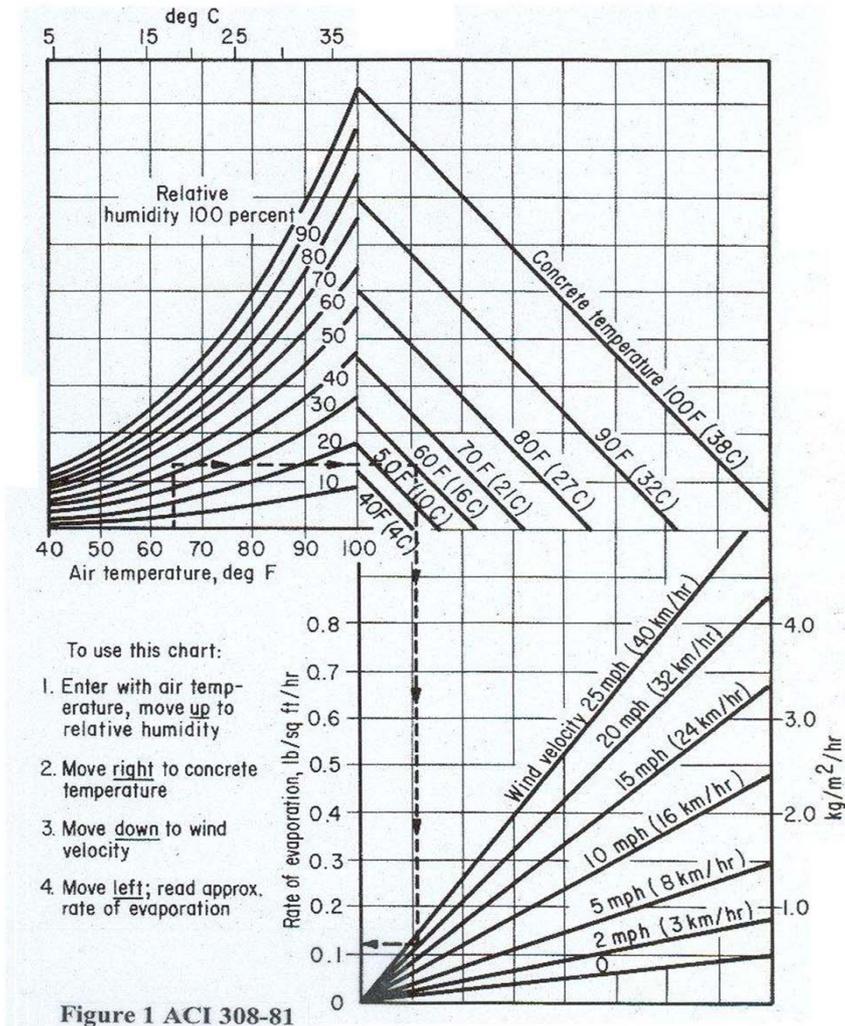
511.08

Drop concrete into the forms with a free-fall distance of 5 feet (1.5 m) or less. As necessary, use drop chutes to limit the free fall to 5 feet (1.5 m) and to ensure the delivery ends as vertical as possible.

Place concrete in structures using vibration. Furnish and use sufficient vibration equipment of the type and size approved by the Engineer to properly compact the concrete immediately after it is placed in the forms. The vibrators shall generally be of a type that is applied directly to the concrete and have a frequency of at least 4500 impulses per minute. If the concrete is inaccessible for this method of vibration, apply the vibrators to the outside of the forms.

Do not move concrete using a vibrator. Vibrate freshly deposited concrete at the point deposited. Slowly insert and withdraw the vibrators vertically into the concrete until the concrete is thoroughly compacted but not segregated. During vibration, do not disturb partially hardened concrete.

As necessary, spade along form surfaces, in corners, and in locations impossible to reach with vibrators to ensure smooth surfaces and dense concrete. Closely observe the results obtained on the first concrete placed, and, if necessary, modify the mix according to this specifications to secure the best results.



511.09 Construction Joints. When construction joints are shown on the plans, all concrete between consecutive joints shall be placed in a continuous operation. Concrete shall not be placed against the side of any joint for at least 12 hours, or as required by 511.14.

Approval of the Engineer must be obtained for placing any construction joint not shown on the plans or permitted by 511.08 and 511.16.

The planes on which a day's work is to terminate shall be predetermined before depositing of concrete begins. They shall in general be perpendicular to the lines of

511.10

principal stress and in regions of small shear. Horizontal joints will not be permitted in concrete girders and beams. Slabs acting with concrete beams or girders shall be deposited continuously with them unless composite construction is specified.

All construction joints shall be made with bulkheads provided with keys which clear all exposed surfaces approximately one-third the thickness of the joint.

Horizontal joints in piers, abutments and retaining walls generally shall be avoided and when they are used, shall not be located within 2 feet of the normal water level.

Construction joints, not shown on the plans and above ordinary low water, in abutments and retaining walls that retain earth fills shall be waterproofed on the back with a 36 inch strip of Type B waterproofing according to 512 at the Contractor's expense.

Joints in cantilevered members shall not be permitted unless approved by the Engineer in writing.

Horizontal construction joints shall have the surface of the concrete below the joint dampened immediately prior to placing adjoining concrete.

Horizontal construction joints between bridge slabs and superimposed curbs, parapets, sidewalks and median strips, shall be placed and protected the same as the remainder of the slab. They shall be cured in accordance with 511.14. If method (b) is used, the membrane shall be removed prior to placing the concrete on the second side of the joint.

Care shall be exercised to avoid disturbing the bond of curb reinforcing steel protruding from the concrete. If the curb areas are used by workmen when placing the deck concrete, the reinforcing steel shall be tied and/or braced to prevent its movement.

Where walls or columns support slabs or beams, the concrete in the vertical member shall be deposited up to the bottom of the supported member and a period of at least 2 hours shall elapse for settlement before placing concrete in the horizontal member.

511.10 Emergency. When the work is unexpectedly interrupted by breakdowns, storms or other causes, and the concrete as placed would produce an improper construction joint, the Contractor shall rearrange the freshly deposited concrete, to provide a suitable construction joint. When such a joint occurs at a section on which there is shearing stress, he shall provide an adequate mechanical bond across the joint by forming a key, inserting reinforcing steel or by some other means satisfactory to the Engineer, which will prevent a plane of weakness.

511.11 Depositing Concrete Under Water. No concrete except for cofferdam seals shall be deposited under water, unless by special permission of the Engineer. If such permission is granted, care shall be exercised to prevent the formation of laitance. Concrete shall not be deposited until any laitance, which may have formed on concrete previously placed, has been removed. Pumping shall be discontinued while depositing foundation concrete if it results in a flow of water inside of forms. If concrete other than cofferdam seals is deposited under water, the proportion of cement used shall be increased at least 10 percent at no extra expense to the City, to compensate for losses due to water. Concrete deposited under water shall be carefully placed in a compact mass in its final position by means of a tremie, a closed bottom dump bucket or other approved method and shall not be disturbed after being deposited.

511.12 Depositing, Protecting and Curing Concrete During Cold Weather. When an atmospheric temperature of 32°F or less exists at the time concrete is placed, or is predicted by weather forecasts to occur during the curing period, the following procedures shall apply.

The water or aggregate or both shall be heated as necessary to make the temperature of the concrete not less than 50°F or more than 70°F when placed.

Concrete shall not be placed in contact with materials having a temperature of less than 32°F. If necessary, the forms, reinforcing steel and foundation materials shall be heated before the concrete is placed.

The concrete shall be protected from freezing, and specified temperatures for curing shall be maintained by a heated enclosure, insulated forms or by either of these used in combination with flooding, except that insulation alone may not be used to protect and cure deck slabs less than 10 inches thick.

The concrete shall be cured by maintaining the surface temperature between 50°F and 100°F for a period of not less than five days except as modified below for concrete flooded with water. At the end of this curing period, the temperature shall be reduced at a rate not to exceed 20°F in 24 hours until it is within 20°F of atmospheric temperature.

Removal of falsework and opening to traffic shall be not earlier than specified by 511.14.

(a) When a heated enclosure is used. The enclosure and heating devices shall be as nearly complete before any concrete is placed as the placing will permit. Throughout the entire concreting operation, the completion of enclosures and the application of heat shall follow the placing of concrete as closely as possible.

Heat may be supplied by any method which will maintain the required temperature continuously with a reasonable degree of uniformity in all parts of the enclosure without discoloring the concrete.

511.13

If dry heat, other than free steam, is used with method (a) curing, all exposed concrete shall be covered with two thicknesses of burlap as soon after placing the concrete as it can be done without marring the surface. The burlap shall be wetted and kept continuously wet and shall not be removed during the heating period, except as required for rubbing. Wood forms without liners, left in place more than two days after the placing of concrete, shall be thoroughly wet at least once each day for the remainder of the heating period. If forms are removed during the heating period, the concrete shall be thoroughly drenched with water and covered with burlap as noted above for the remainder of the heating period.

Enclosures shall be strong and wind proof, and provide adequate space to allow free circulation of air around the forms and deposited concrete.

An operator shall be in active charge 24 hours each day and adequate fire protection equipment shall be accessible at all times during the period of heating.

(b) When insulation is used. Sufficient recording thermometers shall be furnished and installed by the Contractor in such a manner that the surface temperature of the concrete may be readily determined. Whenever the surface temperature, as indicated by the thermometer readings, approaches 100°F, the forms or insulation shall be loosened or otherwise vented to keep the surface temperature within the specified limits. If the thermometer readings indicate that the minimum required temperature is not being maintained, the structure shall be promptly enclosed and heated as provided above or flooded as specified below.

The insulating material shall be wind and water resistant. Precautions shall be taken at edges and corners to insure that such points of extreme exposure are adequately protected. The top surface of the concrete shall be protected by a tarpaulin, or other approved waterproof cover, placed over the insulation.

(c) When the concrete is to be flooded with water. The concrete may be flooded as soon as it can be done without damaging it. Flooding water shall be heated to a temperature of not less than 50°F nor more than 100°F. The heated flood water may be discontinued after 48 hours if the concrete remains flooded to a depth of 1 foot above its highest elevation for at least the subsequent 120 hour period.

511.13 Removal of Forms. In order to facilitate finishing, forms on vertical surfaces which are to receive a rubbed surface finish shall be removed as soon as the concrete has hardened sufficiently that it will not be damaged.

511.14 Curing and Loading. Concrete for structures shall be cured, have the falsework removed, and be opened to traffic in not less time than is specified by the following table:

Span (a)	Age of Concrete in Days
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Curing	Any	7
Removing	Over 10'	14
Falsework	10' or less and all pier caps	7
Traffic	Any	14

- (a) Span in this circumstance is defined as the horizontal distance between faces of the supporting elements when measured parallel to the primary reinforcement.

When the temperature of the air surrounding the concrete is above and maintained above 32°F and below 50°F and the provisions of 511.12 are not in force, the duration of the cure and the time specified above for removing falsework and opening to traffic shall be extended one day for each day the temperature of the air surrounding the concrete is above 32°F but below 50°F.

All superstructure concrete and all other concrete which is to be overlaid with concrete or sealed shall be cured in accordance with Method (a) Water Curing. All other concrete shall be cured either by Method (a) Water Curing or Method (b) Waterproof Membrane Curing; however, if Method (b) is used on construction joints or areas to be waterproofed, the membrane shall be removed as specified in 511.09.

Compression rings are not to be installed on pier columns or similar items of construction for the purpose of supporting falsework or subsequent construction until after a 72 hour curing period.

No load shall be applied or other work conducted that will damage new concrete or interfere with its curing. Where work is necessary on new concrete to complete a structure, such as building forms on a footing, workmen and materials shall be kept off such concrete until such time as it will not be damaged by the work in progress, but in no case shall the elapsed time between placing the concrete and working on it be less than 36 hours. No work that will interfere with the curing shall be done on concrete placed during cold weather, unless insulating material to retain the heat in the mix is placed during periods in the day when the presence of workmen will not interfere with the normal curing procedure. When this is done, the normal protection shall be resumed immediately after work is suspended. Proper curing shall have preference and, if necessary, workmen shall be kept off so that the concrete may be thoroughly wetted and kept wet until the curing is completed.

Method (a) Water Curing. All surfaces not covered by forms shall be protected with two thicknesses of wet burlap which have been spot stitched, wet jute felt cotton mats or wet cotton mats, as soon after placing the concrete as it can be done without marring the surface, and kept wet by the continuous application of water for a period of not less than 7 days. Formed surfaces shall, after the removal of forms, be cured in like manner for the remainder of the curing period, with the entire surface of the concrete being thoroughly drenched with water and covered immediately after forms are removed. Portions of the covering material may be

511.15

removed temporarily and continuous sprinkling stopped when and as necessitated by any required finishing operation.

In lieu of continuous sprinkling, wet burlap covered with white polyethylene sheeting or plastic coated burlap blankets 705.06 may be used. They shall be placed wet with the burlap side against the concrete. Adjoining plastic coated blankets or polyethylene sheets used to cover wet burlap shall be lapped sufficiently and held securely in place at laps and edges so that a positive moisture seal is provided. White polyethylene sheeting or plastic coated blankets containing holes or tears shall be covered with an additional covering of sheeting or blankets as directed.

If the curing is not started before the surface of the concrete begins to dry, the surface of the concrete shall be given a fog spray of water. Additional applications of a fog spray shall be applied as needed until curing material is in place.

Method (b) Membrane Curing. Immediately after the free water has disappeared on surfaces not protected by forms, and immediately after the removal of forms, if such are removed before the end of the 7 day curing period, the concrete shall be sealed by spraying, as a fine mist, a uniform application of the curing material 705.07, Type 1 or 1D, in such manner as to provide a continuous uniform water impermeable film without marring the surface of the concrete.

The membrane curing shall be applied in one or more separate coats at the rate of no less than 1 gallon per 200 square feet of surface. To insure that the proper amount of the curing material is applied, the number of gallons of curing material in the spray container shall be noted and the correct square footage for that gallonage laid off so that the area of concrete surface to be covered will be such that the approved application rate will be secured. Curing material shall be thoroughly agitated immediately previous to use. If the film is broken or damaged at any time during the specified curing period, the area or areas affected shall be given a complete duplicate treatment of the curing material applied at the same rate as the first treatment.

Unless adequate precautions are taken to protect the surface of the membrane; workmen, materials and equipment shall be kept off the membrane for the duration of the curing period.

511.15 Surface Finish. Immediately after the removal of forms, all cavities produced by form ties and all other holes, honeycomb spots, broken corners or edges and other defects shall be cleaned, dampened and completely filled, pointed or trued with a mortar of the same proportions as used in the concrete being finished.

On all exposed surfaces, all fins and irregular projections shall be removed with a stone or power grinder, care being taken to avoid contrasting surface textures. Sufficient white cement shall be substituted for the regular cement in the filling of holes and other corrective work to produce finished patches of the same color as the surrounding concrete.

Exposed surfaces which are not satisfactory to the Engineer because of excessive patching and/or other corrective work, shall be grout cleaned or rubbed as required by the Engineer. Other contiguous exposed surfaces on the structure shall be finished in a similar manner to the extent required to produce a uniform appearance.

Grout Cleaning. Where grout cleaning is called for on the plans or required by the Engineer because of unsatisfactory appearance, the surface, after wetting, shall be uniformly covered with a grout consisting of one part cement to 1-1/2 parts fine sand, 703.03 and sufficient water to produce a consistency of thick paint. White portland cement and a bonding agent shall be used for all or part of the cement in the grout, as directed by the Engineer, to give the color required to match the concrete. The grout shall be uniformly applied with brushes or a spray gun, and all air bubbles and holes shall be completely filled. Immediately after the application of the grout, the surface shall be vigorously scoured with a cork or other suitable float. While the grout is still plastic, the surface shall be finished with a sponge rubber or other suitable float removing all excess grout. This finishing shall be done at the time when grout will not be pulled from the holes or depressions. After being allowed to thoroughly dry, the surface shall be vigorously rubbed with dry burlap to completely remove any dried grout. There shall be no visible film of grout remaining on the surface after this rubbing, and the entire cleaning operations of any area must be completed on the day it is started. If any dark spots or streaks remain after this operation, they shall be removed with a fine-grained silicon carbide stone, but the rubbing shall not be sufficient to change the texture of the surface. Unless otherwise directed by the Engineer, grout cleaning shall be delayed until the final clean up of the project.

Rubbed Finish. Forms shall be removed, if possible, within two days after concrete is placed. Corrections shall be made as outlined above. Rubbing of concrete shall be started as soon as the conditions will permit. Immediately before starting this work, the concrete shall be kept thoroughly saturated with water for a minimum period of two hours. Sufficient time shall have elapsed before wetting down to allow the mortar used in painting insert holes and defects to be thoroughly set. Surfaces to be finished shall be rubbed with a medium coarse silicon carbide stone until all form marks, projections and irregularities have been removed, all voids filled and a uniform surface has been attained. The paste produced by rubbing shall be left in place at this time. No additional material other than water shall be applied to the surface. After all concrete above the surface being finished has been placed, the final finish shall be obtained by rubbing with a fine silicon carbide stone and water. This rubbing shall be continued until the entire surface is of a smooth texture and uniform in color. Any surfaces which have been given a rubbed finish shall be protected from subsequent construction operations. Any surfaces not protected, shall be cleaned and again rubbed if necessary to secure a uniform and satisfactory surface.

511.16

No extra payment will be made for any type of surface finish, the cost being considered as included in the price bid for concrete.

511.16 Roadway Finish. Concrete deck slabs shall be finished in accordance with the requirements of 451.10 and 451.13, except that construction joints shall not be edged, and a strip of surface 9 to 12 inches wide adjacent to curbs (and barriers) shall not be grooved. The requirement for use of a finishing machine may be waived by the Engineer for small bridges where their use is impractical.

The finishing machine shall be self-propelled and shall be approved by the Engineer. It preferably shall be of sufficient size to finish the full width of the decks between curbs, but not less than the projected width of the approach pavement, except for slab bridges. For slab bridges, a longitudinal construction joint may be placed in the slab on the center line of the approach pavement, or as shown on the plans; and each side placed and finished separately. The wheels of the finishing machine shall run on temporary riding rails adequately supported on structural steel or falsework. If such rails are placed within the roadway area, they shall be elevated a sufficient distance above the slab to permit the simultaneous finishing by hand of any portions not finished by the machine. Any rail supports which extend through the roadway area of the slab shall be made and installed in such manner as to permit their removal to at least 2 inches below the top of the slab. Holes formed by the removal of such supports shall be filled during the final finishing of the slab. The concrete shall be delivered and distributed at a uniform and adequate rate ahead of the finishing machine by suitable mechanical equipment.

Bridge decks that are to be waterproofed with a membrane shall be given a burlap drag finish.

511.17 Sidewalk Finish. The concrete shall be struck off after placing with a template and finished in accordance with 456.03.

511.18 ODOT Class HP Concrete Testing. If included as a separate pay item, perform the following tests on the concrete.

A. Rapid Chlorine Permeability Tests. Perform test according to AASHTO T 277. Take a minimum of three tests for decks containing less than 100 cubic yards (75m³) of superstructure concrete. For all other decks, take six tests. Test deck superstructure concrete samples obtained from the actual concrete used.

Provide the Engineer with results of rapid chlorine permeability tests at 28, 56, and 90 days.

B. Drying Shrinkage Tests. Perform test according to ASTM C 157 and at the frequency specified for rapid chlorine permeability tests.

Provide the Engineer with drying shrinkage tests at 4, 7, 14, 28, 56 and 90 days.

C. Heat of Hydration Testing. Perform testing to determine the potential for length change due to thermal expansion and contraction. Immediately after placing the deck, install three thermometers into the fresh concrete at a location that is accessible for readings and representative of the overall deck pour. Locate the thermometer bulbs at 1 inch (25 mm) below the surface of the concrete, at approximately mid-slab, and at 1 inch (25 mm) above the bottom of the deck form. Leave the thermometers in place throughout the testing time. The Contractor may lubricate and place the thermometers in a thin plastic sheath to facilitate eventual removal.

Record temperatures at the following intervals:

Test Intervals	Time
2 Hours	First 12 hours
3 Hours	Second 12 hours
4 Hours	Second day
8 Hours	Third thru fifth day

Record the ambient air temperatures when taking concrete temperatures. Ensure that all testing is performed by a testing laboratory regularly inspected by the Cement and Concrete Reference Laboratories (CCRL). Furnish a copy of the last CCRL inspection report to the Engineer before the test slab pour.

If the Contractor uses ODOT HP 1 or 2 for parapets or substructures, perform three additional chloride permeability and shrinkage drying tests for the parapets or substructure concrete. If used for parapets, perform a heat of hydration test as described above with one thermometer located a 1 inch (25 mm) below the top of the parapet and a second thermometer located 19 inches (500 mm) below the top of the parapet, approximately midway between the front and back faces of the parapet. The Engineer will not require additional testing for units constructed with the same concrete mix option as the deck.

Tabulate test results on the attached form and forward the form to the City of Akron Testing Lab no later than 10 days following the completion of the tests.

After removing the thermometers, drill out and fill the holes as approved by the Engineer.

511.19 Method of Measurement. The yardage shall be the number of cubic yards determined by calculations from plan dimensions, in place, completed and accepted.

No deduction will be made for the volume of the reinforcing steel, conduits or structural steel other than beam flanges embedded in deck slabs. No deduction will be made for the volume of any embedded piles.

511.20

Superstructure concrete includes the concrete in defluctive parapets not having a metallic railing.

511.20 Basis of Payment. Payment for accepted quantities will be made at the contract price for:

<u>Item</u>	<u>Unit</u>	<u>Description</u>
511	Cubic Yard	Class ____ concrete, _____
511	Lump Sum	ODOT Class HP Concrete Testing

ITEM 512 TREATING CONCRETE

- 512.01 Description**
- 512.02 Materials**
- 512.03 Sealing of Concrete Surfaces**
- 512.04 Sealing Concrete Bridge Decks with HMWM Resin**
- 512.05 Soluble Reactive Silicate (SRS) Concrete Treatment**
- 512.06 Treating Concrete Bridge Decks with Gravity-Fed Resin**
- 512.07 Sealing Cracks by Epoxy Injection**
- 512.08 Waterproofing**
- 512.09 Method of Measurement**
- 512.10 Basis of Payment**

512.01 Description. This work consists of sealing and treating concrete surfaces, sealing cracks in concrete, and applying waterproofing to structures.

512.02 Materials. Furnish materials conforming to:

- Asphalt cement..... 702.01 (PG 64 - 22)
- Asphalt primer for..... 702.02 (RC-70 or RC-250),
waterproofing 702.05
- HMWM Resin..... 705.15
- Epoxy-Urethane Sealer 705.23.A
- Non-epoxy Sealer..... 705.23.B
- Soluble Reactive Silicate(SRS)..... 705.24
- Gravity Fed Resin 705.25
- Epoxy injection Materials 705.26
- Sand 703 with the following exceptions:
Maximum moisture content of 0.5 of the percent of absorption when treated according to California Test 226.
- Grading:

SIEVE SIZE	% PASSING MAX.
No. 4 (4.5mm)	100
No. 8 (2.36mm)	90 - 100
No. 20 (850µm)	5 - 15
No. 50 (300µm)	0 - 5

Emulsified asphalt primer,	702.04 (MS-2, SS-1)
Asphalt for waterproofing	702.06
Hot applied joint sealer	705.04
Type 3 membrane primer	705.04
Waterproofing fabric.....	711.24
Sheet Type 2 membrane waterproofing	711.25
Sheet Type 3 membrane waterproofing	711.30

512.03 Sealing of Concrete Surfaces This work consists of applying an approved sealer on existing and new concrete surface areas after the concrete is cured and repairs completed and cured. Apply the sealer to locations described in the plans. Apply the sealer listed in the pay item description. Choose a type of sealer if no sealer is listed in the pay item description.

A. Equipment. Use application equipment recommended by the sealer manufacturer. Use spray equipment, tanks, hoses, brooms, rollers, coaters, squeegees, etc., that are clean, free of foreign matter, oil residue and water.

B. Mixing. Mix the sealer according to the manufacturer's recommended procedures. Furnish the Engineer with the manufacturer's application instructions. Don't mix or apply the sealer until the manufacturer's written recommendations are supplied to the Engineer. Mix materials to a uniform consistency and maintain during application.

C. Storage. Store all sealer components in tightly sealed containers, in a dry location, and as recommended by the manufacturer. Deliver unopened drums or containers of the sealer or sealer components to the job site with the manufacturer's numbered seal intact.

D. Surface Condition. Apply sealers to surfaces which are dry, free from dust, dirt, oil, wax, curing compounds, efflorescence, laitance, coatings and other foreign materials. Repair any structurally unsound surfaces, weak sections or spalled areas before applying any sealer.

Air dry concrete surfaces for at least five (5) days after completion of required curing. Air dry any cavities which require grout filling and curing for five days. Do not apply sealer until the air drying is complete.

Seal accelerated cured precast concrete after it has attained the required 28 day strength and after any cavities which require grout filling have been filled, cured and air-dried for five days.

E. Surface Preparation. Remove dust, dirt, oil, wax, curing compounds, efflorescence, laitance, coatings and other foreign materials from surfaces to be sealed. Use chemicals or other cleaning compounds if removal requires their use but only use products approved by the sealer manufacturer. Furnish the Engineer

512.03

documentation of the sealer manufacturer's approval. Apply the sealer within 48 hours of surface preparation.

Install suitable traps, filters, drip pans and other separation devices in the cleaning equipment so oil and other foreign material isn't deposited on the surface.

Use the following cleaning methods depending on the surface type:

New water cured exposed concrete surfaces:

- Water blast at 7,000 psi (48 MPa) minimum

Exposed surfaces of new prestressed concrete box beams:

- Clean with high pressure hot water or steam jenny, or
- Water blast at 7,000 psi (48 MPa) minimum, or
- Sandblast, followed by air brooming or power sweeping, to remove dust and sand from the surfaces and opened pores

Existing concrete surfaces:

- Water blast at 7,000 psi (48 MPa) minimum, or
- Sandblast, followed by air brooming or power sweeping, to remove dust and sand from the surface and opened pores.

F. Application and Coverage.

Do not apply sealer if rain is anticipated within 2 hours after application. Clearly mark where the sealer application stops if not continuous.

1. Epoxy - Urethane sealers.

Apply each coat of the Epoxy-urethane sealer at the coverage rate specified on the Office of Materials Management's approved list. If no application rate is listed, apply each coat at 120 square feet per gallon (2.9 square meter/liter).

Only apply sealer when the surface temperature is 50° F (10° C) or above

Apply with a brush, squeegee, roller or spraying equipment and as recommended by the manufacturer.

Apply one coat of epoxy and one coat of the urethane top coat. Time between coats shall meet the manufacturer's recommendation. Use epoxy and urethane from the

same manufacturer. Achieve specified coverage regardless of the number of passes per coat.

Tint so the final color is Federal Color Standard No. 17778 - Light Neutral. Pigment content shall be limited so as not to reduce sealing effectiveness of the second coat. Refer to the plans for colors for specific projects.

Sags and runs are not acceptable in the sealer.

For sealed sidewalks or other horizontal surfaces with repetitive foot traffic or vehicular traffic, integrate 1-1/2 lbs. per square yard (0.8 kg/m²) of silica sand into the surface of the second coat to produce a non-skid surface satisfactory to the Engineer.

2. Non-epoxy sealer.

Apply the sealer according to the manufacturer's recommended mode of application and under the observation of the Engineer.

Coverage:

Surfaces subject to abrasive wear (bridge decks, bridge deck shoulders and sidewalks); Minimum, one gallon (3.875 liter) of sealer for each 100 square feet (9.0 square meter);

Curbs, vertical surfaces of beams and deck slabs subject to direct roadway drainage; Minimum, one gallon (3.875 liter) for each 125 square feet (11.5 square meter)

Other surfaces (for example, parapets, abutments, pier caps and median dividers) 3. Minimum, one gallon (3.875 liter) for each 150 square feet (14.0 square meter)

Apply sealer on surfaces in a one-pass operation at the required coverage. Acceptable applications saturate a horizontal surface and take a few seconds before completely penetrating. Broom in the sealer if recommended by the manufacturer.

Vertical surface sealer spraying will create runs. Acceptable applications of penetrating sealer developing 6 to 12 inch (150 to 300 mm) runs below the spray pattern. Apply additional passes in 10 to 15 minutes if coverage rate is not achieved with first pass. Apply sealers with brush or roller if recommended by the manufacturer.

After 10 to 15 minutes, squeegee off excess material on smooth finished or dense concretes where the required coverage is not absorbed.

For sealed sidewalks or other horizontal surfaces with repetitive foot traffic or vehicular traffic, integrate 1-1/2 lbs. per square yard (0.8 kg/m²) of silica sand into the sealer application to produce a non-skid surface satisfactory to the Engineer.

512.03

Tint clear non-epoxy sealers with a vanishing dye that will not damage the concrete.

Don't apply sealer if the ambient temperature is below 40° F (5° C) or will fall below 32° F (0° C) within 12 hours after application.

G. Test Site/Application. Apply sealer to measured coverage areas, both on a horizontal and vertical surfaces, and on different concrete types, demonstrating:

The project's visual effects for the epoxy/urethane sealer application at the required coverage rate.

Visually, the absorption necessary to achieve the specified coverage rate for the non-epoxy sealer. Use at least ½ gallon (2 liter) of sealer, following the manufacturer's recommended method of application, for the total of the test surfaces.

Apply to the deck, safety curb or sidewalk for the horizontal test surfaces and use an abutment parapet or pier face for the vertical test surface so different textures are tested.

H. Appearance. Epoxy/Urethane sealers. Uniform appearance and the final color shall visually match the test section. Re-coating, removal and re-application or other methods recommended by the manufacturer will be required to correct final appearance. Non Epoxy Sealers. The sealer shall result in a uniform appearance.

I. Traffic. Allow traffic on deck shoulder areas after 12 hours of drying time for an epoxy/urethane sealer. Keep traffic off a non-epoxy sealer until the sealer appears totally dry.

J. Safety Precautions. Follow precautions defined on the manufacturer's MSDS. Provide the Engineer a copy of the MSDS sheet for information before any work commences.

K. Protection of Adjoining Surfaces and the Public. Protect the public during all operations, especially when applying sealer to the fascia or the underside portions of a bridge that spans an area used by the public.

During sealing, mask off, or use other means of protection, for surfaces not being sealed. Protect asphalt and mastic type surfaces from spillage and heavy overspray.

Do not apply sealers to joint sealants which have not cured according to the manufacturer's instructions. Joint sealants, traffic paints and asphalt overlays may be applied to the treated surfaces 48 hours after the sealer has been applied. Protect nearby steel, aluminum or glass surfaces when non-epoxy overspray could be deposited on those surfaces.

L. Environmental Requirements. Protect plants and vegetation from overspray by covering with drop cloths.

512.04 Sealing Concrete Bridge Decks with HMWM Resin. This work shall consist of preparing and treating the concrete wearing surfaces of bridge deck with a penetrating sealer in accordance with these specifications, in reasonably close conformity with the plans and the manufacturer's recommendation and as directed by the Engineer.

A. Limitations. Do not perform this work during the period beginning November 1st and ending March 31st.

B. Surface Preparation. Remove roadway dirt and debris from the area of the deck to be treated. Sweep, sandblast, then with the use of a manual or power broom sweep and blow with compressed air so that the surfaces to which the sealer is to be applied is dry and free of dust and dirt. Use high pressure compressed air to blow all loose material from visible cracks. Fit the cleaning equipment with suitable traps, filters, drip pans, driers and other devices to prevent oil and other foreign material from being deposited on the surface. Do not allow traffic on the clean surface prior to application of the sealer. Remove existing pavement markings according to 621.20. Remove all traces of asphalt or petroleum products and concrete curing seals by abrasive blasting prior to air sweeping.

C. Installation. Provide a compatible promoter/initiator system capable of providing the same physical qualities of the hardened resin as if promoted/initiated with 2% cobalt naphthanate (6%) and 2% cumene hydroperoxide. Store materials at 65-80° F (18-27° C). Provide a system that has a resin gel time of not less than 40 minutes to not more than 1½ hours at the time and temperature of application.

Adjust the gel time to compensate for the change in temperature throughout the day. The temperature of the surfaces to be treated may range from 50° F (10° C) to 120° F (49° C). Arrange to have a technical representative on site to provide mixing proportions equipment suitability, and safety advice. Any conflict between these provisions and representative's advice shall be resolved at the job site. The technical representative shall remain at the job site until such time as he and the Engineer agree that the Contractor is qualified in all aspects of the application of the sealer.

Do not allow the promoter and initiator, if supplied separate from the resin, to contact each other directly. Do not store containers of promoter or initiators together in a manner that will allow leakage or spillage from one to contact the containers or materials of the other.

Machine application of the resin may be performed by using a two-part resin system utilizing a promoted resin for one part and an initiated resin for the other part. This two-part resin system may be combined at a spray bar through positive displacement atomization of the resin. Do not use compressed air to produce the spray.

512.04

Use appropriate cleaning and flushing of equipment, tools, etc., with an appropriate solvent, as approved by the Engineer, in such a manner to minimize personal and environmental hazards. Advise workman that the resin will soften gum rubber soles, and a face-mask should be used to protect from accidental splashes. Clothing and leather saturated with resin will harden and become useless.

Prior to resin application the surface to be treated shall be visibly dry and its temperature between 50° F (10° C) and 120° F (49° C). Do not apply the resin within 24 hours after a rain or when rain is forecast within 12 hours or when the ambient air temperature is below 50° F (10° C). Pre-mark the deck to control mixed material usage and to provide a rate of application of approximately 100 square feet per gallon (2.45m²/L). The exact rate shall be determined by the Engineer prior to commencing full-scale deck treatment operations.

Before using the material submit to the Director copies of the manufacturer certified test data showing that the material complies with the qualitative and quantitative requirements of this specification. The test data shall be developed by an independent approved testing laboratory, and shall include the brand name of the material, name of manufacturer, number of the lot tested and date of manufacture. When the material has been approved by the Director, further testing by the manufacturer will not be required unless the formulation of manufacturing process has been changed, in which case new certified test results will be required. The manufacturer shall certify that the formulation is the same as that for which data has been submitted. The state reserves the right to sample and test delivered lots for compliance.

Flood the deck surfaces resin, allowing penetration into the concrete and filling of all cracks. Limit the initiated mix of promoted resin to 5 gallons (19L) at a time for manual application. A significant increase in viscosity shall be cause for rejection. Apply the treatment within 5 minutes after complete mixing. Redistribute excess material by squeegee or brooms within 10 minutes after application.

Take all steps necessary to prevent the resin from flowing into lanes open to traffic. Broadcast sand over the entire treated area of the bridge deck by mechanical means to affect a uniform coverage of 0.80 to 1.2 pounds per square yard (0.43 kg/m² to 0.65 kg/m²). The sand shall be uniformly graded aggregate conforming to the quality requirements of 703 and shall conform to the following limits for grading:

Sieve Size	% Passing Max.
No. 4 (4.75mm)	100
No. 8 (2.36mm)	90-100
No. 20 (850µm)	5-15
No. 50 (300µm)	0-5

It is the intention of the specification to allow the use of commercially available blast sands applied by a common lawn broadcast type seeder/spreader. Place sand between 10 to 15 minutes behind the resin spreading front and before any jelling of the resin occurs. If the surface contains large deep cracks, the low-viscosity liquid could run completely through the concrete slab. Apply a second coat in these areas after the first coat has started to cure.

Before the monomer hardens, fill imperfections or spalls with standing liquid with commercial quality concrete or sandblast sand, and finished to a uniform surface. The sand shall have a maximum moisture content of 0.5 of the percent of absorption when tested in accordance to a California Test 226.

Do not permit traffic and equipment on the tested deck until it is tack free and a minimum of 6 hours have elapsed since treatment and the sand cover adheres sufficiently to resist brushing by hand. Protect the treatment from moisture for not less than 4 hours after placement.

512.05 Soluble Reactive Silicate (SRS) Concrete Treatment This item consist of the necessary labor, materials and equipment to prepare and treat portland cement concrete surfaces with a reactive silicate sealer meeting these specifications.

A. Equipment. Use application equipment that is recommended by the manufacturer. Use spray equipment, tanks, hoses, brooms, rollers, coaters, squeegees, etc., that are thoroughly clean, free of foreign matter, oil residue and water prior to applying the treatment.

B. Cleaning and Surface Preparation. Insure that surfaces which are to be treated meet the approved product's requirements for surface condition. Do not begin sealing until all concrete repairs have been completed and cured. Furnish the Engineer with written instructions for surface preparation requirements and have a representative of the manufacturer present to assure the surface condition meets their requirements.

At a minimum, thoroughly clean the surface to remove dust, dirt, oil, wax, curing components, efflorescence, latence, coatings and other foreign materials. Obtain the approval of the manufacturer or its representative before the use of chemicals and other cleaning compounds to facilitate the removal of these foreign materials. Apply the treatment within 48 hours following surface preparation.

Fit cleaning equipment with suitable traps, filters, drip pans and other devices to prevent oil and other foreign material from being deposited on the surface.

C. Test Application. Treat a measured test coverage area on horizontal and vertical surfaces of the different components of the structure to be treated for the purpose of demonstrating the desired physical and visual effect of an application or of obtaining a visual illustration of the absorption necessary to achieve the specified coverage rate prior to final application. In the latter case, use at least ½ gallon (2

512.06

liter) of treatment following the manufacturer's recommended method of application for the total of the test surfaces. Locate horizontal test surfaces on the deck and on the safety curb or sidewalk and locate vertical test surfaces on an abutment parapet and pier face so that the different textures are displayed.

D. Application. Apply the concrete treatment to concrete surfaces as designated on the plans. Apply the SRS by thoroughly saturating the concrete surfaces at an application rate specified by the manufacturer.

Apply the SRS when the concrete surface temperature is above 35° F (2° C). Use a surface thermometer on the concrete to establish the temperature of the concrete if the air temperature at the time of application is 45° F (7° C) or below.

Spread the SRS from puddles to dry areas.

If unable to complete the entire application continuously, note and clearly mark the location where the application was stopped.

E. Protection of Adjoining Surfaces and the Public. Protect by masking off or by other means adjoining surfaces of the structure which are not to be sealed when applying a treatment. Make provision to protect the public when treating the fascia of a bridge and/or portions of the underside of the deck of a bridge that spans an area used by the public.

Protect asphalt and mastic type surfaces from spillage and heavy overspray. Do not apply joint sealants, traffic paints and asphalt overlays to the treated surfaces until 48 hours after the treatment has been applied. Cover adjoining and nearby surfaces of aluminum or glass where there is a possibility of the treatment being deposited on the surfaces.

Protect plants and vegetation from overspray by covering with drop cloths. Follow precautions as indicated on the manufacturer's MSDS.

F. Opening to Traffic. Only allow traffic on a deck after a treated area does not track.

512.06 Treating Concrete Bridge Decks with Gravity-Fed Resin. This work shall consist of preparing and treating the concrete bridge deck with a gravity-fed crack welding system in accordance with these specifications in reasonably close conformity with the plans and the manufacturer's recommendations and as directed by the Engineer.

A. Limitations. Do not perform this work during the period beginning November 1st and ending March 31st.

Prior to resin application insure that the surface to be treated is visibly dry with a temperature between 40° F (4° C) and 100° F (38° C). Do not apply the resin within

24 hours after a rain, during rain, when rain is forecast within 12 hours or when the ambient air temperature is below 40° F (4° C).

B. Surface Preparation. First remove roadway dirt and debris from the area to be treated. Sweep abrasive blasted surfaces to which the sealer is to be applied, then manual or power broom swept and blown with compressed air so that they are dry and free of dust and dirt. Use high pressure compressed air to blow all loose material from visible cracks. Use a high pressure water blast followed by an air blast if particles are highly embedded in the cracks, to clean cracks. Fit the cleaning equipment with suitable traps, filters, drip pans, dryers and other devices to prevent oil and other foreign material from being deposited on the surface. Do not allow traffic on the clean surfaces prior to application of the sealer. Remove existing pavement marking according to section 641.10 of the ODOT CMS. Remove all traces of asphalt or petroleum products and concrete curing by the abrasive blasting prior to air sweeping.

C. Application. Pre-mark the deck to control mixed material usage and to provide a rate of application of approximately 100-150 square feet per gallon ($2.45\text{m}^2/\text{L}$ - $3.68\text{m}^2/\text{L}$). The Engineer will determine the exact rate but will not exceed 150 square feet per gallon ($3.68\text{m}^2/\text{L}$). Flood the area to be sealed with resin. Allow the resin to penetrate into the concrete and fill all cracks. Mix the resin to a limit of 5 gallons (191) at a time for manual application. Reject resin with a significant increase in viscosity. Redistribute excess material by a squeegee within 10 minutes after application. Front and back movement with the squeegee is recommended over cracks and patch perimeters to enhance penetration. Take all steps necessary to prevent the resin from flowing into lanes open to traffic. Broadcast sand over the entire sealed area of the bridge deck by mechanical means to effect a uniform coverage of 1 pound (0.45kg) per 2-3 square foot (0.1858-0.2787 square meter).

Protect the treatment from moisture for not less than 6 hours after placement.

D. Traffic. Do not permit traffic on the treated deck until the resin is tack free, a minimum of 6 hours has elapsed since treatment, and the sand cover adheres sufficiently to resist brushing off by hand.

512.07 Sealing Cracks by Epoxy Injection. This specification covers the repair of dry, moist or wet cracks or fractures that are 2 to 100 mils (50 to 2500 micrometers) in thickness in reinforced concrete members. The repair is by means of an epoxy injection system. This system shall consist of a paste epoxy used to seal the surface cracks and an injection epoxy used under low pressure, 200 psi (1400kPa) max., to penetrate and fill the cracks and bond the crack surfaces together. Material for each epoxy shall consist of a two-component modified resin bonding system. The unmodified resin shall be known as Component A and the hardener as Component B.

512.07

Arrange to have a manufacturer's representative at the job site to familiarize him and the Engineer with the epoxy materials, application procedures and recommended pressure practice. This representative shall direct at least one complete crack or area injection and be assured prior to his departure from the project that the personnel are adequately informed to satisfactorily perform the remaining repairs.

Furnish the Engineer a copy of the manufacturer's comprehensive preparation, mixing and application instructions which have been developed especially for use with the proposed epoxy injection system. Ensure that any significant changes to these instructions which are recommended by the representative for an unanticipated situation have been approved by the Engineer prior to the adoption of such changes.

Clean concrete surfaces adjacent to the cracks to be sealed only to the extent necessary to achieve an adequate bond with the paste epoxy, and only by procedures which will not cause abrasive grits or concrete dust to penetrate the cracks. Do not permit the use of solvents or thinners in cracks or on bonding surfaces.

Install injection ports or tees in cracks to be injected. Space injection ports or tees at 6 to 12 inches (150 to 300 mm) vertically and 6 to 18 inches (150 to 450 mm) horizontally but in no case closer together than the thickness of the concrete member if full depth penetration is desired unless otherwise specified or directed. Set ports or tees in dust free holes made either with vacuum drills or chipping hammers. Seal all surface cracks in the area to be repaired, after injection ports or tees have been inserted into the holes, with paste epoxy between ports to ensure retention of the pressure injected epoxy within the confines of the member. The Department will allow an alternative procedure of sealing the cracks before the injection holes have been made. Limit the application of paste epoxy to clean and dry surfaces. Limit substrate temperatures to not less than 45° F (7° C) during epoxy applications.

Begin the epoxy injection at the bottom of the fractured area and progress upward using a port or tee filling sequence that will ensure the filling of the lowermost injection port or tees first.

Establish injection procedures and the depths and spacings of holes at injection ports or tees. Use epoxy with flow characteristics and injection pressure that ensure no further damage will be done to the member being repaired. Ensure that the epoxy will first fill the innermost portion of the cracked concrete and that the potential for creating voids within the crack or epoxy will be minimized.

Remove the injection ports or tees flush with the concrete surface after the fractured area has been filled and the epoxy has partially cured (24 hours at ambient temperature not less than 60° F (16° C), otherwise not less than 48 hours). Roughen the surfaces of the repaired areas to achieve uniform surface texture. Remove any injection epoxy runs or spills from concrete surfaces.

Obtain two 4-inch (100 mm) diameter core samples in the first 100 linear feet (30 m) of crack repaired and one core for each 100 linear feet (30 m) thereafter. Take the

core samples from locations determined by the Engineer and for the full crack depth. Cores will be visibly examined by the Engineer to determine the extent of epoxy penetration. Repair the core holes in the concrete with material specified in 705.21.

512.08 Waterproofing

General. Apply an even and uniform coating of asphalt materials using brushes, squeegees, or spray equipment.

If using spray equipment, provide portable power pressure type spraying equipment capable of being moved to the location of the waterproofing operation.

Protect concrete surfaces not covered with waterproofing from overspray, spilling, or otherwise marring of the surface with the asphalt materials.

Ensure that the edge of any exposed application is sharply defined true to line with a uniform exposure.

Preparation of Surface.

Asphalt Materials: Remove concrete projections. Using wire brushes and clear water, remove dirt and the outside film of cement. Before applying asphalt materials, ensure that the concrete is clean and dry and the concrete temperature is at least 40° F (4° C).

Membranes: Remove protrusions from the concrete. Sweep off dirt and dust, and blow the concrete clean. Fill joints or cracks greater than 3/8 inch (10 mm) wide with portland cement mortar. In addition to the above, remove oil and grease from surfaces for Type 3 membranes using water and a detergent designed to remove oil and grease from concrete. Flush residual detergent from the surface. Do not allow traffic on the cleaned surface.

Primer Coat. Apply the primer coat at the rate of 0.10 to 0.15 gallon (0.50 to 0.70 L) of asphalt material per square yard (square meter).

For primer coats applied between June 1 and September 1, use asphalt primer for waterproofing or emulsified asphalt primer conforming to 512.02.

For primer coats applied between September 1 and June 1, use asphalt primer for waterproofing conforming to 512.02.

If practical, apply asphalt emulsion using spray equipment.

If subjected to traffic, spread sand on the primer coat for protection. Broom off excess sand before applying asphalt waterproofing.

Type A Waterproofing. This type of waterproofing consists of one primer coat and at least two coats of asphalt material conforming to 702.06 to provide a total of at

512.08

least 1 gallon (5 L) of asphalt per square yard (m^2) on flat areas and at least 1/2 gallon per square yard ($3 L/m^2$) on vertical or sloping surfaces. Start applying the waterproofing at the lowest point, and progress to a higher elevation. Uniformly cover the surface except apply more asphalt in corners and over construction joints. Apply the asphalt material at a temperature from 250° to 350° F (121° to 177° C).

Type B Waterproofing. This type of waterproofing consists of one primer coat, three coats of asphalt material conforming to 702.06, and two layers of waterproofing fabric conforming to 711.24 applied as follows:

1. On a clean, dry, and well-primed surface, apply a thorough coating of asphalt at a temperature from 250° to 350° F (121° to 177° C).
2. Apply the coating at a rate of at least 1/3 gallon per square yard ($1.5 L/m^2$) of surface.
3. While the asphalt is hot enough to penetrate the fabric, lay the fabric according to the following:
 - a. Surfaces Wider than Normal Fabric Strip. For the first strip, lay a half-width [normally 18 inches (0.5 m) wide] strip of fabric. For the second strip use a full-width strip of fabric, and lap the entire width of the first strip. Lap each succeeding strip 2 inches (50 mm) more than half its full width. Lap the fabric strips in the direction of water flow.
 - b. Surfaces with Same Width as Fabric Strip. For the first strip, lay a full-width strip. For the second strip, lay another full-width strip, covering the first.

Lay each strip without wrinkles, folds, or pockets. Thoroughly coat the strip with asphalt for the full width of the lap before laying the succeeding strip. Each application shall entirely conceal the texture of the fabric.

4. Apply a final coat of asphalt to provide a thorough covering for the fabric.
5. For all three coats, use a total of at least 1 gallon (5 L) of asphalt waterproofing material per square yard (m^2).

Lap ends of fabric strips at least 12 inches (0.3 m), and stagger the end joints.

Type D Waterproofing. This type of waterproofing consists of one primer coat, one layer of waterproofing fabric conforming to 711.24 over joints, three coats of asphalt material conforming to 702.06, and two shingled plies of asphalt saturated waterproofing fabric conforming to 711.24.

Prime the surface to be waterproofed and allow the primer to dry. Fill joints and irregularities in the surface with asphalt cement. Lay a layer of fabric extending at

least 9 inches (230 mm) on both sides of all joints. Leave the underside of this layer unbonded to the concrete surface.

Apply the asphalt at a temperature from 250° to 350° F (121° to 177° C) and conceal the texture of each layer of fabric with the asphalt. Use at least 1/3 gallon (1.5 L) of asphalt per square yard (m²) of surface for each application. Begin applying the asphalt and fabric at the low side or sides of the surface, and proceed toward the apex or high side so that water runs over and not against or along the laps of the fabric. Lay the fabric without wrinkles, folds, or pockets. Lap ends of fabric strips at least 12 inches (0.3 m), and stagger the end joints.

Start applying waterproofing by mopping asphalt on a surface slightly wider than half the width of the fabric strip. Immediately lay a half-width strip of the fabric onto the asphalt. Mop asphalt on this strip and an adjacent surface slightly wider than half the width of the fabric, and lay a full width of fabric that entirely covers the first strip. Mop asphalt on the second half of this second strip and an adjacent concrete surface and lay a third strip of fabric that laps the first strip at least 2 inches (50 mm). Continue this process of applying asphalt and laying fabric until the entire surface is covered and each strip of fabric laps the next to last strip already placed by at least 2 inches (50 mm). Finish laying fabric with a partial-width strip and mop the entire surface with asphalt.

Type 2 Membrane Waterproofing. This type of waterproofing consists of a rubberized asphalt and peel-and-stick waterproofing membrane 711.25. If the ambient temperature is below 50° F (10° C), use a manufacturer recommended primer coat for vertical surface application. After installing the primer coat, if required, remove the membrane's release liner and place the adhesive side on the prepared concrete surface. Lay the membrane smooth and free of wrinkles. Lap joints in membranes by at least 1 inch (25 mm). Store membrane materials indoors at temperatures not to exceed 120° F (49° C).

For precast concrete three- and four-sided structures, install Type 2 membrane on the exterior vertical and exterior top horizontal surfaces.

Type 3 Membrane Waterproofing. This type of waterproofing consists of a primer coat conforming to 705.04 and a waterproofing membrane consisting of a high density asphalt mastic between two layers of polymeric fabric conforming to 711.29.

Keep membrane and primer materials dry before installation.

Heat the membrane primer in an oil primer heated, double-jacket kettle. Use a kettle that is clean and free of other materials with any obvious buildup scraped out. The Contractor may use a single-jacket kettle if the primer is capable of being heated in direct fire to the application temperature. Heat primers within the manufacturer's recommended temperatures.

512.09

On bridges with curbs, apply the primer and membrane 3 inches (75 mm) up the curb face. On prestressed box beam bridges with no approach slab, apply the primer and membrane 6 inches (150 mm) over the ends of the beams. On prestressed and slab bridges with approach slabs, apply the primer 2 feet (600 mm) out onto the approach slab.

If the plans require a Type 3 membrane on the top exterior surface of precast concrete three- or four-sided structures, apply the primer and membrane to overlay the vertical exterior sides of the structure by 12 inches (300 mm).

Apply primer no further than 5 feet (1.5 m) in front of the membrane using a squeegee to fill all voids and imperfections. Apply membrane from the low to the high side of the surface. Apply an extra bead of primer at the edge of the membrane. Lap joints in membranes by at least 3 inches (75 mm). After installing the membrane over the entire surface, seal joints in the membrane by applying primer and smoothing with a V-squeegee.

512.09 Method of Measurement. The Engineer will measure Waterproofing, of the type specified, by the number of square yards (square meters) or on a lump sum basis.

The Engineer will measure the sealing of concrete surfaces, sealing of concrete bridge decks with HMWM resin and treating concrete bridge decks with SRS as the actual area in square yards (square meters) of surfaces treated.

The Engineer will measure the actual length in linear feet (meters) of crack repaired by epoxy injection.

512.10 Basis of Payment. The Engineer will pay for accepted quantities at the contract prices as follows:

The Engineer will consider the cost for the obtaining and repairing the two cores used by the Engineer to determine the extent of the epoxy penetration as incidental to the work of repairing the concrete by epoxy injection.

<u>Item</u>	<u>Unit</u>	<u>Description</u>
512	Square yards	Sealing of concrete surfaces
512	Square yards	Sealing of concrete surfaces (non-epoxy)
512	Square yards	Sealing of concrete surfaces (epoxy urethane)
512	Square yards	Sealing of concrete bridge decks with HMWM resin
512	Square yards	Treating concrete bridge decks with SRS
512	Square yards	Treating concrete bridge decks with Gravity-Fed Resin
512	Linear feet	Concrete repair by epoxy injection
512	Square Yard or Lump Sum	Type A Waterproofing

512	Square Yard	Type B Waterproofing
	Lump Sum	
512	or Square Yard	Type D Waterproofing
	Lump Sum	
512	or Square Yard	Type 2 Waterproofing
	Lump Sum	
512	Square Yard	Type 3 Waterproofing
	or Lump Sum	

ITEM 513 STRUCTURAL STEEL

513.01 Description

513.02 General

513.03 Material

513.04 Material Control

513.05 Care of Material

513.06 Workmanship and Straightening

513.07 Finish

513.08 Stiffeners

513.09 Fillers

513.10 Horizontally Curved Beams and Girders

513.11 Joints and Splices

513.12 Pin Holes

513.13 Pins and Rollers

513.14 Holes for High-Strength and Bearing Bolts

513.15 High-Strength Steel Bolts, Nuts and Washers

513.16 Bearing Bolts

513.17 Welding

513.18 Stud Shear Connectors

513.19 Threads for Bolts and Pins

513.20 Camber

513.21 Shop Assembly

513.22 Nondestructive Testing

513.23 Shipping, Storage and Erection

513.24 Cleaning ASTM A 588 Steel

513.25 Shop Painting

513.26 Method of Measurement

513.27 Basis of Payment

513.01 Description. This item shall consist of preparing shop drawings, and furnishing, fabricating, nondestructive testing, cleaning, shop painting, galvanizing, and erecting of all structural steel, and other structural metals, as specified. It shall also include any work required to move existing steel structures to the plan location,

513.02

to make necessary repairs and alterations, and to connect or join new with old construction.

513.02 General. 501 includes general information pertaining to structural steel fabrication and erection. Shop painting shall conform to 514.

Shop drawings required under 501.05 shall show details, dimensions, size of materials, match mark diagrams for field connections, and other information necessary for the complete fabrication and erection of the metal work. These drawings shall also show a diagram identifying, by some unique mark, each area of a welded splice to be covered by a single radiograph.

The shop drawings for all multiple span beam and girder bridges shall include an overall layout with dimensions showing the relative unloaded vertical and horizontal position of beam or girder segments with respect to a full length base or work line; camber and horizontal curvature of the beams or girders and the effect of deck surface profile shall be accounted for in this relationship. Required offsets for horizontal curvature shall be shown for each 10 feet of length.

Shop drawings shall specifically identify each piece of steel as to grade (ASTM designation). Pieces made of different grades of steel shall not be given the same assembling or erecting mark, even though they may be of identical dimensions and detail.

When changes on submitted drawings are requested by the Engineer and the Contractor makes changes in addition to those expressly requested, the next copy of prints submitted shall identify the additional changes with some suitable marking.

Deviation from the contract plans or approved shop drawings will not be permitted without the written order or consent of the Engineer. Requests for such deviation or change shall be submitted in writing. For changes in location or addition or elimination of splices, approval shall be obtained prior to ordering material. After approval by the Engineer, such plans shall be taken as supplemental to, but in no sense a substitute for, the original plan.

After shop drawings have been approved, the Fabricator shall furnish three complete copies of shop bills showing the weight of individual pieces, computed in accordance with 513.26 for approval of pay weights.

All steel fabrication including the shop coat of paint shall be performed in a structural steel fabricating shop having adequate size, equipment, heating and lighting facilities and experienced personnel to satisfactorily perform all necessary operations. Areas where flame cutting, air carbon-arc gouging, welding, cleaning and painting are performed shall be kept dry. The required air temperature levels shall be maintained while these operations are in progress. Shop assembly of large pieces for fit-up of field connections may be performed outdoors. The shop shall at all times provide an adequate number of supervisory and inspection personnel to

control the work properly and to assure satisfactory materials and workmanship. These provisions will not apply to steel requiring fabrication at the site in the repair, alteration or extension of an existing structure.

Where work consists of repairing and extending or altering existing structures the Contractor shall make such measurements of the original construction as may be required to join accurately old and new work. Shop drawings, when required, shall include these measurements. Measurements which may appear upon contract plans to indicate the extent and nature of such repair or extension shall not relieve the Contractor of this responsibility.

Fabricated material shall not be shipped from the shop without prior inspection unless such inspection is waived by the Engineer.

Shop inspection or approval of shop drawings by the Engineer shall not relieve the Contractor of responsibility for erroneous or inconsistent dimensions, notations, omissions or other errors. All parts forming a structure shall be built in accordance with approved drawings.

The Fabricator shall notify the Engineer at least two weeks in advance of the beginning of shop fabrication, and furnish a tentative fabrication schedule for the work. Notification of schedule changes shall be made as soon as practicable.

The Fabricator shall provide office accommodations having a minimum floor area of 120 square feet and a minimum ceiling height of 7 feet. This office shall be equipped with adequate working and storage facilities, lighting and electrical outlets. It shall have provisions for heating to a temperature of not less than 68°F and be adequately ventilated and maintained. It shall also contain a telephone with direct access to an outside trunk line which shall be for the exclusive use of the inspector.

The Fabricator shall cooperate fully with the inspector, in his inspection of the work in progress. This shall include the storage of members completed during the inspector's absence, in such a manner, that he can completely and safely inspect the finished work, unless such inspection has been waived.

In subsequent sections where the terms "Main," "Secondary," or "Detail" are used, it shall be understood that reference has been made as follows: "Main" refers to material, members and fasteners that are primarily stressed by live load and structure weight; "Secondary" refers to material, members and fasteners that do not directly support live load or main members; "Detail" refers to material, members and fasteners that are essentially nonstressed.

Where steel stamps are used for identification purposes, they shall be of the "mini-stress" or "stressless" type.

513.03

513.03 Material. Structural steel and other structure metals shall conform to 711, except that steel bar stock utilized for end dams and scuppers may be any weldable grade of low or mild carbon steel available commercially.

Welded stud shear connectors shall be in accordance with 513.18.

Steel plates for main and secondary members shall be cut and fabricated so that the primary direction of rolling is parallel to the direction of the main tensile or compressive stresses.

513.04 Material Control. Each piece of Steel to be fabricated shall be properly identified for the Engineer.

The issuance of cutting instructions by the Fabricator to the shop shall be by cross-referencing of the assembly marks shown on the shop drawings with the corresponding item covered on the mill purchase order. The Fabricator's system of assembly-marking individual pieces of steel and the issuance of cutting instructions shall be such as to provide a direct reference to the appropriate mill test report.

The Fabricator may furnish from stock, material that he can identify by heat number and mill test report.

Any excess material placed in stock for later use shall be marked with the mill test report number and the ASTM A 6 specification identification color code, if any, when separated from the full-size piece furnished by the supplier.

During fabrication, each piece of steel shall show clearly and legibly its specification identification color code and heat number.

Individually marked pieces of steel which are used in furnished size, or reduced from furnished size only by end or edge trim, that does not disturb the heat number or color code or leave any usable piece, may be used without further color coding provided that the heat number and color code remains legible.

Pieces of steel which are to be cut to smaller size pieces shall, before cutting, be legibly marked with the ASTM A 6 specification identification color code and heat number.

Individual pieces of steel which are furnished in tagged lifts or bundles shall be marked with the ASTM A 6 specification identification color code and heat number immediately upon being removed from the bundle or lift.

Pieces of steel which will be subject to fabricating operations such as blast cleaning, galvanizing, heating for forming, or other operations which might obliterate paint color code and heat number marking, shall be marked with steel stamps or by a substantial tag firmly attached, or shall be approved by the Engineer for obliteration of material identity markings.

513.05 Care of Material. Structural material shall be stored at the shop above the ground, upon platforms, skids or other supports. It shall be straight and have clean and dry surfaces before being worked in the shop. Any rusted or corroded material shall be cleaned prior to use and shall meet ASTM A 6 thickness tolerances after cleaning.

513.06 Workmanship and Straightening. If straightening of rolled material is necessary, it shall be done by methods that will not damage the member. When carefully planned and supervised, the application of localized heat is permitted for straightening. The temperature of the heated area shall not exceed 1200°F as controlled by pyrometric stick or thermometers. Quenching to accelerate cooling is prohibited.

Fabricated structural steel shall be within the dimensional tolerances specified by Articles 3.5 and 9.23 of the AWS Code, except where indicated otherwise in these specifications, and with the following additions. Waviness, the deviation of the top or bottom surface of a flange from a straight line or plan curvature, shall not exceed 1/8 inch when the number of waves in a 10 foot length is four or less, or 1/16 inch when more than four, but sharp kinks or bends shall be cause for rejection.

For the measurement of camber during laydown, the bearing points shall be relatively positioned both horizontally and vertically to plan dimensions \pm 1/8 inch.

513.07 Finish. Sheared edges of all main material shall be planed to a minimum depth of 1/4 inch except for ASTM A36 material having a thickness of 5/8 inch or less. Burrs and sharp edges shall be removed.

Structural steel permitted by these specifications may be flame cut, provided a smooth surface free from cracks and notches is secured and provided that an accurate profile is secured by the use of a mechanical guide. At the project site the use of a mechanical guide may be waived at the discretion of the Engineer.

Rolled and flame cut surfaces shall meet the requirements of AWS D 1.1 and Ohio Department of Transportation Supplement 1027.

The surface finish of bearing and base plates and other bearing surfaces that are to come in contact with each other or with concrete shall meet the ANSI surface roughness requirements as defined in ANSI B46.1, Surface Roughness, Waviness and Lay, Part I:

Steel slabs	ANSI 2,000
Heavy plates in contact in shoes to be welded	ANSI 1,000
Milled ends of compression members, milled or ground ends of stiffeners and fillers	ANSI 500
Bridge rollers and rockers	ANSI 250

513.08

Pins and pin holes	ANSI 125
Sliding bearings	ANSI 125

513.08 Stiffeners. The bearing ends or bearing stiffeners shall be flush and square with the web and shall have at least 75 percent of this area in contact with the inner surface of the flange. The other end of the stiffener shall have a tight fit as defined below. Bearing stiffeners shall be positioned to be vertical after erection.

Intermediate stiffeners to which crossframe angles are connected shall be welded to the top and bottom flange. Where intermediate stiffeners are not used in pairs they shall be welded to the compression flange. A tight fit is defined as one in which the stiffener and flange are in physical contact over some portion of the end of the stiffener and having no gap in excess of 1/16 inch. Welds attaching stiffeners to the web plate shall not extend into the clip area.

All stiffeners shall be clipped to clear flange-web welds and fillet of rolled shapes. The clip shall be 2-1/2 inches along the web and 1 inch along the flange.

513.09 Fillers. Fills shown on the shop drawings shall be dimensioned to the nearest 1/16 inch in thickness, but not less than 1/8 inch thick, based on the dimensions for detailing and intended relative position of the abutting elements to be spliced. However, in the final shop assembly, fills shall be furnished with thicknesses sufficient to compensate for any misalignment of abutting elements due to standard rolling mill tolerances. The actual fills used shall be such as to compensate for differences in total thickness or relative positions of more than 1/16 inch.

Fill plates in bolted joints shall be made flush with the perimeter of the splice plates and not be tack welded.

513.10 Horizontally Curved Beams and Girders. Beams and girders shall be heat curved as specified by AASHTO Standard Specifications for Highway Bridges, except that flanges for girders may be cut to shape.

When members are to be heat curved, the detailed procedure including necessary calculations shall be submitted with the shop drawing for approval prior to starting work.

513.11 Joints and Splices. In bolted construction where tension or flexural members are spliced, not more than 1/4 inch clearance will be allowed between the abutting surfaces of spliced members. For spliced compression members, the abutting surfaces shall be truly faced so as to have a uniform bearing when properly aligned and completely bolted.

In welded construction, all abutting surfaces shall receive the proper joint preparation as shown on approved shop drawings. The preparation for field welded

butt joints in main members shall be verified by a complete shop assembly as specified in 513.21.

Any opening in a joint or splice in the finished structure that allows the entrance of water shall be filled as directed by the Engineer with an approved caulking before paint is applied.

513.12 Pin Holes. Pin holes shall be bored true to gage, at right angles to the axis of the member and parallel to each other. The boring shall be done after the member is completely fabricated.

Pin holes for up to 5 inch diameter pins shall not exceed the pin diameter by more than .020 inches; holes for larger pins shall not exceed the pin diameter by more than .031 inches.

513.13 Pins and Rollers. Pins and rollers shall be of cold rolled steel and accurately turned to gage; they shall be straight and smooth and entirely free from flaws.

Pins over 9 inches in diameter shall be annealed. In pins larger than 9 inches in diameter, a hole not less than 2 inches in diameter shall be bored full length along the axis.

One pilot and one driving nut shall be furnished for each size of pin.

513.14 Holes for High-Strength and Bearing Bolts. Holes shall be cylindrical, perpendicular to the member, clean cut, and free of ragged edges. All burrs shall be removed by countersinking not more than 1/16 inch or by grinding. The finished size of the holes for high-strength bolts shall be not larger than the nominal diameter of the bolt plus 1/16 inch and for bearing type bolts the holes shall provide a driving fit. The diameter shall not vary by more than 1/32 inch from a true circle for 85 percent of the holes in a contiguous group, and not more than 1/16 inch for the remainder.

Punched holes shall be made with a die whose diameter does not exceed that of the punch by more than 1/16 inch.

Reaming and drilling shall be done with twist drills, and wherever possible the reamer shall be directed by mechanical means.

Holes for shop bolts shall be subpunched or subdrilled 3/16 inch less in diameter than the nominal diameter of the bolt, and shall be reamed to size with the parts assembled, except:

1. A36 material thicker than 3/4 inch and high strength material thicker than 5/8 inch shall not be punched.

513.14

2. Materials assembled and adequately clamped together may be drilled full size.
3. Secondary and detail material of A36 steel not thicker than 3/4 inch and high-strength steel not thicker than 5/8 inch fastened with high strength bolts may be punched full size.

Holes for field bolts shall be made in the same manner as holes for shop bolts except:

1. Field splices in and connections to main material shall be reamed or drilled assembled. See 513.21.
2. Assemblies such as floor beams to girders and rolled beam spans connected by diaphragms may be made through steel templates.

All holes punched full size, subpunched, or subdrilled shall be located with sufficient accuracy that after assembling (before subpunched or subdrilled holes are reamed) a cylindrical pin 1/8 inch less in diameter than the nominal size of the punched hole may be entered perpendicular to the face of the member without drifting in not less than 75 percent of the contiguous holes in the same plane. All holes shall permit a pin 3/16 inch smaller than the nominal size of the punched holes to be inserted in the above manner.

After holes are reamed or drilled full size, 85 percent of the holes in any contiguous group shall have no offset greater than 1/32 inch between adjacent plies; the remainder of the holes shall not be offset more than 1/16 inch between adjacent plies.

Plugging of improperly located holes is permitted only as approved by the Engineer.

Steel templates shall have hardened bushings in holes accurately located in relation to the centerline of the connection as inscribed on the template. The template shall be accurately positioned and bolted or clamped firmly in place prior to its use in reaming or drilling full-size holes. Templates used for reaming matching members or the opposite faces of a single member shall be exact duplicates. Templates used for connections on like parts or members shall be located with sufficient accuracy that the parts or members are duplicates and require no individual match marking.

Holes through multiple plies shall be reamed or drilled full size only when the plies of the joint are held tightly together with bolts or clamps. The joint shall also be pinned if the holes have been subpunched or subdrilled. The plies shall be disassembled and cleaned of burrs and shavings prior to final assembly.

513.15 High-Strength Steel Bolts, Nuts and Washers. High strength steel bolts, nuts and washers shall meet the provisions of 711.09.

1. General. The Engineer shall be furnished the necessary access to the work in order that he may observe the installation, tightening and checking of the bolts.

Based on the experience gained by the Engineer and Contractor during the use of the below described installation and inspection procedures for a particular bridge, the Engineer may elect to modify the amount of testing specified in order to expedite the work while still accomplishing properly compacted joints and tightened bolts.

Consideration will be given to the use of other fastening systems or assemblies and bolt tightening procedures, if a written request is submitted to the Engineer in accordance with 108.05.

The required bolt length shall be determined by adding to the grip the value shown in Table 1. The table values are generalized, with an allowance for manufacturing tolerances, to provide for the nut and a positive "stick-through" at the end of the bolt. For each hardened flat washer that is used, add 5/32 inch, and for each beveled washer add 5/16 inch. The length determined by the use of Table 1 should be adjusted to the next 1/4 inch so that when installed, the end of the bolt shall project several thread lengths outside the face of the nut.

TABLE 1

Bolt Size	To determine required bolt length, add to grip* inches
1/2	11/16
5/8	7/8
3/4	1
7/8	1-1/8
1	1-1/4
1-1/8	1-1/2
1-1/4	1-5/8
1-3/8	1-3/4
1-1/2	1-7/8

*Total thickness of all connected material exclusive of washers.

Washers may when necessary be clipped at one location not closer than 7/8 of the bolt diameter from the center of the washer.

2. Preparation. Joint surfaces, including those adjacent to the bolt heads, nuts or washers, shall be free of paint (except for inorganic zinc primers), lacquer, dirt, oil, loose scale, rust, burrs, pits and other substances or defects which would prevent solid seating of the parts or would interfere with the development of complete frictional contact. No gaskets or other yielding material shall be interposed.

Bolts, nuts and washers are normally received with a light residual coating of oil and galvanized nuts are provided with additional lubricant. These coatings are not detrimental and need not be removed. However, no additional oil or grease shall be applied.

Hot-dip galvanized contact surfaces shall be lightly scored by wire brushing or brush blasting prior to assembly.

3. Installation. In the final assembly of the parts to be bolted, drift pins shall be placed in a sufficient number of holes (preferably not less than 25 percent for field erection) to provide and maintain accurate alignment of holes and parts, and sufficient bolts shall be installed and brought to a snug tight condition to bring all parts of the joint into complete contact. However in each flange and web of each beam or girder a minimum of two drift pins shall be used. Snug tight shall be defined as the tightness attained when an impact wrench begins to impact or when the full effort of a man using an ordinary spud wrench is applied. Bolts shall then be installed in any remaining open holes and tightened to a snug tight fit, after which all bolts shall be tightened completely by the turn-of-nut method. Where difficulty is experienced with the fit of the connection and the bolts are used to draw the elements into contact, the bolts in the affected portion of the connection shall be checked for sustained snug tightness after all the bolts are installed. Drift pins shall then be replaced with bolts tightened in the same manner.

After the bolts are snug tight, the outer face of the nut shall be match-marked with the protruding portion of the bolt to provide the Engineer visual means of determining the relative rotation occurring between the bolt and nut during the process of final tightening. Such marks shall be made by the wrench operator with crayon or paint.

Each bolt shall have a hardened washer under the element (nut or bolt head) turned in tightening. Where an outer face of the bolted parts has a slope of more than 1:20 with respect to a plane normal to the bolt axis, a smooth beveled washer shall be used to compensate for the lack of parallelism.

Galvanized A 325 bolts shall not be reused. Retightening previously tightened bolts, which have become loose by tightening adjacent bolts, is not considered a reuse.

4. Tightening. Tightening of the bolts in a joint should commence at the most rigidly fixed or stiffest point, and progress toward the free edges, both in the initial snugging up and in the final tightening. If required because of bolt entering and wrench operation clearances, tightening may be done by turning the bolt. Impact wrenches, if used, shall be of adequate capacity to perform the required tightening of each bolt in approximately ten seconds.

5. Bolt Tension. Each bolt shall be tightened to provide, when all bolts in the joint are tight, at least the minimum bolt tension shown on Table 2 for the size of bolt used.

TABLE 2
BOLT TENSION

Bolt Size inches	Bolt Tension* kips, minimum A 325
1/2	12
5/8	19
3/4	28
7/8	39
1	51
1-1/8	56
1-1/4	71
1-3/8	85
1-1/2	103

*Equal to 70 percent of specified minimum tensile strengths of bolts, rounded off to the nearest kip.

The bolt tension specified in Table 2 shall be attained by tightening all bolts in the joint the applicable amount of nut rotation specified in Table 3 by the turn-of-nut method.

**TABLE 3
NUT ROTATION FROM SNUG TIGHT CONDITION**

Bolt Length (as measured from underside of head to extreme end of point)	Disposition of Outer Faces of Bolted Parts		
	Both faces normal to bolt axis	One face normal to bolt axis and other face sloped not more than 1:20 (bevel washer not used)	Both faces sloped not more than 1:20 normal to bolt axis (bevel washers not used)
Up to and including 4 diameters	1/3 turn	1/2 turn	2/3 turn
Over 4 diameters but not exceeding 8 diameters	1/2 turn	2/3 turn	5/6 turn
Over 8 diameters but not exceeding 12 diameters	2/3 turn	5/6 turn	1 turn

Nut rotation is relative to bolt, regardless of the element (nut or bolt) being turned. For bolts installed by 1/2 turn and less, a tolerance of plus or minus 30 is permitted; for bolts installed by 2/3 turn and more a tolerance of plus or minus 45 is permitted.

6. Inspection. (a) The first completed connection of each bridge on the project and as many subsequent connections as are deemed necessary by the Engineer shall be inspected as per paragraph (b) below. Thereafter where the Engineer has approved the joint compactness and snug tight condition of bolts prior to bolt tightening by the turn-of-nut method, the bolt tension as required in Table 2 shall be considered as attained if the amount of nut rotation specified by Table 3 is verified by the required match-marking.

(b) Bolts shall be inspected by the use of manual torque wrenches furnished by the Contractor. This testing shall be witnessed by the Engineer and shall be performed to his satisfaction. The inspection wrenches shall be calibrated at least once each working day, in a device capable of indicating bolt tension. In this device, which shall have been approved by the Engineer, three bolts representative of the grade, size, length and condition used in the structure shall be placed and tensioned individually. A washer shall be used under the part being turned.

(c) Each of the three bolts shall be tightened in any convenient manner to the tension shown in Table 2. Then the inspection wrench shall be applied by a slow steady pull to the tightened bolt and the torque required to turn the nut or head 5 degrees (approximately 1 inch at a 12 inch radius) in the tightening direction shall be

determined. The average torque measured in the tensioning of the three bolts shall be taken as the job inspection torque.

(d) Bolts represented by the sample described in paragraph (b) which have been tightened in the structure, shall be inspected by applying, in the tightening direction, the inspection wrench and its job inspection torque to 10 percent of the bolts, but not less than two bolts, selected at random in each connection. If no nut or bolt head is turned by this application of the job inspection torque the connection will be accepted as properly tightened. If any nut or bolt head is turned by the application of the job inspection torque, this torque shall be applied to all the bolts in the connection, and all bolts whose nut or head is turned by the job inspection torque shall be tightened with the inspection wrench to the job inspection torque. The connection shall then be reinspected in the original manner.

7. Calibration Devices. Each calibration device shall be periodically examined by a manufacturer of such devices or by a qualified testing laboratory. Such examination shall be made at least once each year or more often if requested by the Engineer. The testing agency shall certify that each calibration device furnishes, after recalibration if necessary, an accurate indication of actual bolt tension.

513.16 Bearing Bolts. Turned, ribbed or other approved bearing type bolts shall meet the provisions of 711.10. The bolts shall be of sufficient length to project at least 1/4 inch beyond the nut when tightened and the threads on the projecting end shall be burred. The thread shall not extend into the shear planes of the contact surfaces between the connected parts. In determining whether the bolt threads are excluded from the shear planes, thread length of bolts shall be calculated as two thread lengths greater than the specified thread length as an allowance for thread run out. A washer not thicker than 1/4 inch may be used under the nut.

513.17 Welding. All welding shall be performed by the shielded metal-arc, submerged arc, gas metal-arc, flux cored arc, or stud welding process. Consideration will be given to other methods of metal-arc welding if a written request is submitted to the Engineer in accordance with 108.05.

In other respects, the AWS Structural Welding Code modified by Ohio Department of Transportation Supplements shall govern.

513.18 Stud Shear Connectors. Stud welding shall conform to the requirements of 513.17, to the AWS Structural Welding Code modified by Supplement 1027 and the following.

Stud shear connectors that are to be welded to the top flanges of beams or girders shall be placed after the steel has been erected and suitable scaffolding or deck forming has been provided. Studs that are to be welded to beam or girder webs, end dams, bearing plates, or to other secondary members and detail material may be placed in the shop.

513.19

In addition to the stud bend tests of supplement AWS 4.24 and 4.25, bend tests of stud shear connectors shall also be made at the start of each work day, when welding has been interrupted for an hour or more, when changing grounds, when changing weld settings or when changing cable loop due to arc blow. In any case, no more than 500 studs shall be welded to a beam or girder without the welds being field bend tested in accordance with the specified procedure. All tested studs that show no sign of failure as determined by the Engineer shall be left in the bent position.

513.19 Threads for Bolts and Pins. Threads for bolts and pins shall conform to the Unified Standard Series UNC-ANSI B1.1 Class 2A for external threads and Class 2B for internal threads except that pin ends having a diameter of 1-3/8 inches or more shall be threaded 6 threads to the inch.

513.20 Camber. Rolled beams shall be cambered as called for on the plans in the fabricating shop by use of heat or hydraulic jacks. Heating shall be controlled as specified in 513.06.

Plate girders shall be cambered by trimming web plates prior to assembly.

Camber shall provide a smooth unbroken curve over the full length of the member.

During fabrication, shipping and erection, members shall be so supported and handled that camber is maintained.

513.21 Shop Assembly. All contact surfaces shall be free of paint, grease, oil, rust, loose mill scale and protruding edges or burrs.

The flanges and webs of plate girders shall not be assembled and welded to form the girder, nor shall any fabrication or assembly which would interfere with the repair of a butt weld be accomplished until radiographs of all butt welds in the component parts are examined and approved by the inspector.

All fit-up work shall be done with the members assembled in their unloaded position as shown on the shop drawings layout required by 513.02. While assembled in the shop, members shall be adequately supported to prevent misalignment or deflection, especially at joints. Supports shall be designed to prevent settlement during the fit-up, reaming or drilling of connections. The Fabricator shall maintain records of the actual dimensions and relative positions of each assembly and furnish a copy to the Inspector; this provision shall apply to both horizontal and vertical dimensions. Members that become a part of two assemblies shall be repositioned for the second assembly to the dimensions recorded for the first assembly.

All connecting parts assembled in the shop for the purpose of reaming or drilling of holes for field connections or for fit-up of field welded connection shall be match-marked with steel stamps prior to disassembly.

Continuous beam and plate girders, including sections adjacent to hinged or pin connected joints exclusive of those having sliding bearings loaded in compression, shall have at least three adjacent segments assembled and holes reamed or drilled while assembled. The fit-up of field welded connections shall be checked by similar shop assembly.

Transverse girders, floor beams, and diaphragms into which longitudinal girders or beams frame or connect, shall be shop assembled to check fit-up of connections to be field welded or to ream or drill holes for bolted connections.

Trusses shall be assembled in lengths not less than three abutting panels before field connections are drilled or reamed while assembled.

Deck expansion devices shall be shop assembled after fabrication to check fit-up, straightness and roadway crown.

Parts not completely assembled in the shop shall be secured by bolts, as far as practicable, to prevent damage in handling and shipping. Field splice plates may be bolted in their final position in the shop or shifted laterally with respect to their final positions so that the ends of the plates are flush with the ends of the member.

Welding or tacking will not be permitted on bolted assemblies unless shown on the shop plans and approved by the Engineer. Authorized welding shall be performed according to 513.17.

513.22 Nondestructive Testing. Nondestructive testing shall conform to the AWS Structural Welding Code modified by Ohio Department of Transportation Supplements and this item.

Welded repairs in main members for thick scabs, deep kerfs or nicks, misplaced holes and similar gross flaws shall be subject to ultrasonic or radiographic inspection as directed by the Engineer.

All examined welds and base metal adjacent to a welded joint shall be subject to the quality requirements specified in 513.17. Welds requiring nondestructive testing shall be allowed to cool before they are tested.

Where controversy may arise, regarding the interpretation of radiographs, magnetic particle indications or the acceptability of welds, the Engineer shall have the final authority to approve the welds.

A. Radiographic Inspection of Welds. Radiographic inspection shall be made of the following welds:

- (1) The full length of all butt welds in flange material of plate girders or rolled beams.
- (2) The top and bottom one-third of transverse web splices in plate girders or rolled beams including the cope holes, if any.
- (3) Butt welds in longitudinal stiffeners attached to tension areas of webs.
- (4) Twenty-five percent of each longitudinal web splice as selected by the inspector.
- (5) Any other weld specified by the plans.

The radiograph identification mark shown on the shop drawing layout shall be stamped in the area marked "Weld Identification" of AWS Code Figure 6.10.5a in a manner to make it visible in the radiograph of the area without resorting to superimposed like markings. Stamped identification marks on flange plates shall be placed, so that after assembly of girders, they will be on inside of flange, but out of the area to which the web will fasten. Films of repaired welds shall also be identified by the letter "R." Stamped identification numbers shall not be placed within the weld area. Other required markings shall be made by using superimposed characters.

Where areas being radiographed are adjacent to the edge of the plate, the film shall be located and a technique employed which will include the top and bottom images of the plate edge.

Films 4-1/2 by 17 inches shall be used where practicable; the minimum film size shall be 4-1/2 by 10 inches.

Whenever an unacceptable weld occurs in the web sections enumerated, an adjoining 12 inch length of weld not previously examined shall be radiographed; if unacceptable flaws are found in this adjoining segment, the remainder of the weld (if any) shall be examined.

Radiographs submitted to the Inspector shall be accompanied by certification from the Contractor or Fabricator that the radiographic examination was performed in conformance to these specifications and by two copies of the radiographic technician's analysis report listing unacceptable defects and causes for rejection. The technician's report shall also include identification and energy level or source strength in curies of the radiation source, film to source distance, film type, and exposure time for each radiograph as well as the signature of the technician and his NDT level. The contact films shall become the property of the City.

B. Magnetic Particle Inspection of Welds. Dry powder magnetic particle inspection shall be made of at least one foot of each ten feet or fraction thereof for each size of weld in the following:

- (1) Flange-to-web welds
- (2) Moment plate to flange welds
- (3) Bearing stiffener welds
- (4) Other welds designated by the plans.

Test sections shall be random locations selected by the Inspector, and the examination shall be conducted with the Inspector observing. The Fabricator shall notify the Engineer at least 48 hours in advance of such inspection. Requests for an Inspector to observe the examination shall be limited to not less than 500 feet of weld unless a lesser amount constitutes the entire project.

The Fabricator shall position the weldments as necessary for the inspection with consideration of safety and convenience to the inspecting personnel.

Weldments shall be inspected after they have been cleaned. Test equipment shall be provided with a functioning ammeter. The magnetizing current shall be 100 amperes per inch of prod spacing but not less than 400 amperes.

When unacceptable defects are found in a section, both adjacent 5 foot segments, or the full length of the weld if it is a lesser amount, shall be tested. Welds requiring repair shall be retested after repairs are completed.

Not all of the enumerated subsurface defects of Article 9.25 of the AWS Code will be located by an inspection of this type. Welds shall be considered unacceptable if they produce such indications that are, in the Inspector's opinion, in excess of the above quality standards.

The Fabricator shall record for each structural member the location of inspected areas, the location and description of any defects found, and repairs made. This report shall be submitted to the Engineer.

C. Ultrasonic Testing of Welds. Ultrasonic inspection shall be made of the following:

- (1) At least 1 foot in each 10 feet or fraction thereof at locations selected by the Inspector of all complete joint penetration flange-to-web welds.
- (2) Other welds designated by the plans.

513.23 Shipping, Storage and Erection. Structural members shall be loaded, transported, unloaded, stored and erected in such a manner that they will not be excessively stressed, deformed or otherwise damaged.

513.23

During transport, adequate blocking shall be in place between members to prevent movement and facilitate unloading. Field connection holes shall not be used for tie-down unless they are reinforced by additional plates, angles or other material bolted in place. Bearing components shall be banded together.

Material to be stored either in the fabricating shop or in the field shall be placed on skids or blocks to prevent the metal from coming in contact with the ground. Girders and beams shall be placed and shored in an upright position for shipment and both field and shop storage. All material shall be kept clean and properly drained.

Bearing devices and anchorages shall be installed according to 516.

Bearing surfaces and surfaces to be in permanent contact shall be thoroughly cleaned before the members are assembled. During erection, drifting will be permitted to draw the parts into position, but the holes shall not be enlarged nor the metal distorted.

Erection (drift) pins shall be cylindrical and not more than 1/32 inch smaller than the diameter of the hole.

Field splices and connections shall have not less than one-half of the holes filled with pins and snug tight bolts (preferably half bolts and half pins) before the member is released from the hoisting equipment. Field splices and connections commenced prior to erection of the connected parts shall be completed before erection.

Splices and connections subject to construction loads during erection shall have not less than three-fourths of the holes so filled.

Permanent fastening of steel truss tension chord members shall be completed before the falsework is removed, but compression chord members shall not be permanently fastened until the span is released sufficiently from the falsework to bring the compression chord joints into full bearing. Elevations of panel points and ends of floor beams shall be properly regulated and maintained until the falsework is removed.

Enlarging by any method the holes of splices and/or connections between segments or elements of Main members is prohibited without prior approval of the Engineer.

Structures shall be adjusted to correct alignment and camber before permanent fastening is begun.

Crossframes and lateral bracing in continuous beam or girder spans shall not be permanently fastened in any span until all Main connections in adjacent spans have been completed; however, sufficient bracing shall be installed to meet the

requirements of 501.06. Where erection bolts are used, they shall be not less than 5/8 inch diameter. Bolts for unpainted applications of A 588 steel shall be A 325, Type 3. Erection bolts shall remain in place with the nut tightened and tack welded to the bolt.

End crossframes and end dams shall be erected in a manner that assures all bearing parts will remain in bearing contact.

513.24 Cleaning ASTM A 588 Steel. The exposed surfaces of ASTM A 588 steel that are to be left unpainted shall be free from grease, oil, chalk marks, paint, concrete splatter or other soilage. The use of acid for cleaning will not be permitted.

The outside surfaces and the bottom surface of the bottom flange of the fascia beams (girders) shall be blast cleaned to grade Sa 1 after the superstructure concrete has been placed.

513.25 Shop Painting. Steel surfaces specified to be painted shall receive a prime coat applied in the shop (except that structural steel joints containing elastomeric compression seals shall not be painted). Payment for which is included in the price bid for structural steel.

513.26 Method of Measurement. Structural steel shall be measured by the plan weight of steel, or by a lump sum, as shown on the plans.

The quantity of structural steel to be paid for shall be the number of pounds as computed from the approved shop drawing by using a unit weight of 490 pounds per cubic foot. Waste material, such as is removed by burning, cutting, machining, etc., shall not be considered as pay weight except for that material removed in the edge preparation for groove welds. Material removed to form bolt holes shall be included in the pay quantity provided that only those portions of the bolts projecting beyond the holes are included for payment. Only bolts and materials that remain in place shall be included. Any thickness and weight of members in excess of that called or on the plans (due to overweight or other cause) shall not be included in determining the weight to be paid for, unless an increase in size of a member has been requested by the Engineer.

Pay weight for steel castings shall be based on scale weights of the finished pieces prior to painting. Castings shall be weighed by the Fabricator, in the presence of the Inspector, and weights recorded on shop bills.

The weight of paint coat, galvanized coat, run-off bars, and weld metal in all field welds and shop butt welds shall not be included. Fillet welds may be included if completely itemized.

The weight of other metals and preformed bearing pads not separately itemized is to be included with the structural steel. The following unit weights in

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pounds per cubic foot shall be used: cast steel and deposited weld metal 490, cast iron 450, phosphor or leaded bronze 550, lead 710. The weight of preformed bearing pads shall be calculated as an equivalent volume of lead.

The number of welded stud shear connectors to be paid for shall be the actual number installed and accepted.

513.27 Basis of Payment. Payment for accepted quantities will be made at the contract prices for:

<u>Item</u>	<u>Unit</u>	<u>Description</u>
513	Pound	Structural steel (AISC Certification not required)
513	Pound	Structural steel (AISC Category I)
513	Pound	Galvanized structural steel (AISC Category I)
513	Pound	Structural steel (AISC Category III)
513	Pound	Fracture critical structural steel (AISC Category III)
513	Each	Welded stud shear connectors

ITEM 514 PAINTING

514.01 Description

514.02 General

514.03 Materials

514.04 Shop Painting New Steel

514.05 Field Painting New Steel

514.06 Cleaning Existing Steel

514.07 Field Painting Existing Steel

514.08 Painting Wood

514.09 Soil Testing

514.10 Method of Measurement

514.11 Basis of Payment

514.01 Description. This item shall consist of furnishing all paint and incidental materials, cleaning the surfaces, and applying the paint as specified, including soil testing if specified on the plans.

514.02 General.

(1) Provisions for Field Inspection. In addition to the requirements of CMS 105.12, the Contractor shall furnish and erect scaffolding or other appropriate access to permit inspection of any portion of the bridge during all phases of the cleaning and painting operations and after the painting is completed. Scaffolding shall meet Ohio Administrative Code and O.S.H.A. requirements. Rubber rollers, or other protective devices meeting the approval of the Engineer shall be used on

scaffold fastenings. Metal rollers or clamps and other types of fastenings which will mar or damage freshly coated surfaces shall not be used.

(2) Protection of Persons and Property. The Contractor shall protect all portions of the structure which are not to be painted against damage or disfigurement by splashes, spatters or smirches of paint.

For bridges over railroad tracks the Contractor shall be apprized of the specific requirements of the railroad companies and be in compliance at all times. No work shall commence until certificates of insurance have been furnished to the Engineer and the various railroad companies involved.

The Contractor shall submit to the Engineer for approval a procedure for handling complaints resulting from overspray of moving vehicles. No work shall commence until the method of handling complaints has been approved by the Engineer.

The Contractor shall install and maintain suitable shields between painting operations and open traffic lanes to prevent damage to vehicles traveling on or under the structure. The shields shall be of a type and construction approved by the Engineer to prevent materials from dropping onto or being blown into pavement lanes open to traffic. Shields shall be suitably anchored and reinforced to prevent interference with traffic operations in the open lanes.

Whenever the intended purposes of the protective devices and methods for blasting and painting are not being accomplished, work shall be suspended until corrections are made.

The Contractor shall collect, remove and dispose of all buckets, rags or other discarded materials, and leave the job site in a clean manner and condition.

(3) Pollution Control. The Contractor shall take all necessary precautions to comply with pollution laws, rules and regulations of federal, state or local agencies. In addition, the Engineer shall have the Contractor cease operations if the wind or other conditions are such that the surrounding environment is being detrimentally affected due to the work.

Any additional costs resulting from restrictions or additions to the blast cleaning and painting operations, and any penalties resulting from violation of any pollution control regulations shall be borne by the Contractor.

The Contractor is responsible for cleanup of all blasting debris which may collect on roadways, sidewalks and buildings in the vicinity of the structure at the end of each day's work. Also, should analysis reveal that lead levels in soil samples taken within a specified distance of the bridge have risen above 5 p.p.m. due to the paint removal operation, the cost of removal and legal disposal of the offending soil

514.02

and debris and restoration of the ground to its original condition shall be borne by the Contractor.

(4) Mixing the Coating. The coating shall be mixed with a high shear mixer (such as a Jiffy Mixer), in accordance with the manufacturer's direction, to a smooth, lump-free consistency. Paddle mixers or paint shakers are not permitted. Mixing shall be done, as much as practicable, in the original containers, and shall be continued until all the metallic powder or pigment is in suspension. Care shall be taken to insure that all the coating solids that may have settled to the bottom of the container are thoroughly dispersed. The coating shall then be strained through a screen having openings no larger than those specified for a no. 50 sieve in ASTM E 11.

(5) Thinning the Coating. In general, the coatings are supplied for normal use without thinning. If it is necessary to thin the coating for proper application in cool weather or to obtain better coverage of the urethane topcoat the thinning shall be done in accordance with the manufacturer's recommendations.

(6) Conditions for Coating. Coatings shall be applied only after the following conditions have been met:

The surfaces to be painted shall be clean and free of moisture or frost.

Welds on new work shall be blast cleaned or neutralized.

All cleaned surfaces shall be approved by the Engineer, and painting shall be completed on the inspected surfaces before they have degraded from the prescribed standards, but in all cases within 24 hours.

Temperature. The temperature of the air and steel shall be above 40°F (4°C) for coatings other than epoxies. For epoxies the temperature of the air and steel shall be above 50°F (10°C). Coatings shall not be applied if the temperature is high enough to cause blistering.

Humidity. The coating shall not be applied when the relative humidity is greater than 85 percent nor when a combination of temperature and humidity conditions are such that a clearly defined thin film of water placed with a damp cloth upon the surface being coated fails to evaporate within 15 minutes.

Before any work commences, the Contractor shall demonstrate the ability to provide the required surface preparation. This will be accomplished on a small area of the bridge near one abutment. The appearance of the blast cleaned demonstration area shall correspond to the applicable pictorial standards of SSPC-VIS 1-67T. Work will not proceed until it is assured that the Contractor can meet those requirements. At that time, work can proceed and the Contractor is expected to clean the remainder of the bridge to the same degree as the demonstration area.

All abrasive and paint residue shall be removed from steel surfaces with a good commercial grade vacuum cleaner equipped with a brush-type cleaning tool, or by double blowing. If the double blowing method is used, the exposed top surfaces of all structural steel, including flanges, longitudinal stiffeners, splice plates, hangers, etc., shall be vacuumed after the double blowing operations are completed. The steel shall then be kept dust free and primed within eight hours after blast cleaning.

Care shall be taken to protect all freshly coated surfaces, appurtenances not intended to be painted, galvanized surfaces and adjacent concrete from blast cleaning operations by masking. Blast damaged primed surfaces shall be thoroughly wire brushed or if visible rust occurs, reblasted to a commercial grade SSPC SP6. The wire brushed or blast cleaned surface shall be vacuumed and reprimed.

Each coat of paint shall be applied in a neat workmanlike manner as a continuous film of uniform thickness which is free of holidays, pores, runs or sags. Spray application shall produce a wet coat at all times; the deposition of semi-dry particles on the surface shall not be permitted. The paint shall penetrate all joints, connections and edges of all surfaces in contact. An approved caulking material shall be used where necessary to seal open joints. The Contractor or Fabricator shall take precaution to prevent contamination of surfaces that have been prepared for painting and surfaces freshly painted. These precautions shall include the suppressing of traffic dust during field painting when necessary, as determined by the Engineer.

The dry film thickness will be determined by use of a magnetic film thickness gage. The gage shall be calibrated on the blasted steel with plastic shims approximately the same thickness as the minimum dry film thickness. A Tooke film thickness gage may be used to verify the coating thickness when requested by the Engineer. If the Tooke gage shows the primer coat to be less than the specified minimum thickness, the total coating system will be rejected even if the total dry film thickness exceeds the minimum total thickness of all coats.

The completion date, month and year, of the finish coat shall be stenciled in a contrasting color at a location directed by the Engineer.

514.03 Materials. The Contractor shall select a complete coating system from the following products list:

514.04

<u>Producer</u>	<u>Coat</u>	<u>Product</u>	<u>Min. Dry Film Thickness (Mils)</u>
Koppers Company, Inc.	1st.	Koppers Organic Zinc	3
Organic Materials Group Elmhurst, Illinois 60126 (312) 530-6300	2nd.	Koppers Hi-Gard Epoxy	6
	3rd.	Koppers 1122BRS Urethane	2
or			
Ameron Protective Coating Division P.O. Box 349 Akron, Ohio 44309 (216) 896-3602	1st.	Ameron's Amercoat 68A Zinc Rich Primer	3
	2nd.	Ameron's Amercoat 383HS Polyamide Epoxy	6
	3rd.	Ameron's Amercoat 450GL Aliphatic Polyurethane	2
or			
Mobil Chemical Company Maintenance, Transportation and Steel Container Coatings Department 901 North Greenwood Ave Kankakee, Illinois 60901 (815) 933-5561	1st.	Mobil Zinc 4 Series' 13-F-4	3
	2nd.	Mobil's High Solids Epoxy 76 Series	6
	3rd.	Val-Chem Urethane Enamel 40 Series	2

All three coats shall be manufactured by the same company. The color of the coatings shall be as selected by the Engineer. Before any coating work commences, the Contractor shall furnish the Engineer with the product data sheets, which shall indicate the mixing and thinning directions and recommended application equipment and instructions.

The coating materials specified can be hazardous to the health of the applicator if not applied as per manufacturer's instructions. The Contractor shall follow the recommendations contained on the material safety data sheet, product data sheet and the label on the paint containers. These precautions shall include the use of respirators and eye and skin protection as specified. The Contractor shall comply with the City's "Right to Know" laws as defined in Chapter 100 of the City Code.

514.04 Shop Painting New Steel. Oil and grease shall be removed from surfaces to be painted with a suitable solvent prior to cleaning by blasting.

Steel surfaces specified to be painted shall be prepared in conformance with ASTM D 2200 by blast cleaning to grade Sa 2-1/2, except for interior surfaces that are inaccessible to blast cleaning after fabrication which may be cleaned by scraping and brushing to grade St 3.

Cleaning shall be done with abrasives suitable to produce a surface having a nominal height of profile equal to or greater than 2 mils but not greater than 3 mils, and having a texture similar to that obtained by use of grit or sand.

The prime coat shall be applied within the shop and the steel shall not be handled unnecessarily or removed from the shop until the paint has dried sufficiently to allow thickness gaging and to resist being marred in handling and shipping.

Pins, pin holes and contact surfaces of bearing assemblies, except those containing self-lubricating bronze inserts, shall be painted with one coat of prime paint.

Erection marks shall be applied after the prime coat is dry, using a thinned paint of a type and color which will be completely concealed by and compatible with the second coat. The Fabricator's name may be applied in a similar manner by use of a stencil or by use of removable tape.

The coating system used for the shop paint shall match that selected for the field painting.

A prime coat shall be applied to all steel surfaces including contact surfaces of connection or splice material which are to be fastened with high strength bolts but excluding surfaces which are to be imbedded in concrete and surfaces within 2 inches of field welds other than those attaching intermediate or end crossframes to beams or girders.

The dry film thickness for the prime coat shall be not less than 3 mils or more than 10 mils, except that on faying surfaces of bolted splices the thickness shall not exceed 5 mils. Thick films shall be reduced by screening, sanding or sweep blasting. Any recoating of prime paint that has cured longer than 24 hours with prime paint shall be done as recommended by the paint manufacturer's printed instructions.

If "mud cracking" occurs, the affected area shall be scraped to soundly bonded paint and the area recoated.

Uncured paint damaged by rain, snow or condensation shall be permitted to dry; the damaged paint shall then be removed and the surface repainted.

514.05 Field Painting New Steel. Before the steel is erected, surfaces other than contact surfaces which will later be inaccessible for painting shall be given one coat each of intermediate and finish paint. Field painting of the interior of voided or hollow sections where the void is permanently sealed from the weather is not required.

After the steel is erected, field bolts, field welds and adjacent surfaces, edges of contact surfaces and all surfaces from which the prime coat was omitted or has been removed or has become defective shall, using procedures specified in 514.04, be cleaned and painted with one spot coat of the same type and color paint as used for the prime coat. The prime coat shall be free of foreign materials and, if necessary, the steel shall be cleaned by the use of bristle brushes, high pressure water spray or washing with solvents and recoated.

All exposed steel surfaces shall receive intermediate and finish coats of paint. Adequate curing time shall elapse between the application of the prime and

514.06

intermediate coats, and between the intermediate and finish coats, as determined by the Engineer, but in no case less than that recommended by the paint manufacturer's printed instructions. The coatings shall be applied by spray methods except that small touch up areas may be brushed. The minimum dry film thickness shall be as specified in 514.03. Concrete shall be shielded to protect it from overspray and to permit complete coverage of the steel surfaces adjacent to the concrete.

514.06 Cleaning Existing Steel. Prior to commencing any paint removal operations, the Contractor shall submit to the Engineer for approval the method of worker protection and details of the methods of paint removal, containment and recovery. When the existing coatings on the structure consist of lead based paint systems, the Contractor shall provide suitable respiratory and eye protection to all workers and inspectors in the vicinity of blasting operations. To eliminate environmental health hazards of lead particulates polluting the air, water and soil, the Contractor shall provide a blast enclosure or use vacuum-shrouded blasters and hand tools as necessary in order to contain and recover all removed paint as nearly as practicable, as determined by the Engineer.

All ungalvanized steel surfaces to be painted shall be blast cleaned, and areas of oil and grease shall be cleaned with clean petroleum solvents and then blast cleaned, per SSPC-SPI0-near white blast cleaning to SSPC-VIS-1 pictorial standard (grade Sa 2-1/2). Abrasives used for blast cleaning shall be either cast steel shot and grit, malleable iron shot and grit, chilled cast iron shot and grit, crushed metal refining slag, zircon, novaculite, copper slag, silicon carbide, or aluminum oxide. Not more than 1 percent by weight of the abrasive shall be able to pass through a no. 70 U.S. standard sieve, and after blasting not more than 1.8 percent by weight shall be 0.005 millimeters or smaller. The abrasive shall have a gradation which will produce a uniform profile of 2 to 3 mils, as measured with replica tape, or by other approved methods.

At piers, a minimum of 5 feet on each side of the piers shall be blast cleaned on the same day and primed as a unit to prevent damage to previously primed surfaces.

All fins, tears, slivers and burred or sharp edges that are present, or that appear after blast cleaning, shall be removed by grinding, and the area reblasted to give a 2- to 3-mil surface profile.

Scaling hammers may be used to remove heavy scale, but heavier type chipping hammers that would excessively scar the metal shall not be used.

514.07 Field Painting Existing Steel. After the surfaces to be coated have been cleaned and approved by the Engineer, the coatings shall be applied with the spray equipment in accordance with the paint manufacturer's printed instructions so as to attain the film thickness specified. The recommended pressures and nozzle sizes must be supplied to the Inspector.

Compatible brushes and rollers may be used for portions of the structure inaccessible with spray equipment. Bristles and roller material shall not be left in the paint film. If this occurs, no further coating shall be done until system-compatible application equipment is obtained and used. The minimum dry film thickness shall be as specified in 514.03.

The visual differentiation of coats shall be facilitated by the prime coat color obviously differing from the near-white steel substrate and by the intermediate coat color obviously differing from both the prime coat color and the finish coat color.

All dry spray shall be removed, by sanding if necessary. In areas of deficient primer thickness the areas shall be thoroughly cleaned, with power washing equipment if necessary, to remove all dirt, wire brushed, vacuumed and recoated.

At least 24 hours, but no more than 7 days, shall be allowed for curing of a coat before applying a succeeding coat.

After the steel is primed, it shall be vacuumed before any remaining coats are applied, and vacuuming between paint coats shall be continued until the entire blasting operation is completed, at which time vacuuming may be suspended by the Engineer. If for any reason vacuuming does not remove all the accumulated dust and/or dirt, or if more than three (3) weeks has elapsed since the steel was primed, or if in the opinion of the Engineer the surface is unfit for additional coating, the surface shall be scrubbed with a mild detergent solution (any commercial laundry detergent) and thoroughly rinsed with clean water before applying additional coating.

All coating shall be done in a neat and workmanlike manner as described in SSPC-PA 1, producing a uniform even coating which is bonded to the underlying surface. All metal coated with impure, unsatisfactory or unauthorized coating material or coated in an unworkmanlike or objectionable manner shall be thoroughly cleaned and recoated or otherwise corrected as directed by the Engineer. If the application of coating at the required thickness in one pass produces runs, bubbles or sags, the coating shall be applied in multiple passes of the application equipment, the passes separated by several minutes. Where excessive coating thickness produces "mud-cracking", such coating shall be scraped back to soundly bonded coating and the area recoated to the required thickness.

Particular care shall be given to rivet heads, bolts, edges and corners to ensure adequate coverage.

514.08 Painting Wood. New wood shall be painted with a prime coat, a second coat and a finish coat, all of 708.05 except where black paint is specified. Black paint shall conform to 708.11. Butt ends of timbers and all surfaces inaccessible after erection shall be well coated with white lead paste before erection.

514.09

Previously painted wood shall have all cracked or peeling paint, loose chalky paint, dirt and other foreign matter removed by wire brushing, scraping or other approved means immediately before repainting.

514.09 Soil Testing. Environmental sampling and analysis of lead in the soil beneath and, within a distance noted on the plans, on either side of the bridge shall be conducted prior to blasting operations and after completion of painting. Locations of sampling sites shall be determined by the Engineer.

Analysis of the soil samples for determination of the mobile/fraction of lead in the soil shall be performed according to the extraction procedure (EP) toxicity test in accordance with Environmental Protection Agency requirements.

All sampling and analysis shall be performed by an independent testing laboratory selected by the Contractor subject to the approval of the Engineer and the City of Akron.

514.10 Method of Measurement. Field painting of structural steel and wood are based on lump sum. Soil testing will be measured as the actual number of samples taken and analyzed.

514.11 Basis of Payment. Shop prime painting of new steel is included in the unit price bid for structural steel. Payment for accepted quantities of field painting and soil testing will be made at the contract price for:

<u>Item</u>	<u>Unit</u>	<u>Description</u>
514	Lump Sum	Field painting new steel
514	Lump Sum	Field painting existing steel
514	Lump Sum	Field painting wood
514	Each	Soil testing

ITEM 515 PRESTRESSED CONCRETE BRIDGE MEMBERS

- 515.01 Description**
- 515.02 General**
- 515.03 Materials**
- 515.04 Plant Requirements**
- 515.05 Casting Beds**
- 515.06 Cold Weather Operations**
- 515.07 Equipment**
- 515.08 Inspection Facilities**
- 515.09 Construction Methods**
- 515.10 Concrete**
- 515.11 Release of Prestressing Strands**

515.12 Transportation, Storage and Erection**515.13 Method of Measurement****515.14 Basis of Payment**

515.01 Description. This item shall consist of the manufacture, transportation, storage and erection of prestressed concrete bridge members produced in accordance with the plans, proposal and these specifications.

515.02 General. Fabricator approval shall be in accordance with 501.04. Shop drawings shall be prepared, submitted and approved according to pertinent paragraphs of 501.05 and 513.02.

All members shall be produced in accordance with 511, except as herein provided.

515.03 Materials. Material shall conform to the following:

Concrete	515.10
Aggregate*	703.02
Portland cement	701.01 thru 701.06
Air-entraining admixture.....	705.10
Chemical admixtures for concrete	705.12
Prestressing steel	711.27
Reinforcing steel	509
Transverse tie rods	711.01

*Coarse aggregate shall be modified as follows:

Deleterious materials, max 0.4%

Gradation shall be No. 57, No. 6, No. 67, No. 7, No. 78 or No. 8 standard size coarse aggregate.

515.04 Plant Requirements. Plants for the manufacture of precast pretensioned bridge elements shall be approved by the Engineer before bridge elements are produced. Requests for such approvals shall be submitted to the Engineer at least three weeks prior to the date of manufacture of elements. Requests shall include details of the plant facilities and the production method the manufacturer intends to use. Satisfactory qualification on previous projects of similar type will be accepted as prequalification, provided plant operations continue to be satisfactory.

515.05 Casting Beds. Casting beds shall be constructed of steel or concrete. The beds shall be above grade to insure that they will not be submerged due to accumulation of water as a result of curing operations. Beds and abutments shall be so designed that they are capable of safely resisting all forces applied to them without appreciable movement or deflection. These forces consist of compression

515.06

and eccentric forces due to end-jacking operations, forces at holddown points when draped strands are used and downward forces due to the dead weight of the members.

515.06 Cold Weather Operations. The following procedures will be employed when the ambient air temperature is below 50°F. Mixing water, aggregates or both shall be heated as necessary to result in concrete temperatures not less than 50°F and not more than 70°F when placed. Water heated above 150°F shall not be permitted to come in contact with forms, reinforcing steel, prestressing strand or other hardware materials having a temperature less than 32°F. When casting bed temperatures are less than 30°F, prestressing strand shall be tensioned to provide the design tension at 50°F.

515.07 Equipment. Hydraulic jacks of sufficient capacity and stroke shall be used for tensioning strands. Either single or multiple strand tensioning may be used. Tensioning jacks shall be equipped with automatic cutoff valves and gages with a minimum diameter of 6 inches and 500 pound increments. Gages shall be calibrated for the jacks with which they are to be used and a graph or table showing the calibration shall be furnished the Inspector. Two calibrated gages shall be provided for jacks, one of which shall be used during routine stressing, while the other is locked out and used only by the Inspector to verify the accuracy of the working gage. Calibration of jacks shall be done by a method acceptable to the Laboratory, at least once every six months or as ordered by the Engineer.

The jacking system shall be of such design as to insure uniform stress in all strands. When multiple strands are tensioned simultaneously, plants shall be equipped with approved types of dynamometers for equalizing the initial stress on all strands prior to application of the full tensioning load with the master jack. The capacity of the dynamometers shall be such that the desired readings are in the middle to upper range.

515.08 Inspection Facilities. The plant shall provide a minimum floor area of 120 square feet for the use of Inspectors. This area shall be adequately heated and ventilated and equipped with necessary desks, chairs, tables and electrical outlets.

515.09 Construction Methods. Forms shall be adequate to produce members within the tolerances set forth on the plans. Only metal forms shall be used, with the exception of bulkheads and voids. The surface of the forms in contact with the concrete shall be smooth, and the joints between panels shall be tight. The soffit form shall have a plane surface at right angles to the vertical axis of the members and the two bottom edges shall be beveled 3/4 inch with a triangular strip built into the forms.

The length of the members shall be increased by the amount expected for elastic shortening and normal concrete shrinkage, and the forms shall be so designed that they will not resist this movement.

Forms for voids in box beams shall be water-resistant and shall be constructed of a material that will resist breakage and deformation during the placing of the concrete, and they shall not excessively increase the dead load of the beams.

When forms are coated in accordance with 508.03, care shall be taken to prevent the oil from coming in contact with the prestressing strands or other reinforcing steel.

Strands shall be accurately placed in the positions shown on the plans. Strands with kinks, bends, nicks, broken wires or other defects, including scale or loose rust, will not be permitted. Slight rusting, provided it is not sufficient to cause visible pits, shall not be cause for rejection. Before placing of the concrete, the strands shall be carefully cleaned of all dirt, grease, oil or other foreign matter. Splicing of the strands within a member will not be permitted.

Each strand shall be tensioned to the stress indicated on the plans. When two or more strands are stressed by one jack, each strand shall be individually stressed to about 1000 pounds by means of a dynamometer before being attached to the jacking system. The required stress in the strands shall be measured by the jacking equipment and checked by the elongation of the strands. A record shall be kept of all jacking forces and elongations.

The strands shall be secured by suitable anchorage devices capable of developing at least 85 percent of the ultimate strength of the strands. The anchorage shall be such that no slippage of the strand will occur after the tensioning operation.

When draped strands are used the loss of stress due to friction shall not exceed 5 percent, which shall be proved to the satisfaction of the Inspector. In order not to exceed 5 percent, the strands shall be tensioned at both ends if necessary. Hold-down points shall be placed within 12 inches of the locations shown on the plans.

515.10 Concrete. The concrete shall be machine mixed according to 499 except that 499.03 does not apply. The concrete shall contain 6 plus or minus 2 percent entrained air and slump shall be maintained within the range 1 to 4 inches.

The concrete shall be proportioned of materials specified in 515.03 to provide a minimum cylinder strength of 5500 psi in 28 days, as determined from the testing by the Laboratory of at least 2 cylinders. Each pair of cylinders shall have an average strength of not less than 5500 psi and each cylinder shall have at least 90 percent of this strength. A minimum of 2 cylinders shall be cast for each 200 feet of beam produced in a day, or each casting bed used per day.

Calcium chloride or admixtures containing calcium chloride are prohibited.

515.11

Concrete may be placed in the bottom flange of a box beam before the interior forms and reinforcement for the upper portion of the member is placed, providing continuous placement is not interrupted for more than 45 minutes.

The top surfaces of non-composite members shall be screeded and finished with a burlap drag or other means to provide a uniform surface with a gritty texture suitable for waterproofing. The top surface of composite members shall be screeded and given a wire broom finish, in a transverse direction, penetrating the finished surface approximately 1/4 inch.

The concrete shall be given an accelerated cure by low pressure steam or radiant heat within a suitable enclosure to contain the live steam or heat. The initial application of the steam or heat shall be from two to four hours after the final placement of concrete to allow the initial set to take place. If retarders are used, the waiting period shall be increased to four to six hours. The time of initial set may be determined by ASTM C 403, and the time limits described above may then be waived.

During the waiting period the temperature within the curing enclosure shall be not less than 50°F.

During the initial application of live steam or radiant heat, the ambient temperature within the curing enclosure shall increase at an average rate not exceeding 40°F per hour until the curing temperature is reached. The maximum curing temperature shall not exceed 160°F. The maximum temperature shall be held until the concrete has reached the desired strength. Detensioning shall be accomplished immediately after the steam or radiant heat curing has been discontinued. Additional curing is not required after detensioning.

(1) Curing with low pressure steam. Application of live steam shall not be directed on the concrete forms so as to cause localized high temperatures.

(2) Curing with radiant heat. Radiant heat may be applied by means of pipes circulating steam, hot oil or hot water, or by electric heating elements. Moisture loss shall be minimized by covering all exposed concrete surfaces with plastic sheeting or by applying an approved liquid membrane curing compound to all exposed concrete surfaces. Shear faces of composite members and other surfaces to which field-cast concrete or other materials will be bonded in the finished structure shall have the curing compound removed from them unless tests are performed which prove that the residue of the membrane does not reduce the bond on the shear face below the design value.

Cavities in the exposed surface of beams shall be neatly filled with grout. Honeycomb that is considered to impair the member shall be cause for rejection.

515.11 Release of Prestressing Strands. Prestressed strands shall not be released until the concrete has reached a strength of at least 4000 psi as determined

by the testing of pairs of concrete cylinders made according to AASHTO T 23, cured by the exact method used to cure the beam, and tested according to AASHTO T 22. These cylinders shall be tested in the manufacturer's laboratory. The Inspector shall be notified in advance and shall have the right to observe the testing of the cylinders by the manufacturer.

The strands shall be released immediately after accelerated curing by steam has been discontinued. Prior to release of prestressed strands, forms and hold-downs which restrict either horizontal or vertical movement of prestressed members shall be loosened or removed.

Each strand shall be burned or heat released simultaneously at selected exposed points between anchorages and the sequence should follow a predetermined pattern, approved by the Engineer, to equalize the forces being transferred to the various areas of the cross section of the member. For heat release, a low-oxygen flame shall be used with at least a 4 inch length of strand being uniformly heated.

515.12 Transportation, Storage and Erection. Prestressed members shall not be shipped until the 28 day design strength of the concrete is reached.

The members shall be stored, transported and erected in an upright position, and points of support and direction of reactions shall be approximately the same during storage and transportation as when the members are in their final position. Whenever members are to be stored, care shall be taken to provide unyielding horizontal supports capable of maintaining the members in a vertical position. If it is found necessary to transport the members in any position other than vertical, it shall be done only with the written approval of the Engineer. The members shall be lifted by approved lifting devices. Members damaged by improper handling, storing, transportation or erection shall be replaced at no expense to the City.

515.13 Method of Measurement. The quantity shall be the number of members, or the linear feet of members.

This item includes all inserts, sleeves, fittings, reinforcing steel fully or partially encased in the members, and all transverse tie rods necessary to complete this item.

Concrete diaphragms 511 and bearing plates or pads or other expansion materials 516 will be paid for as separate items.

515.14 Basis of Payment. Payment for accepted quantities will be made at the contract price for:

<u>Item</u>	<u>Unit</u>	<u>Description</u>
515	Each	Prestressed concrete bridge members
515	Linear Foot	Prestressed concrete bridge members

**ITEM 516 EXPANSION AND CONTRACTION JOINTS, JOINT
SEALERS AND BEARING DEVICES**

- 516.01 Description**
- 516.02 Materials**
- 516.03 Expansion and Contraction Joints**
- 516.04 Joint Sealer**
- 516.05 Bearing Devices**
- 516.06 Method of Measurement**
- 516.07 Basis of Payment**

516.01 Description. This item shall include the furnishing of all materials and labor necessary to fabricate, assemble, construct, paint, coat, and install expansion and contraction joints, vertical extension of structural expansion joints, joint sealers or bearing devices of the type and size necessary specified. The fabrication and painting of joints and bearings shall conform to 513 and 514 respectively.

516.02 Materials. Materials shall conform to the following:

Structural steel.....	513
Bearing bolts and Anchor rods	513.16
Painting	514
Steel castings.....	711.07
Sheet copper.....	711.15
Bronze	711.16, 711.17, 711.18
Sheet lead	711.19
Preformed bearing pads.....	711.21
Elastomeric bearing pads.....	711.23
Preformed fillers.....	705.03
Joint sealer, hot applied.....	705.01
Preformed elastomeric compression joint seal for concrete	705.11

Mill test reports for structural steel, steel castings, bronze and sheet lead shall be submitted according to 501.07.

516.03 Expansion and Contraction Joints. Open expansion joints shall be completely open for the dimension specified for their full length. Care shall be taken to remove all stones, forms or other material that would in any way interfere with expansion.

The surfaces against which preformed expansion joints are to be placed shall be finished to a smooth, uniform surface. The expansion joint materials shall be adequately anchored, but methods of fastening that interfere with the free compression of the joint material shall not be used. The joint material shall neatly fill the space, and have a uniform thickness for the full extent of the joint.

Preformed joints between sliding surfaces shall consist of two thicknesses of joint material, laid without surface irregularities and with joints in the layers staggered.

Folded metal joints shall be watertight, and so placed that the fold will be free from kinks. The splices shall be riveted and soldered. At bends the strip shall be preferably one piece.

516.04 Joint Sealer. The surface to which joint sealer is applied shall be prepared as follows: concrete shall be cleaned of all foreign matter, curing compounds, oil, grease, dirt, free water and laitance; steel shall be thoroughly cleaned by sand blasting.

The joint sealer shall have a minimum depth of 1 inch at its thinnest section. Joints shall be filled to within 1/4 inch of the roadway surface.

No joint sealer shall be placed in contact with any bituminous material but shall be separated from it by a barrier of foil or other material that is impervious to bitumen.

Where it is required to prevent bonding of the joint sealer with a joint surface, a suitable bond breaker barrier shall be placed, at no extra cost, before applying the joint sealer.

Any joint sealer that is intended to be bonded but is not bonded to the joint face 24 hours after placing, shall be removed and the joint shall be thoroughly cleaned by sand blasting and resealed at the Contractor's expense.

The mixing and placing instructions of the manufacturer shall be adhered to. A copy of these specifications for the application shall be filed with the Engineer.

Joints which will be subjected to concrete protective coatings containing mineral spirits shall have the sealer protected by an impervious masking tape during the application of the protective coating.

516.05 Bearing Devices. For sliding plates the sliding surfaces shall be lubricated with flake graphite and one shall be superimposed on the other with their edges flush.

Concrete surfaces on which sheet asbestos packing is to be placed shall be finished smooth with a metallic trowel.

Elastomeric bearings, bearing pads and bolsters shall be accurately set as to level and alignment. Bearing plates and bolsters shall be bedded on sheet lead 1/8 inch thick, meeting the requirements of 711.19, or preformed bearing pads 1/8 inch thick, meeting the requirements of 711.21.

516.06

Elastomeric bearing pads shall be set directly on the concrete surface. Bearing plates or bolsters shall be placed upon bridge seat areas which are plane and smoothly finished. If the bridge seat area is high or uneven, proper elevation and a level surface shall be secured by bushhammering or grinding the area and then smoothing with a thin film of portland cement mortar or paste to fill the pitted surface. If the bridge seat area is low, the proper elevation shall be secured by the use of steel plate shims of the same bearing area as the bearing plates and bolsters.

Rockers or rollers shall be so placed that when the bridge is completed and at 60°F the rockers will stand in a vertical position and the rollers will center on the base.

Anchor bolts that are clear of the beam or girder flanges shall be set in the concrete after the erection of the main structural steel, except as hereafter specified for bearing devices at abutments. When structural steel will interfere with the setting of the anchor bolts, they shall be set before the steel is erected by the use of a template for support and embedded in the concrete when it is placed, or by drilling or forming the holes. Bearing devices at abutments shall not be permanently fastened to the abutments, steel beams or girders until the abutments have been backfilled to within one foot of the top of the bridge seat. Reinforcing steel in the bridge seat shall be placed so that it will not interfere with the drilling of anchor bolt holes. Anchor bolts shall be accurately set in the holes and bedded in cement mortar. Care shall be used to prevent the entrance and freezing of water in anchor bolt holes.

Swedged anchor bolts or bars shall be fabricated by deforming a minimum of 20 percent of the embedded bolt surface with deformations whose radial dimensions are 15 to 20 percent of the bar diameter.

516.06 Method of Measurement. The quantity shall be the actual number, linear feet, square feet, or pounds. The quantity for structural steel expansion joints extended vertically, for the purpose of deck resurfacing, shall be the actual horizontal length of joint.

516.07 Basis of Payment. Payment for accepted quantities will be made at the contract price for:

<u>Item</u>	<u>Unit</u>	<u>Description</u>
516	Lin. Ft., Lb.	Structural steel expansion joints
516	Lin. Ft.	Structural expansion joints inc. elastomeric ___ seals
516	Lin. Ft.	Elastomeric compression seals for structural steel joints, width.
516	Lin. Ft.	Folded copper strip
516	Lin. Ft.	Vertical extension of structural expansion joints
516	Sq. Ft.	___ Preformed expansion joint filler
516	Lin. Ft.	Joint sealer
516	Ea., Lin. Ft.,	

	Sq. Ft., Lb.	Bearing devices
516	Ea.	<u> </u> x <u> </u> x <u> </u> Elastomeric bearing pads
516	Ea.	<u> </u> x <u> </u> x <u> </u> Laminated elastomeric bearings
516	Sq. Ft.	1/8-inch Preformed bearing pads

ITEM 517 RAILINGS

517.01 Description

517.02 General

517.03 Materials

517.04 Steel and Iron Railings

517.05 Aluminum Railings

517.06 Method of Measurement

517.07 Basis of Payment

517.01 Description. This item shall include the furnishing of all materials and the necessary labor to construct and erect the completed railing of the type specified. Structural posts, anchors, connections, anodizing and galvanizing are a part of this item.

517.02 General. The line and grade of the railing shall be true to that shown on the plans. Railing posts, panels and openings shall be vertical, except that posts for low metal railings on concrete parapets shall be normal to grade line. Tops of railings shall be parallel to grade line.

The shores or falsework supporting the superstructure shall be removed or released before placing railing that has no expansion joints or that is of the concrete parapet type.

517.03 Materials. Railing materials shall conform to the following:

Concrete, Class S.....	499, 511
Reinforcing steel	509, 709
Structural steel.....	513
Ductile iron castings.....	711.13
Aluminum	711.20
Stainless steel fasteners	711.14
Metal deep beam rail	710.06
Timber.....	711.26
Paint	708
Pipe	707.08, 707.11
Steel tubing	707.10
Preformed fillers (sponge rubber or PVC)	705.03, 711.28

517.04

Mill test reports for structural steel and aluminum shall be submitted according to 501.07.

517.04 Steel and Iron Railings. All parts of steel and iron railings shall be galvanized except where painting according to 514 is specified.

Erection of metal deep beam rail elements shall be in accordance with 606.

517.05 Aluminum Railings. The materials for aluminum railings shall be an alloy conforming to 711.20.

The extreme outer surfaces of cast railing posts shall be given a 40-grit finish. No special finish shall be required for other portions of railings, but care shall be taken to avoid scratches, dents or other defects that may affect the durability or appearance of the railing.

Anchor bolts and hexagon nuts shall be galvanized steel conforming to 711.02. The entire projecting portion of such bolts shall be coated with aluminum-impregnated caulking compound and the space between the bolts and the post base shall be filled with the same material.

Where aluminum is to be in contact with concrete or stone masonry, the contact surfaces shall be thoroughly coated with an aluminum-impregnated caulking compound or with heavy bituminous paint, provided the exposed paint shall be pigmented with aluminum powder or paste, so as to have an aluminum appearance. Where aluminum is to be in contact with another metal, the contact surface shall be thoroughly coated with an aluminum-impregnated caulking compound, or a synthetic rubber impregnated fabric gasket shall be used. Aluminum shims, if required, shall be similarly separated from other metals.

Welding will be permitted only where specifically called for on the plans, and it shall be done by the inert gas shielded metal-arc or tungsten-arc method without flux, or by other approved methods.

517.06 Method of Measurement. The footage shall be the actual length of railing including end posts. Where deep beam guardrail is used the footage shall be the length of railing between the first posts off the bridge. Where hand rails or tubular backup rails are used any portions extending beyond the first posts off the bridge shall not be measured for payment, but are included for payment in the unit price bid for the measured footage.

517.07 Basis of Payment. Payment for accepted quantities will be made at the contract price for:

<u>Item</u>	<u>Unit</u>	<u>Description</u>
517	Linear Foot	Railing

ITEM 518 DRAINAGE OF STRUCTURES

- 518.01 Description**
- 518.02 Materials**
- 518.03 General**
- 518.04 Porous Backfill**
- 518.05 Pipe**
- 518.06 Scuppers**
- 518.07 Painting**
- 518.08 Excavation**
- 518.09 Method of Measurement**
- 518.10 Basis of Payment**

518.01 Description. This item shall consist of constructing drainage systems according to the details and dimensions called for on the plans. All work shall be governed by the parts of this specification that are applicable.

518.02 Materials. Drainage materials shall conform to the following:

Porous backfill shall be durable gravel, stone or air-cooled blast furnace slag, No. 467, No. 57, No. 67, No. 6 or No. 78 size. The sodium sulfate soundness loss shall not exceed 15 percent.

Scuppers, structural steel and cast steel	513
Metal pipe	707

Pipe specials shall be of a grade at least as high as the type of pipe specified.

Plastic pipe	707.19
Other metals	711

Mill test reports for all metals shall be submitted according to 501.07.

518.03 General. The structure drainage shall be a satisfactory operating system and all parts shall be properly connected to new or existing sewers or other outlets, insofar as such connections are called for on the plans.

Special care shall be exercised to prevent sags and low points. In making superstructure installations the deflection of spans under full dead load shall be taken into account.

518.04 Porous Backfill. Porous backfill shall be placed behind the full length of abutments, wing walls and retaining walls with a thickness normal to the abutment or wall face of not less than 18 inches except that undisturbed rock or shale

518.05

within this limit need not be removed. The bottom of the porous backfill shall be between 3 and 6 inches below the weep holes of perforated pipe except that it shall extend no lower than the bottom of the footing when the bottom of the perforated pipe is specified to be placed at the elevation of the adjacent footing. The top surface shall coincide with the plane of the subgrade within the roadway area extended laterally to the wing walls or to the embankment side slopes. Sufficient coarse aggregate or other material shall be placed immediately adjacent to but not more than 6 inches below the bottom of the weep hole to retain the porous backfill. The method of compacting the fill shall be as described in 203, and the combination of material sizes used shall be such as to obtain a rigid unyielding fill, which will also permit free drainage through the open voids to the outlet system.

518.05 Pipe. Conductor pipe leading down from the superstructure shall be either alloy steel pipe, 707.11; galvanized steel pipe, 707.08; or plastic pipe, 707.19. The specials, elbows, tees, wyes, etc., essential for a complete and satisfactory installation shall be supplied in the same material and have the same quality as the pipe furnished.

Joints shall be watertight and have adequate strength. In steel pipe, they shall be made by welding or by use of clamp-type couplings having a ring gasket; in plastic pipe, joints shall be made in accordance with the pertinent ASTM specification. The pipe shall be securely fastened with hanger and/or clamp assemblies to the structure. These assemblies shall be galvanized in accordance with 711.02 or be painted as specified for alloy steel conductors when used with plastic and galvanized or alloy steel pipe respectively.

Alloy steel conductors and accessories shall be painted in accordance with 514.

Subsurface pipe shall be placed as described in 551.

For corrugated metal pipe, specials need not be perforated and bends may be made with adjustable elbows meeting the gage and thickness requirements of the pipe specifications.

518.06 Scuppers. All connections shall be secure and watertight, including the connection to adjacent concrete. Castings shall be sound and shall be true to form and dimension. Structural steel scuppers shall have welded joints. All work shall be neatly finished. Scuppers shall be galvanized according to 711.02.

518.07 Painting. All exposed steel surfaces except galvanized surfaces shall be painted according to 514. The color of coats shall be such as to match the color of the adjacent concrete or steel surface.

Painting shall be included with the pertinent drainage item for payment.

518.08 Excavation. The excavation needed for the installation of the pipe or other drainage facility back of abutments and for outlets, including removal of all materials encountered, shall be of such dimensions, with necessary sheeting and bracing, as to give ample space for satisfactory construction. Backfill and excavation not separately itemized shall be considered as included for payment with the drainage facility which necessitates them.

518.09 Method of Measurement. The quantity or quantities shall be the actual amount of each kind and size, according to the specified unit of measurement. Pipe specials shall be measured by the same method as the pipe proper; if pipe is by the linear foot, it shall be measured along its center line.

Subdrainage for wearing surface course shall be measured as the length of the longitudinal conductor.

518.10 Basis of Payment. Payment for accepted quantities will be made at the contract price for:

<u>Item</u>	<u>Unit</u>	<u>Description</u>
518	Cubic Yard	Porous backfill
518	Linear Foot	___ inch __Pipe, including specials
518	Each	Scuppers, including supports
518	Pound, Linear Foot	Trough horizontal conductors
518	Pound, Linear Foot	Pipe horizontal conductors
518	Linear Foot	___ inch Pipe downspout including specials

ITEM 519 PATCHING CONCRETE STRUCTURES

519.01 Description

519.02 Materials

519.03 Determination of Repair Areas

519.04 Removal of Disintegrated Concrete

519.05 Cleaning and/or Replacement of Reinforcing Steel

519.06 Preparation of Surface

519.07 Patching with Concrete

519.08 Method of Measurement

519.09 Basis of Payment

519.01 Description. This item shall consist of the removal of all loose and disintegrated concrete, the preparation of the surface, the furnishing and placing of the reinforcing steel including welded steel wire fabric, dowels and expansion bolts, the coating of the surface with cement grout and the placing of concrete patches, including curing of same. All operations not described in this item shall be done in

519.02

accordance with the requirements of the item of these specifications that apply to the particular kind of work being done.

519.02 Materials. Materials shall conform to the following:

Concrete Class S.....	499, 511*
Dowels	709.01, 709.03 or 709.05
Reinforcing steel	509
Welded steel wire fabric	709.10 or 709.12

*Aggregate for Superstructure shall meet the requirements of 703.02 and shall be No. 57 or No. 8 size.

519.03 Determination of Repair Areas. The Contractor shall make a detailed examination of the surfaces to be repaired. Hammer and/or chain drags of a type designed for the purpose of examining concrete shall be furnished by the Contractor and used, as directed by the Engineer, to determine, by sound or by loosening disintegrated surface concrete, the limits of concrete to be repaired. The area limits of repair shall be marked by the Contractor as directed by the Engineer.

All existing asphalt patch material shall be removed, whether sound or not.

For vertical surfaces, the Contractor shall furnish and erect scaffolding, or provide other appropriate access to permit the examination of concrete surfaces to be repaired. Scaffolding shall meet the Ohio Administrative Code and O.S.H.A. requirements.

519.04 Removal of Disintegrated Concrete. All loose and disintegrated concrete within the area limits shall be removed in such a manner and to such an extent as to expose a sound concrete surface. The perimeters of all marked removal areas that are not full depth removals shall be sawcut to a depth of 1/2 inch, with square or preferably slightly undercut shoulders. Sound concrete (beneath the disintegrated concrete) shall be removed for a depth of not less than 1/4 inch and not more than one inch, provided that the minimum depth of patch is maintained. Square or preferably slightly undercut shoulders, having a depth not less than the specified minimum depth of the patch, shall be made at the edges of all patch.

Care shall be used in working around reinforcing steel so as to not loosen the steel, or to shatter the concrete around the steel, beyond the area to be patched. Where the bond between the concrete and a reinforcing bar has been destroyed, or where more than one half of the periphery of such bar has been exposed, the adjacent concrete shall be removed to a depth that will provide a minimum one inch clearance around the bar, except where other reinforcing bars make this impracticable. Reinforcing bars which have become loose shall be adequately supported and tied back in place.

Only pneumatic or hand tools that will give results satisfactory to the Engineer shall be used in the removal of disintegrated concrete and in preparing and shaping the areas to be patched. Concrete may be removed by chipping or hand dressing. Chipping hammers shall not be heavier than nominal 35 pound class and shall be operated at an angle of less than 45 degrees with respect to the surface of the deck. Concrete shall be removed in a manner that prevents cutting, elongating or damaging the reinforcing steel. Reinforcing damaged during Contractor's operation shall be replaced at no cost to the City.

After completion of the removal operations, the deck shall be resounded as described in 519.03 to insure that only sound concrete remains.

If the Contractor punches through the deck, a full depth repair shall be made in the area. If punching through the deck is a result of improper workmanship such as use of too large a chipping hammer, operation at too vertical an angle, or any other unacceptable practice, the full depth repair shall be made at the Contractor's expense. In full depth repair areas, provisions shall be made to adequately key the replacement concrete to the remaining concrete slab.

The Contractor shall accept complete responsibility for assuring the integrity of the structure throughout the duration of the contract. Wherever necessary, barricades, shoring and bracing shall be provided, installed and maintained, and shall remain in place until the concrete repairs are completed and the concrete has cured for at least seven days.

519.05 Cleaning and/or Replacement of Reinforcing Steel. Reinforcing steel exposed by the concrete removal operation shall be sandblasted to remove rust and scale. Where corrosion has reduced the area of the existing steel to 75 percent or less than the area of new steel of the same nominal size, additional new steel reinforcement shall be installed.

New bars of the same nominal size shall be tied to the existing bars, and shall extend at both ends 32 bar diameters beyond the length requiring replacement. Where impracticable to extend 32 bar diameters, in the opinion of the Engineer, reinforcement shall consist of welded steel wire fabric either 2 inch by 2 inch using wire size number W 0.9 or 3 inch by 3 inch using wire size number W 1.4. This fabric shall cover the entire area of the patch and shall be placed and held approximately 1 inch from the completed exposed surface of the patch. It shall preferably be securely fastened to the reinforcing steel in the original structure exposed in removing the disintegrated concrete, but when there is no such steel exposed or it is not practicable to fasten the fabric to this steel, it shall be fastened to dowels or expansion bolts installed, by the Contractor, at not to exceed 18-inch centers in both directions.

519.06 Preparation of Surface. After all disintegrated and loose concrete has been removed, the area to be patched shall be properly shaped. All surfaces of the area to be patched shall be thoroughly cleaned of all dirt, dust or other foreign

519.07

materials by the use of water, air under pressure or any other method that produces satisfactory results. Before coating with the bonding grout, the surfaces shall be allowed to dry.

Immediately prior to placing the repair concrete and/or mortar, the surfaces of the area to be patched shall be cleaned by an air blast and then covered with a thin coating of bonding grout, which shall consist of equal parts by volume of portland cement and sand, mixed with enough water to form a stiff slurry. The consistency of this slurry shall be such that it can be applied with a stiff brush or broom to existing concrete surfaces in a thin even coating that will not run or puddle. The grout shall be scrubbed onto the dry surfaces (surfaces which are dry enough to absorb some of the moisture from the grout) with enough care to insure that excess grout will not collect in low areas. The bonding grout shall be applied only for a short distance in advance of the placement of fresh concrete so that grout does not dry or set up prior to placing repair concrete and/or mortar.

The surfaces of full depth repair areas shall be similarly cleaned and coated with bonding grout, which shall be thinned to a paint consistency, immediately prior to placing the repair concrete.

519.07 Patching with Concrete. The concrete shall be Class S and shall be proportioned, mixed, placed and finished in accordance with 499 and 511. The depth of a patch shall be not less than 4 inches, except on top horizontal surfaces, on which it shall be not less than 3 inches.

When the patched area extends across a construction or control joint in the existing deck, the joint shall be replaced in kind in the same location.

Every attempt shall be made to make the repaired area blend in with the existing concrete. All exposed surfaces of patches shall be finished by rubbing or by other acceptable methods so as to match as nearly as practicable the surrounding concrete. In full depth repair areas, the concrete surface on the underside of the deck shall have all fins, ridges and protrusions removed and all voids filled with mortar.

All patched surfaces shall be cured in accordance with 511.14 Method (a) Water Curing. Method (b) Waterproof Membrane Curing is not permitted.

After curing and before final acceptance, all patched areas shall be sounded. All unsound areas shall be removed and replaced.

519.08 Method of Measurement. The quantity shall be the actual volume in cubic feet or the actual area in square feet of concrete placed, completed and accepted. If area measure is used, it shall be of the exposed surfaces of all completed patches, irrespective of the depth or thickness of the patch; if a patch includes corners or edges of such members as beams, curbs, columns, etc., all of the exposed surfaces shall be included, or if a patch extends completely through a member or a

slab, both exposed surfaces shall be measured. Contractor and Engineer shall agree on quantity before the placement of any patching material.

519.09 Basis of Payment. The accepted quantities will be paid for at the contract unit price, complete and in place. Barricades, shoring, bracing, reinforcing steel, wire mesh, dowels, expansion bolts, cement grout, removal of fins, ridges and protrusions and other related items will not be paid for separately, but the cost thereof shall be included in the cost of this item of which they are a part.

Payment for accepted quantities will be made at the contract price for:

<u>Item</u>	<u>Unit</u>	<u>Description</u>
519	Square Feet, Cubic Feet	Patching Concrete Structures

ITEM 520 PNEUMATICALLY PLACED MORTAR

- 520.01 Description**
- 520.02 Materials**
- 520.03 Removal of Concrete**
- 520.04 Reinforcement**
- 520.05 Preparation of Repair Area**
- 520.06 Mixing**
- 520.07 Proportions**
- 520.08 Pressures**
- 520.09 Placing**
- 520.10 Method of Measurement**
- 520.11 Basis of Payment**

520.01 Description. This item applies to the surface repair of concrete structures using pneumatically placed mortar, where the depth of repair generally will be less than 6 inches. This item consists of the removal of all loose, soft, honeycombed and disintegrated concrete, the removal of sound surface concrete in areas designated for repair, the preparation of the surface, the furnishing and placing of reinforcing steel including wire fabric, dowels and/or expansion anchor bolts, mixing and applying pneumatically placed mortar composed of portland cement and sand, to the areas shown or noted on the plans or where directed by the Engineer. The thickness of pneumatically placed mortar shall be not less than 1-1/2 inches, except on top horizontal surfaces where it shall be not less than 3/4 inches. Mortar repairs shall be finished flush with the original masonry surface, except as noted below for areas of exposed reinforcing steel.

520.02 Materials. Materials shall conform to the following:

Fine aggregate	703.02, 703.03
Portland cement.....	701

520.03

Reinforcing steel509
Welded steel wire fabric709.10 or 709.12

Water shall be free from sewage, oil, acid, strong alkalis, vegetable matter, clay and loam. Water which is potable is satisfactory for use in mortar.

520.03 Removal of Concrete. In areas to be repaired, all loose, soft, honeycombed and disintegrated concrete, plus a 1/4 inch depth of sound concrete, shall be removed. Additional concrete shall be removed, where necessary, to permit the placement of the minimum specified mortar thickness. All work shall be done in such manner as not to damage or shatter the concrete that is to remain. Square or preferably slightly undercut shoulders shall be made at the edges of all repair areas.

Reinforcing bars exposed after concrete removal, as required above, shall be encased with pneumatically placed mortar. Where such bars would be less than 1 inch from the proposed finished surface of mortar, they shall, if practicable, be driven back into recesses cut in the masonry to obtain that coverage, but if this is impracticable, because of large concentrations of reinforcing bars, the minimum specified mortar coverage shall be provided by such modification of the finish surface as approved by the Engineer.

Where the bond between the concrete and a primary reinforcing bar has been destroyed, or where more than one half of the periphery of such a bar has been exposed, the adjacent concrete shall be removed to a depth that will provide a minimum 3/4-inch clearance around the bar except where other reinforcing bars make this impracticable. Reinforcement which has become loose shall be adequately supported and tied back into place. Reinforcement that is damaged during the Contractor's operations shall be replaced at no cost to the City.

Only pneumatic or hand tools that will give results satisfactory to the Engineer shall be used in the removal of concrete and in preparing and shaping the areas to be repaired.

Care shall be used in working around reinforcing steel so as not to loosen the steel, or to shatter the concrete around it, beyond the repair area.

520.04 Reinforcement. Where pneumatically placed mortar is specified to repair areas of unsatisfactory concrete, or for surface coverage of exposed reinforcing steel, wire fabric shall be placed in all areas where the thickness of the mortar patch is 1-1/2 inches or more. For areas where the thickness of the mortar patch exceeds 4 inches, a single layer of wire fabric shall be used to reinforce each 4 inch thickness of patch or fractional part thereof. Fabric shall be either 2 inch by 2 inch using 12 gage wire, or 3 inch by 3 inch using 10 gage wire. All fabric shall be placed parallel to the proposed finished surface. Each layer of fabric shall be completely encased in mortar which has taken its initial set, before the succeeding layer of fabric is applied. Fabric supported adjacent to the prepared masonry surface shall be no closer than 1/2 inch to the existing surface. Adjacent sheets of fabric shall

be lapped 6 inches and securely tied together. Fabric shall be carefully prebent before installation to fit around corners and into re-entrant angles, and shall in no case be sprung into place.

All steel items, including reinforcing bars and wire fabric shall be no closer than 1 inch to the proposed finished surface of mortar.

Wire fabric shall be supported by anchor bolts except where existing reinforcing steel in the repair area is considered by the Engineer to be satisfactory for this purpose. Anchors shall consist of 1/4 inch minimum diameter expansion hook bolts, each of which shall have sufficient engagement in sound masonry to resist a pull of 150 lbs., applied parallel to the axis of the bolt. For repairs that are generally 4 inches thick or less, anchors shall be spaced no more than 12 inches and 18 inches, center to center, on overhead and vertical surfaces respectively, and 36 inches, center to center, on top horizontal surfaces. For repairs that exceed 4 inches in thickness, anchor bolts shall be capable of supporting three times the weight of suspended mortar and two times the weight of mortar on vertical surfaces. No less than three anchors shall be used for each patch.

When specified, reinforcing exposed in the original structure, or exposed after concrete removal as required above, shall be thoroughly cleaned and any appreciable reduction in steel area restored as directed.

520.05 Preparation of Repair Area. After all unsatisfactory concrete has been removed, the sound concrete surface properly shaped, dowels and/or expansion hook bolts placed, the existing reinforcing steel cleaned and steel area restored as directed, the concrete surfaces shall be thoroughly cleaned of all dirt, dust and other foreign materials by the use of water or air under pressure and such other methods as are necessary to secure satisfactory results. Where a bonding compound is not specified the following shall be strictly adhered to: the prepared masonry surface shall be drenched with water and kept wet during the 2 hours preceding the placement of the mortar. All surfaces shall be damp, without free water, as mortar is placed. Preparation and condition of all surfaces shall be approved by the Engineer immediately prior to the application of the mortar.

520.06 Mixing. The materials shall be thoroughly mixed dry in a batch mixer. Before placing the mixture in the hopper of the cement gun, all materials and lumps over 1/4 inch in size shall be removed by screening.

The screened sand and cement shall be applied to the masonry surface within 1 hour after being combined.

520.07 Proportions. The mixture as placed in the hopper shall be one volume of portland cement and three volumes of sand.

520.08 Pressures. Not less than 35 pounds pneumatic pressure per square inch at the cement gun shall be used in placing the mixed material. If more than 100

520.09

feet of hose or a greater lift than 25 feet is used the pressure must be increased proportionately. The water shall be maintained at a uniform pressure of not less than 25 pounds above the pressure of the air on the gage at the cement gun.

520.09 Placing. The premixed, dry cement and sand shall be placed by pneumatic equipment with the proper amount of water applied in the mixing nozzle for the correct placement consistency. In order to reduce shrinkage cracks to a minimum, the mortar shall be applied as dry as practicable. Shooting strips shall be employed to insure square corners, straight lines and a plane surface of mortar, except as otherwise permitted by the plans or approved by the Engineer. They shall be so placed as to keep the trapping of rebound at a minimum. At the end of each day's work, or similar stopping periods requiring construction joints, the mortar shall be sloped off to a thin edge. In shooting all surfaces, the stream of flowing material from the nozzle shall impinge as nearly as possible at right angles to the surface being covered, and the nozzle shall be held from 2 to 4 feet from the working surface.

A sufficient number of mortar coats shall be applied to obtain the required thickness. On vertical and overhead surfaces, the thickness of each coat shall be not greater than 1 inch, except as approved by the Engineer, and shall be so placed that it will neither sag nor decrease the bond of the preceding coat. Where a successive coat is applied on mortar which has set for more than 2 hours, the mortar surface shall be cleaned and dampened as required in 520.05 for the prepared masonry surface. Deposits of rebound from previous shooting, whether loose or cemented, shall be removed.

After mortar has been placed to desired thickness, all high spots shall be cut off with a sharp trowel, or screeded to a true plane as determined by shooting strips or by the original masonry surface, or as directed. Screeds, where used, shall be lightly applied to all surfaces so as not to disturb the mortar for an appreciable depth, and they shall be worked in an upward direction when applied on vertical surfaces. After placing, all mortar patches shall be sounded and any indications of sand pockets or hollow areas shall be investigated and repaired as directed. Special care shall be taken to obtain a slightly appearance on all exposed surfaces.

The pneumatically placed mortar patches shall be covered with burlap or cotton mats and kept wet for 7 days after placing, but where not practicable to use mats, it shall be kept wet by sprinkling for the same length of time. Where the Engineer determines that the above curing procedures are impracticable, because of the inaccessibility of isolated repair areas, the final mortar surface may be cured according to 511.14, Method (b). No pneumatically placed mortar may be placed when the air temperature is below 50°F or against a surface in which there remains any frost. All mortar placed after October 31 and before April 15 shall be protected according to the requirements of 511.12.

520.10 Method of Measurement. The quantity shall be the area in square feet determined as follows:

The actual area of exposed surfaces of all completed patches, irrespective of depth or thickness of the patch; if a patch includes corners or edges of such members as beams, columns, curbs, etc., all of the exposed surfaces shall be included, or if a patch extends completely through a member or a slab, both exposed surfaces shall be included. Measured area shall be agreed upon by the Contractor and Engineer before any mortar is placed.

520.11 Basis of Payment. Payment for accepted quantities will be made at the contract price for:

<u>Item</u>	<u>Unit</u>	<u>Description</u>
520	Square Foot	Pneumatically placed mortar

ITEM 522 STRUCTURAL PLATE CORRUGATED METAL STRUCTURES ON FOOTINGS

522.01 Description

522.02 Materials

522.03 General

522.04 Method of Measurement

522.05 Basis of Payment

522.01 Description. This item shall consist of furnishing structural plate corrugated metal structures of specified dimensions, including metal bearing angles or channels as required, and erecting same on concrete footings as detailed on the plans. The structures shall be constructed at locations designated on the plans or ordered by the Engineer, in reasonably close conformity with specified lines and grades.

Excavation will be performed under 203 or 503 as indicated on the plans. Backfilling shall be performed in accordance with 503. Concrete footings will be constructed under 511.

522.02 Materials. Plates and bolts shall be in accordance with 707.03 or 707.23. Steel bearing angles or channels shall be in accordance with either 707.03 or 711.01. Aluminum bearing angles or channels shall be in accordance with 707.23.

522.03 General. The metal bearing angle or channel shall be properly supported in the position shown on the plans before footing concrete is placed.

522.04

The plates shall be erected according to the manufacturer's assembly instructions. The unsupported edges of all plates shall be held in position by temporary props. A sufficient number of bolts shall be progressively installed to hold the plates in position. Bolts shall not be tightened until tightening will not interfere with the adjustment and matching of additional sections. Special care shall be exercised in the use of drift pins or pry bars to prevent chipping or injury to the galvanized coating. Final tightening of bolts shall be to a minimum torque of 100 ft. lbs.

522.04 Method of Measurement. The footage shall be the actual number of linear feet of the corrugated metal structure installed in place. The measurements shall be the average of the two side measurements, end to end, at the point of bearing.

522.05 Basis of Payment. Payment for accepted quantities will be made at the contract price for:

<u>Item</u>	<u>Unit</u>	<u>Description</u>
522	Linear foot	_____ ft. _____ inch Structural plate corrugated metal structure, _____ - inch

ITEM 523 DYNAMIC LOAD TESTS

- 523.01 Description**
- 523.02 General**
- 523.03 Equipment**
- 523.04 Test Procedures**
- 523.05 Method of Measurement**
- 523.06 Basis of Payment**

523.01 Description. This item shall consist of a dynamic load applied by a pile hammer to a driven pile (restrike) or to a pile being driven, while transducers obtain measurements for predicting the static capacity of the pile. Waiting periods may be required so that soil set-up and relaxation characteristics can be determined.

523.02 General. The Contractor shall notify the Engineer of his intent to drive piling at least three days prior to the installation of the first pile. The Engineer shall determine if the test is to be performed or if some pile driving experience at the proposed site is to be obtained before a decision can be made. The Engineer will establish a date for the tests and will also determine the location of all piles to be dynamically load tested.

The hammer selected for driving the test loaded pile shall be used for driving all piles represented by the load test pile. If the Contractor subsequently finds it necessary to use a different hammer, the Engineer will determine if an additional

dynamic load test is necessary. Any such test shall be completed at no additional cost to the City.

523.03 Equipment. The Contractor shall supply all personnel and equipment needed to strike the test pile with the pile hammer. The Contractor shall also supply a source of 115 V, 1500 VA, 60 Hz electrical power with extension power cords. When fluted piles are being used, the Contractor shall supply a cutting torch.

The City will provide the transducers, the Pile Driving Analyzer, and the personnel to operate the equipment.

523.04 Test Procedures. Approximately three piles will be tested in one day. City personnel will drill holes into the piles to be tested so that electronic transducers (2 accelerometers and 2 strain gages) can be attached. When the transducers have been placed in position and the Pile Driving Analyzer has been made ready to receive the acceleration and strain measurements, the Contractor shall strike the pile with the pile hammer as many times as is required to obtain adequate measurements as determined by City personnel.

After the dynamic testing measurements have been obtained and analyzed, the City will provide instructions for driving the piles.

523.05 Method of Measurement. The hours to be paid for under this item will be the sum of the time intervals that the City has requested the Contractor to discontinue his normal production pile driving operation so that the dynamic load tests can be performed. The Engineer will measure and record the time needed to perform the tests to the nearest one-tenth of an hour.

523.06 Basis of Payment. Payment for the sum of the testing time intervals will be made at the contract price for:

<u>Item</u>	<u>Unit</u>	<u>Description</u>
523	Hour	Dynamic load tests

ITEM 524 WATERPROOF DECK COATING

- 524.01 Description
- 524.02 General
- 524.03 Materials
- 524.04 Preparation of Surfaces
- 524.05 Application
- 524.06 Method of Measurement
- 524.07 Basis of Payment

524.01

524.01 Description. This item consists of furnishing the necessary labor, materials, equipment and supervision required to install a fluid applied waterproofing system to parking decks as indicated on the plans.

524.02 General. The system applicator shall submit evidence of either being licensed by the manufacturer or having a minimum of five (5) years experience as a General Contractor in the application of urethane deck coatings to areas in excess of 25,000 square feet.

Submit complete manufacturer's literature and technical data for the coating system proposed, along with test results from a recognized independent laboratory verifying manufacturer's published technical data.

Completed installation shall be guaranteed against defects of materials and workmanship, as defined in the Proposal, for a period of five years, beginning with the date of acceptance by the City of Akron of the deck coating system. Guarantee shall be submitted prior to commencing work.

Deliver materials to the job site in sealed, undamaged containers. Each container shall be identified with material name, date of manufacture and lot number.

Components shall be products of a single approved manufacturer, or shall be certified as compatible with components produced by the approved manufacturer.

524.03 Materials. Deck coating materials shall be a fully loaded system comprising of a low odor polyurethane elastomer, capable of producing a seamless, waterproof, traffic bearing deck coating such as the following:

“Iso-Flex 750U-HL – MVT & HVT”, as manufactured by Lym-Tal International,

“Qualideck Traffic Coating System – Standard & Heavy Duty”, as manufactured by Advanced Polymer Technology,

“Conipur II – Medium Duty & Heavy Duty” (Heavy Duty 1-TC Method not accepted), as manufactured by Sonneborn,

“Mark 170.2 Flexodeck II – Medium Duty & Heavy Duty”, as manufactured by Poly-Carb, or an approved equal.

Two coat systems shall be applied to parking areas and three coat systems shall be applied to traffic areas. Locations of heavy-duty traffic areas are marked on the plans or will be designated by the Engineer. Final coatings shall match the color of the existing deck coating. Dry mil thickness of each coat shall be according to manufacturers specifications. The use of solvents, such as Xylene in the

waterproofing material is to be utilized only upon approval from the Engineer and in accordance with the manufacturers recommendations.

All coatings shall be low or no odor and VOC compliant.

Five copies of the material specifications shall be submitted to the Engineer for review prior to the application of any deck coatings.

524.04 Preparation of Surfaces. Voids in the existing concrete surfaces shall be patched prior to waterproofing.

All surfaces designated for waterproof deck coating shall be cleaned by the shot blast method such as the Blastrac Surface Preparation System, Wheelabrator-Frye, Inc., Materials Cleaning Systems Division, 500 Byrkit Avenue, Mishawaka, Indiana 46544, telephone: (219) 255-2141 or an approved alternate. Any surface inaccessible to the shotblast method of cleaning shall be cleaned by sandblasting. A thin layer of portland cement concrete shall be removed from the entire area in addition to any dirt, dust, laitance, oil, grease, paint, bituminous material and other foreign matter. The surface shall be left free of loose particles and shall be without sharp ridges, projections, voids and concrete droppings that would be mechanically detrimental to membrane application. Preparation of surfaces shall be in accordance with the recommendations of the manufacturer of the waterproof deck coating system.

A 1/4" deep saw cut shall be made at the edge of any section to be coated for the purpose of providing a secure termination of the coating material. This sawcut is to be filled during the application of the base coat. The deck coating shall be extended 2" beyond the sawcut.

All construction and control joints to be coated shall be cleaned and filled with sealant.

Provide flashings as recommended by coating manufacturer at all locations of potential movement such as wall/slab intersections.

At projections through the deck such as posts, vents, pipes, stanchions, railings and similar locations of potential slight movement, provide a 1/4" bead of sealant. Tool sealant to form a cove and allow to cure before overcoating.

Prime all concrete, masonry and metal surfaces. Apply primer at coating manufacturer's recommended rate.

Detail work shall be as recommended by the coating manufacturer and shall include all flashings, cracks, new concrete used for patching of the deck surface, control joints, and construction joints.

524.05

For repairs to and recoating of waterproofing membrane, follow the manufacturers written instructions and recommendations. Base coat should be applied to areas where repairs have been performed and the waterproof membrane has been removed. The base coat should be applied to a thickness such that it matches the profile of the existing waterproof membrane.

Areas to be coated with a medium duty or heavy duty membrane will be cleaned and prepared according to the polyurethane manufacturers recommendations and coated with the approved coating system which includes primer, polyurethane and aggregate.

All joints shall be routed and cleaned to approximately ¼ inch wide by ½ inch deep. A backer rod shall be installed and the joint filled with polyurethane sealant such as Sikaflex -1CSL or an approved equal. Rout or sawcut all cracks exceeding 1/16 inch but less than 1 inch in width and fill with sealant.

524.05 Application. Before membrane work is commenced, surface shall be reinspected and treated as necessary to remove laitance, loose material on the surface, grease, oil and other contaminants which could affect bonding of the membrane. Surfaces shall be left broom and vacuum clean.

Concrete surface shall be visibly dry and pass a four-hour rubber mat test (no condensate) prior to application of coating system. Mat shall be taped to deck on all edges.

Do not apply if rain is anticipated within eight hours of application.

Substrate surface temperatures shall be above 40°F (5°C) and lower than 110°F (44°C).

Continuous positive ventilation shall be provided for interior applications throughout the application period and eight hours after. Open fires, smoking and operation of spark producing equipment shall not be permitted in the application area until vapors have dissipated.

The waterproof deck coating shall be applied to a height of four inches at walls, curbs, columns and other vertical intersections unless otherwise noted on the plans.

Apply base coat material at the dry film thickness recommended by the coating manufacturer. Base coat shall be rolled to assure uniform coverage of surface.

Apply deck top coat and aggregate to parking areas and travel lanes as shown on the plans in strict conformance with manufacturer's written specifications.

524.06 Method of Measurement. Waterproof deck coating shall be based upon the area in square feet of membrane completed in place.

524.07 Basis of Payment. Payment for joint cleaning and sealing, crack filling, caulking, removal of the existing waterproofing if necessary and all other surface preparation along with the application of the waterproofing system shall be included in the price bid for the item listed below:

<u>Item</u>	<u>Unit</u>	<u>Description</u>
524	Square Foot	Waterproof Deck Coating

ITEM 525 MICRO-SILICA MODIFIED CONCRETE OVERLAY

- 525.01 Description**
- 525.02 Quality Assurance**
- 525.03 Materials**
- 525.04 Equipment**
- 525.05 Proportioning and Mixing**
- 525.06 Preparation of Existing Deck**
- 525.07 Finishing Machine Dry Run**
- 525.08 Placing, Consolidating and Finishing**
- 525.09 Curing**
- 525.10 Limitation on Placing Operations**
- 525.11 Manufacturer's Representative**
- 525.12 Method of Measurement**
- 525.13 Basis of Payment**

525.01 Description. This work shall consist of furnishing the necessary labor, materials and equipment to overlay concrete bridge decks in accordance with these specifications and in reasonably close conformity with the grades, thicknesses and cross sections shown on the plans or as directed by the Engineer. This work shall include the removal of patches other than sound portland cement concrete and all loose and unsound concrete by hydrodemolition; preparation of the existing concrete surface; removal, forming and concrete for full-depth repairs; blast cleaning; furnishing, placing, finishing, texturing and curing of a micro-silica modified concrete (MSC) overlay; and all other operations necessary to complete this work according to the specifications and to the satisfaction of the Engineer.

The MSC overlay shall be not less than 1-1/4" inches thick (thicker where loose or disintegrated concrete is to be replaced and/or as indicated on the plans) and be constructed as a single monolithic element of the structure. Its surface shall be finished level with the surface of the original concrete deck.

525.02 Quality Assurance. The contractor shall submit evidence of having a minimum of five (5) years experience in the placement of micro-silica modified concrete overlays.

525.03 Materials. The materials shall conform to the following requirements:

Fine aggregate (natural sand)	703.02*
Coarse aggregate (no. 8)	703.02*
Portland cement, Type 1 or 1A**	701.04 or 701.01
Water.....	499.02
Chemical admixture	705.12, ASTM C 494, Type A or D
Air-entraining admixture.....	705.10
Superplasticizing admixture (High Range Water Reducer)	705.12, ASTM C 494, Type F
Portland cement concrete (for full-depth repair)	511, Class S
Curing materials	705.05 or 705.06, white opaque
Curing (for full-depth repair)	511.14

Micro-silica admixture As recommended and furnished by:

Cormix Construction Chemicals	or	Euclid Chemical Co.
Dallas, TX		Cleveland, Ohio

Grace Construction Products	or	Master Builders
Cambridge, Massachusetts		Cleveland, Ohio

Sika Corporation
Lyndhurst, New Jersey

* Deleterious material shall not exceed one-half the requirement for superstructure aggregate and sodium sulfate soundness loss shall not exceed that specified for superstructure concrete in 703.02.

** Only one brand of cement shall be used for each bridge deck overlay unless otherwise permitted by the Engineer.

Note: The Contractor shall obtain a written statement from the manufacturer of the micro-silica admixture that he is satisfied with the compatibility of the combination of materials and the sequence in which they are combined.

525.04 Equipment.

A. Mixers. Concrete shall be mixed in a central mixing plant or by a ready-mixed concrete truck capable of discharging concrete having a maximum water-cement ratio of 0.36. Mixing equipment shall meet the requirements of 499.04(b). Admixtures shall be introduced into the concrete in such a manner that will disperse it throughout the entire load. Batch plants shall meet the requirements of 499.04(a) and shall be located such that the maximum time required from start of mixing to completion of discharge of the concrete at the site of work shall not exceed 90 minutes.

B. Finishing Machine. An approved self-propelled finishing machine shall be used with supports outside the scarified deck surface to be overlaid, except where hand finishing equipment is authorized. The finishing machine shall be equipped with forward and reverse drive mechanisms that enable precise velocity control of the machine while it is moving in either direction. It shall be equipped with one or more rotating rollers. It shall be equipped with augers and either a vibrating pan or vibrating rollers. Vibrating frequency for pans and rollers shall be variable from 1500 to 5000 pulses per minute. The Contractor shall furnish the necessary verification of these vibration frequencies. Screeds shall have provisions for raising above the finished concrete surface.

The placing and finishing equipment shall be designed so that the elapsed time between depositing concrete and final finishing shall not exceed 10 minutes.

C. Finishing Machine Rail and Supports. Finishing machines shall be supported by rail and supports made of steel. Rail shall be furnished in sections not less than 10 feet in length and be of sufficient cross-section so that the weight of the finishing machine causes zero vertical deflection while in motion. Rail shall be straight with no sections exceeding a tolerance of 1/8 inch in 10 feet in any direction. Rail supports shall be screw-type, adjustable saddles and shall be of sufficient number under the rail so that zero vertical deflection occurs under the weight of the finishing machine.

D. Hydrodemolition Equipment. The hydrodemolition equipment shall be a self-propelled machine that utilizes a high pressure water jet stream capable of removing concrete to the depth specified herein and/or as shown on the plans and be capable of removing rust and concrete particles from reinforcing steel. Hand held high pressure wands or 35 lb. maximum jackhammers operated at no more than a 45 degree angle from horizontal shall be used in areas that are inaccessible to the self-propelled machine or in patching areas that require work to remove the remaining unsound concrete.

525.05 Proportioning and Mixing. All required characteristics of the mix, i.e. air entrainment and slump, shall be adjusted off the deck before placement of the overlay begins. The components for micro-silica modified concrete shall be combined into a workable mixture of uniform composition and consistency. They shall be proportioned as follows:

QUANTITIES OF MATERIAL PER CUBIC YARD (DRY WEIGHTS*)

Type of Coarse Aggregate	Coarse Aggregate (lbs)	Fine Aggregate (lbs)	Cement (lbs)	Silica (lbs)	Maximum Water- Cement Ratio
Gravel	1265	1430	700	70	0.36
Limestone	1280	1430	700	70	0.36
Slag	1110	1430	700	70	0.36

*The specific gravities used for determining the above weights are: natural sand 2.62, gravel 2.62, limestone 2.65, slag 2.30 and micro-silica 2.20.

The batch weights previously described shall be corrected to compensate for the moisture contained in the aggregate at the time of use. A chemical admixture (705.12, Type A or D) shall be used. The transit mixer charge shall be limited to 3/4 of its rated capacity or 6 cubic yards, whichever is the smaller, unless a larger size is approved by the Engineer.

The specified cement content shall be maintained and a maximum water-cement ratio of 0.36 shall not be exceeded. Any admixture added at the job site shall be mixed a minimum of five minutes at mixing speed. After five minutes, the addition of any additional admixture to the concrete shall be mixed a minimum of five minutes. After all components have been added, the slump range shall be 6 plus/minus 2 inches. The air content of plastic concrete at the time of placement shall be 8 plus/minus 2 percent. Two cylinders shall be made for every other ready-mixed concrete truck load of MSC incorporated into the work. The Contractor shall furnish the required materials and samples without charge to the City.

If a slump loss occurs after mixing and before placement of the MSC overlay, the charge may be "retempered" with the admixture to restore plasticity. The slump range and air content shall be rechecked to ensure conformance to the allowable values. If the consistency of the charge after "re-tempering" is such as to cause segregation of the components, this will be cause for rejection of the load. The MSC overlay shall still be placed within the 90 minute limitation as per 525.04.

The Contractor shall make one trial batch of the MSC to be hauled at least 4 days before the overlay is to be placed. He shall cast one or more small test slabs, e.g. 8 ft. long x a width which is wide enough to accommodate his tining equipment x 1-1/4 in. thick, for texturing according to 525.08 and shall prepare other samples and specimens as directed by the Engineer. The Contractor shall furnish the required materials and samples without charge to the City. The Engineer shall be notified 7 days in advance of the test batch preparation and will conduct all the required tests.

525.06. Preparation of Existing Deck.

Concrete Removal by Hydrodemolition. The entire top surface of the concrete bridge deck shall be completely removed to a depth 1/4" or as shown on the plans.

The measurement shall be nominal and shall be taken from the portland cement concrete surface to the mortar line.

The intent is to permit the removal of unsound concrete using hydrodemolition equipment. The contractor may choose to use conventional scarifying equipment to make an initial pass across the deck to remove a portion of the total depth required (not to exceed 3/5 of the total removal depth of the concrete bridge deck or 1/8"). In all cases, hydrodemolition shall be used for the final pass. If the use of mechanical scarifying equipment results in exposing or snagging the top mat of reinforcing steel, approval of the use of the scarifying equipment shall be immediately rescinded and the remaining removal will be done with hydrodemolition equipment or by chipping. Damaged or dislodged reinforcing steel shall be repaired or replaced at the Contractor's expense.

Prior to the commencement of the removal operation, the equipment shall be calibrated on an area of sound concrete as designated by the Engineer

The Engineer will verify the following settings:

1. Water Pressure Gauge
2. Machine Staging Control (step)
3. Nozzle Size
4. Nozzle Speed (travel)

During the calibration, any or all of the above settings may be modified in order to achieve removal in accordance with the requirements of the plan. When the designated depth of removal is attained, the settings shall be recorded and maintained throughout the removal operation unless otherwise directed by the Engineer.

Calibration shall be required on each structure, each time the hydrodemolition is performed and as required to achieve the results required by the plan. The depth of removal shall be verified as necessary, and at least every 30 feet along the cutting path. The readings shall be documented and, if necessary, the equipment recalibrated to insure the specified depth of removal.

The Contractor shall block all drains on the deck and install aggregate dams every 150 feet [6 inches high by 1 foot wide, minimum] to strain run-off. The deck shall be used as a settlement basin within itself. A settlement basin outside or at the end of the structure is required if further straining is necessary to produce visibly clear water.

The Contractor shall provide shielding, as necessary, to insure containment of all dislodged concrete within the removal area in order to protect the traveling public from flying debris both on and under the work site.

525.06

After the hydrodemolition operation has completed the removal, and the deck is allowed to dry, the deck shall be resounded to assure that all unsound material has been removed. The final sounding of the deck shall be done by the Engineer and shall not be performed within 24 hours after a rain. In no case shall the final sounding be made unless the deck is dry. Final sounding shall consist of as many successive resoundings as required to ensure that all deteriorated and fractured concrete has been removed. Additional removal shall be performed with the hand held wand or 35 lb. maximum jackhammer operated at an angle of no more than 45 degrees from horizontal. If the bond between concrete and reinforcing steel has been destroyed, the adjacent concrete shall be removed to a depth that will provide a minimum 3/4-inch clearance around the steel except where other reinforcing steel makes this impractical.

Cleaning shall be performed with a vacuum system capable of removing wet debris and water all in the same pass. The deck shall then be blown dry with air to remove excess water. Cleaning shall be done in a timely manner, before debris and water is allowed to dry on the deck surface. All exposed reinforcing steel which is left unsupported by the hydrodemolition process shall be adequately supported and protected from bending from all construction wheel traffic. All reinforcing steel damaged or dislodged by these operations shall be replaced with bars of the same size and coating at no additional cost to the City.

Full Depth Repair. Where the deck is sound for less than one half of its original depth, the concrete shall be removed full depth except for limited areas as may be designated by the Engineer. Forms shall be provided to support concrete placed in full-depth repair areas. The forms for areas of up to 4 square feet may be suspended from wires from the reinforcing steel. For areas greater than 4 square feet, the forms shall be supported from the primary members of the superstructure or by shoring from below. Areas of full-depth repair shall have the concrete faces and reinforcing steel cleaned as described below.

Preparation Prior to Overlay Placement. Not more than 24 hours prior to placing the overlay, all surfaces to which the overlay is to bond, including exposed reinforcing and structural steel, the work face of a previously placed overlay, and the faces of curbs and barriers up to a height of at least 1 inch above the proposed overlay surface, shall be cleaned by abrasive blasting or an approved method of waterblasting with 7000 psi minimum pressure. Steel surfaces shall be cleaned nearly to White Metal cleanliness, until at least 95% of the surface area is free of all visible residues. Concrete surfaces shall be made free of spalls, laitance, and all contaminants detrimental to achieving an adequate bond.

Bridge scuppers shall be cleaned of all foreign matter and plugged prior to placement of the overlay. Scuppers shall be unplugged to permit free drainage of water from the deck surface following overlay placement.

General. Vehicles other than approved construction equipment will not be permitted on those sections of the deck where concrete removal operations or

scarification have begun. Contamination of the deck by construction equipment or from any other source shall be prevented.

The Contractor is responsible for protecting traffic under the bridge while removing deck concrete. This may require temporary plywood sheeting (adequately supported) be erected under the deck to prevent pieces of concrete from falling onto traffic below.

525.07 Finishing Machine Dry Run. After the screed rails or other supports have been set to proper profile and prior to placing the overlay, the finishing machine, with filler blocks attached to the bottom of the screed, shall be passed over the entire area of the deck to be overlaid. The thickness of the filler blocks shall be the plan specified overlay thickness minus 1/4 inch.

The filler blocks should clear the scarified deck surface by not more than 1/8 inch. Concrete which does not clear the filler blocks shall be removed by hydrodemolition or other methods approved by the Engineer.

525.08 Placing, Consolidating and Finishing. Immediately before the MSC overlay is placed, the newly exposed concrete surfaces shall be cleaned with an air blast and then surfaces that have been prepared with a jackhammer shall be covered with a coating of bonding grout. The MSC overlay shall be placed only when the existing deck is surface dry. The bonding grout, if required, shall consist of equal parts by volume of portland cement and sand, mixed with enough water to form a slurry of paint-like consistency which shall be such as to allow it to be applied with a stiff brush or broom to existing concrete surfaces in a thin even coating that will not run or puddle. The grout shall be scrubbed onto the surface dry deck (surfaces which are dry enough to absorb some of the moisture from the grout) with enough care to ensure that all surfaces are evenly covered and that excess grout will not collect in low areas. The bonding grout shall be applied for only a short distance, not to extend beyond the rear of the mixer or overlay carrier, in advance of the placement of the overlay and shall not be allowed to dry prior to overlay placement. The grout shall be mixed and placed within the same time requirements as for the overlay.

The newly exposed surfaces in full-depth repair areas shall be similarly cleaned and prepared immediately prior to placing concrete.

Concrete for full-depth repairs shall be 511 concrete or, at the option of the Contractor, MSC placed simultaneously with the overlay. When 511 concrete is used, it shall be pre-placed onto the plan lower boundary of the overlay, given a broom finish, and cured as specified in 525.09.

At the option of the Contractor, the deep areas of variable thickness may be pre-placed with 511, Class S concrete using No. 8 size coarse aggregate prior to the uniform thickness. Pre-placed areas must be a minimum of 1 inch in depth. The perimeter of these patches shall be nearly vertical or slightly undercut. Prior to

525.08

placing concrete, the areas of pre-placed variable thickness shall be cleaned as per 525.06. The concrete shall be hand vibrated during placement, given a wire broom finish, water cured and shall have attained a modulus of rupture of 400 psi prior to loading. Before placing the uniform thickness of MSC, all surfaces including the cured pre-placed variable thickness areas shall be blast cleaned as per 525.06.

Contamination of the wetted deck by construction equipment or from any other source shall be prevented by placement of a clean 4-mil polyethylene sheet (or any other covering as approved by the Engineer) on the surface of the deck following the air blast cleaning. Where reinforcing steel is exposed, the Contractor shall provide adequate supports for the concrete mixer so that reinforcing steel and its bond with the concrete will not be damaged by the weight and movement of the concrete mixer, or shall provide means to convey concrete from the mixer to the finishing machine.

The MSC overlay shall be placed, consolidated and finished to the plan surface. Hand vibrators shall be used for full depth repair, variable depth area, at all edges and adjacent to joint bulkheads.

After the MSC has been consolidated and finished, it shall be textured transversely to provide a relatively uniform pattern of grooves spaced on 5/8-inch centers with a tolerance of plus/minus 1/8 inch. Grooves shall be approximately 0.15 inches deep and 0.10 inches wide. A strip of surface 9 to 12 inches wide adjacent to curbs and barriers shall not be textured.

At the Contractor's option an evaporation retardant and finishing aid may be used after finishing and prior to the texturing operation. Any product used for such purpose shall be specifically marketed for such use (plain water is not acceptable). The product may also be sprayed over textured areas. The evaporation retardant and finishing aid shall be applied as per the manufacturer's recommendations. The wet burlap cure shall follow this operation as closely as possible.

The Contractor shall stencil the date of construction (month and year) and the letters MS into the overlay before it takes its final set. The date shall be located in the right-hand corner of the deck at the forward abutment. It shall be placed parallel to the edge of the overlay and centered at 12 inches in from both the edge of the overlay and end finish. The numerals shall be 3 to 4 inches in height, 1/4-inch in depth and face the centerline of the roadway.

Longitudinal joints are permitted, but only to the extent necessary to accommodate the width of the finishing machine, to facilitate changes in roadway crown, and to permit maintenance of vehicular traffic, except as approved by the Engineer. Longitudinal joints shall not be used in close proximity to faces of curbs or barriers or at edges of decks. All joints in the overlay shall be formed.

Any pending problem which is noted prior to final acceptance of the overlay shall be corrected by the Contractor at no cost to the City.

A 10-foot straightedge shall be used to check the overlay directly behind the finishing machine. It shall also be used to check transversely along the edges of the overlay where hand finishing is done. Any irregularities exceeding 1/8 inch in 10 feet shall be corrected immediately.

525.09 Curing. Before a full-depth repair made with 511 concrete is overlaid, it shall be water-cured and shall have attained a modulus of rupture of 400 psi.

As soon as the tining operation is completed, the finished overlay surface shall be covered with a single layer of clean wet burlap. The fresh overlay surface shall receive a wet burlap cure for 3 days. For the entire curing period of 72 hours the burlap shall be kept wet by the continuous application of water through soaker hoses. Either a 4-mil white opaque polyethylene film or a wet burlap-white opaque polyethylene sheet shall be used to cover the wet burlap for the entire 72 hour period.

A cure day shall be defined as a 24-consecutive hour period of time. The temperature at the overlay surface shall be maintained above 35 degrees Fahrenheit until the curing period is completed. Any day during which the air temperature at the overlay surface falls below 45 degrees Fahrenheit shall not be counted as a cure day.

As soon as the overlay has been cured, all joints and abutting surfaces shall be sealed with an approved high molecular weight methacrylate sealer. The sealer shall be prepared and applied in accordance with the manufacturer's recommendations. Joints to be sealed shall include transverse joints in the MSC overlay, joints between MSC overlay and steel end dams, longitudinal joints between MSC overlay placements, and longitudinal joints between MSC concrete and safety curbs, barriers, parapets, bulb angles, etc. On the edges of decks without curbs, the interface between the overlay and the existing deck shall be sealed in a similar manner. Any cracking which occurs prior to opening traffic shall be sealed in this manner or repaired or corrected in another manner as directed by the Engineer at no cost to the City. The deck shall be sounded and any delaminated areas removed and replaced at the Contractor's expense.

Traffic will not be permitted on the finished overlay surface until after completion of the 3-day wet cure.

Any improperly cured overlay may be ordered to be removed by the Engineer.

525.10 Limitation on Placing Operations. Prior to overlay placement, the Engineer shall establish the Contractor's ability to place the overlay on a continuous basis and to consolidate finish, texture and commence curing within the time interval specified in 525.09. Once the finishing machine has made the first pass, workers shall not be allowed to walk in the freshly placed overlay.

525.11

The overlay shall be placed only when the local ambient temperature is above 45 degrees Fahrenheit and is forecast to remain above 45 degrees Fahrenheit for the curing period. The overlay shall not be placed when rain is forecast within the intended working period. Overlays shall be placed only if the overlay surface evaporation rate, as affected by ambient air temperature, concrete temperature, deck temperature, relative humidity and wind velocity, is 0.1 pound per square foot per hour or less. The Contractor shall determine and document the atmospheric conditions, subject to verification by the Engineer. No MSC shall be placed if the ambient air temperature is 85 degrees Fahrenheit or higher or predicted to go above 85 degrees Fahrenheit during the overlay placement regardless of the surface evaporation rate.

Figure 1 in section 511.08 shall be used determine graphically the loss of surface moisture for the overlay. In no case shall the temperature of the MSC exceed 90 degrees Fahrenheit during placement. If rain occurs during placing of the overlay, all operations shall cease. No MSC overlay shall be placed after October 15th except by specific permission of the Engineer.

If placement of the overlay is to be made at night, the Contractor shall submit a plan which provides adequate lighting for the work area. The plan shall be submitted at least 15 calendar days in advance and be approved by the Engineer before concrete is placed. The lights shall be so directed that they do not affect or distract approaching traffic.

During delays in the overlay placement operations of more than 10 minutes, the work face of the overlay and any bonding grouted areas shall be temporarily covered with wet burlap. If an excessive delay is anticipated, a bulkhead shall be installed at the work face and the overlay placement operation terminated.

Unless otherwise authorized by the Engineer, an overlay shall not be placed adjacent to a previous overlay which has cured for less than 36 hours.

Adequate precautions shall be taken to protect the freshly placed overlay from rain.

Prior to the end of the full curing period for any section, no power driven tools heavier than a 15-pound chipping hammer shall be used adjacent to the new overlay.

Vehicles other than approved construction equipment will not be permitted on those sections of the deck where concrete removal operations have begun. Contamination by construction equipment or from any other source shall not be permitted.

525.11. Manufacturer's Representative. The manufacturer's technical representative for the micro-silica admixture shall be notified when the admixture is selected and shall be present during the placement of the overlay unless his presence is waived by the Engineer. Operations and procedures which are considered by the representative as being detrimental to the integrity of the overlay will not be permitted.

525.12. Method of Measurement. MSC overlay 1-1/4 inches thick shall be measured as the actual deck area in square yards overlaid. The thickness shall be as per 525.01. The bid price for this item includes the cost of furnishing, placing, finishing, texturing and curing the specified thickness overlay. It also includes the cost of surface preparation (includes all handwork), removal of surface preparation debris, cleaning, applying bonding grout if required, and all other materials, labor and equipment required to complete this work, but not specifically included in the other items for payment. Payment shall also include all labor and equipment to place the variable thickness overlay (since the variable thickness and the constant thickness overlay are placed in one operation).

Full-depth repair shall be measured as the volume in cubic yards based on the measured area of full-depth openings in the deck and the existing slab thickness, less 1/4 inch. The bid price for this item includes the cost of removing sound concrete where the depth of sound concrete is less than half of the original thickness of the deck, furnishing and installing forms and supports, furnishing and placing MSC, and if the full depth repair is pre-placed, the finishing and curing required.

MSC overlay (variable thickness) shall be the volume in cubic yards measured as the difference between the total volume (as indicated by the batch quantity tickets for the ready-mix trucks) of MSC overlay placed and accepted, less the calculated volume of the MSC overlay (plan specified thickness), less the volume of the overlay concrete used for full-depth repair, and less any wasted overlay concrete. The volume of overlay concrete remaining in the drum of the last ready-mix truck shall be weighed or measured by the Engineer. The bid price for this item includes the cost of material only, furnished to the job site. No separate payment shall be made for the placement of the concrete or for any tools, labor, equipment or incidentals necessary for such placement complete and in conformance with these notes. The intent of this item is to pay material costs only for all materials, other than uniform thickness overlay material, regardless of the depth of removal incurred and including any material required for grade correction.

Concrete for the test slabs required under 525.05 shall be paid for on a lump sum basis. All other concrete for testing purposes shall be furnished without charge to the City.

525.13 Basis of Payment. Payment for completed and accepted quantities as measured above will be made at the contract price bid for:

<u>Item</u>	<u>Unit</u>	<u>Description</u>
525	S.Y.	MSC Overlay Using Hydrodemolition 1-1/4" Overlay
525	C.Y.	MSC Overlay (Variable Depth Repair-Material Only)
525	C.Y.	Full Depth Repair
525	L.S.	Test Slab

ITEM 526 – CRACK FILLING WITH EPOXY

- 526.01 Description**
- 526.02 Quality Assurance**
- 526.03 Delivery, Storage & Handling**
- 526.04 Job Conditions**
- 526.05 Surface Preparation**
- 526.06 Materials**
- 526.07 Mixing and Application**
- 526.08 Cleaning**
- 526.09 Method of Measurement**
- 526.10 Basis of Payment**

526.01 Description. This item shall include all materials, labor and equipment for the repair of cracks in concrete structures. The Contractor shall accompany the Engineer or his authorized representative in making a detailed examination of the designated work areas to locate cracks between 1/8" and 1/4" wide in need of repair. Cracks to be repaired shall be marked by the Contractor as directed by the Engineer. This item shall be completed after patching any concrete structures and before application of any waterproofing membrane.

526.02 Quality Assurance. Contractor qualifications: Contractor shall be an approved Contractor of the manufacturer of the specified product, who has completed a program of instruction in the use of the specified repair material, and provide a notarized certification from the manufacturer attesting to their approved Contractor status.

Provide a notarized certificate stating that the repair material meets the specified requirements and have the manufacturer's current printed literature on the specified product.

526.03 Delivery, Storage and Handling. Deliver the specified product in original, unopened containers with the manufacturer's name, labels, product identification, and batch numbers.

Store and condition the specified product as recommended by the manufacturer.

526.04 Job Conditions. Environmental Conditions: Do not apply material if rain or snow will come in contact with material during application.

Protection: Precautions should be taken to avoid damage to any surface near the work zone due to mixing and handling of the specified repair material.

526.05 Surface Preparation. The cracks and adjacent substrate must be clean, sound and free of frost. Remove dust, laitance, grease, curing compounds, waxes, impregnations, foreign particles, efflorescence and other bond inhibiting

materials from the surface by mechanical means, i.e. - sandblasting, high pressure waterblasting, etc., as approved by the Engineer.

Epoxy resin adhesive - repair area may be dry or damp, but free of standing water prior to product application.

526.06 Materials. The crack filling material shall be an epoxy adhesive such as Sikadur 35, Hi-Mod LV with Sikadur 31, Hi-Mod Gel as manufactured by the Sika Corporation, Concrete Standard LVI with Concrete Paste SPL as manufactured by Master Builders Technologies, or an approved equal.

Seven copies of the material specifications shall be submitted to the Engineer for his review.

526.07 Mixing and Application. Follow the material manufacturer's instructions and recommendations in the mixing and application of the crack filling material.

526.08 Cleaning.

A. After the epoxy resin adhesive has cured, removal of the epoxy resin adhesive for sealing and porting devices shall be removed as required by the Engineer. Grinding of cured epoxy overflow shall be executed in such a manner to produce a finished appearance acceptable to the Engineer.

B. The uncured epoxy resin adhesive can be cleaned from tools with an approved solvent. The cured epoxy adhesive can only be removed mechanically.

C. All injection ports shall be removed by cutting the ports and grinding the remainder down to the concrete surface or to a depth acceptable by the Engineer.

D. Leave finished work and work area in a neat, clean condition without evident of spillovers onto adjacent areas.

526.09 Method of Measurement. The quantity to be paid for under this item shall be the number of linear feet of crack epoxy injected, complete and accepted.

526.10 Basis of Payment. The repair of the structural and non-structural cracks will be paid for at the contract unit bid price per lineal foot, which payment shall be full compensation for furnishing and installing all materials, grinding, labor tools, equipment, and other incidentals necessary to complete the specified operation. Payment will be made at the contract price for:

<u>Item</u>	<u>Unit</u>	<u>Description</u>
526	L.F.	Crack Filling with Epoxy