STATEWIDE SPECIAL PROVISION **01/01/16**
SSP-1

Delete Subsection 202-3.05 Removal of Pavement, Sidewalks, and Curbs and replace with the following:

SECTION 202
REMOVAL OF STRUCTURES AND OBSTRUTIONS

202-3.05 REMOVAL OF PAVEMENT, SIDEWALKS, AND CURBS. Dispose of all pavement, base course, sidewalks, curbs, gutters, etc., designated for removal, in an acceptable manner.

In removing pavements, curbs, walks, driveways and similar structures, make all cuts clean, vertical, and true to designated lines where an abutting structure or a part of a structure is to be left in place.

STATEWIDE SPECIAL PROVISION **01/01/16**
SSP-2

Delete the first paragraph of Subsection 3.01-3.03 Shaping and Compaction and replace with the following:

SECTION 301
AGGREGATE BASE AND SURFACE COURSE

3.01-3.03 SHAPING AND COMPACTION. The maximum density and optimum moisture will be determined by ATM 207 or ATM 212.

STATEWIDE SPECIAL PROVISION **01/01/16**
SSP-3

Delete Subsection 401-2.08 Recycled Asphalt Pavement and replace with the following:

SECTION 401
HOT MIX ASPHALT PAVEMENT

401-2.08 RECYCLED ASPHALT PAVEMENT. Recycled asphalt pavement (RAP) may be used in the production of HMA. The RAP may be from pavements removed under the Contract, or from an existing stockpile. Conform to Subsection 703-2.16.

Delete Subparagraph 1.a. of Section 401-4.04 Asphalt Material Price Adjustment and replace with the following:

401-4.04 ASPHALT MATERIAL PRICE ADJUSTMENT.

1.a. To asphalt material meeting the criteria of Section 702, and is included in items listed in the bid schedule of Sections 306, 307, 308, 401 thru 408, 520, 608 and 609.

STATEWIDE SPECIAL PROVISION **01/01/16**
SSP-4

Delete Subsection 606-2.01 Materials and replace with the following:

SECTION 606
GUARDRAIL

606-2.01 MATERIALS. Use materials that conform to the following:

Concrete, Class A or W (or an approved, pre-mixed, sacked concrete)	Subsection 501-3.01
Guardrail Connection Plate	Section 722
Guardrail Hardware	Subsection 710-2.07
Guardrail Posts and Blocks	Subsection 710-2.06
High Strength Bolts	Section 722
Metal Beam Rail	Subsection 710-2.04
Terminals	Subsection 710-2.11
Wire Cable	Subsection 709-2.02

Terminal Markers. Single piece marker, constructed of a durable UV resistant, continuous glass fiber and marble reinforced, thermosetting composite material.

1. designed for use as road markers.

2. impact-resistant temperature range, -40°F to +140°F

3. 0.125 by 3.75 inches by 66 inches long, 18 inch burial depth

Furnish white flexible markers with a 3 inch by 12 inch retroreflective sheeting, color orange, shall meet ASTM D4956 requirements for Type VIII or IX. Alternately, use 3M Diamond Grade DG3 or approved equivalent.

Fabricate guardrail reflector assembly brackets from aluminum alloy, galvanized steel, or polycarbonate. Use retroreflective sheeting meeting ASTM D4956 requirements for Type VIII or IX. Alternately, use 3M Diamond Grade DG3 or approved equivalent.

STATEWIDE SPECIAL PROVISION **01/01/16**
SSP-5

Delete subsection 614-2.01 Materials and replace with the following:

SECTION 614
CONCRETE BARRIER

614-2.01MATERIALS. Use materials that conform to the following:

Concrete, Class A	Subsection 501-3.01
Reinforcing Steel and Wire Rope	Subsection 709-2.01
Retroreflective Sheeting Material	ASTM D4956, Type III, IV, or V
Reflector Assemblies	Side-mounted or top-mounted as shown on the Plans.

STATEWIDE SPECIAL PROVISION **01/01/16**
SSP-6

Delete subsection 616-2.01 Thaw Pipe and replace with the following:

SECTION 616
THAW PIPE AND THAW WIRES

616-2.01 THAW PIPE. Use materials that conform to the following:

Pipe	ASTM A53, Galvanized
Fittings	ASTM A197, galvanized per AASHTO M 232
Pipe Hangers	AASHTO M 218
Braces for Stand Pipe	ASTM A36, galvanized per AASHTO M 111
Bolts and Nuts	ASTM A307, galvanized per AASHTO M 232

STATEWIDE SPECIAL PROVISION **01/01/16**
SSP-7

Delete subsection 617-2.01 Materials and replace with the following:

SECTION 617
RAILROAD CROSSINGS

617-2.01 MATERIALS. Use materials that conform to the kind, grade, type, and size specified on the Plans or as listed below:

Anchor Bolts	ASTM A307, Galvanize per AASHTO M 232, Class A
Rigid Metal Conduit, Couplings, and Fittings	UL Standard UL-6, NEMA Standard C 80.1, hot-dip galvanized
Concrete	Section 501 (Class A)
Railroad Crossing Pads	Rubber or high density polyethylene as manufactured by the Goodyear Tire and Rubber Co., St. Mary's , Ohio; Railroad Friction Products Corp., Wilmerding, Pennsylvania 15148; Red Hawk Rubber Company, Inc. 3911 Dayton Street, McHenry Illinois 60050; Omni Rubber Products, Inc., P.O. Box 2788, Portland, Oregon 97208-2788; or an approved equal.

Repair damage to galvanized coatings according to AASHTO M 36.

STATEWIDE SPECIAL PROVISION **01/01/16**
SSP-8

Delete subsection 625-2.01 Materials and replace with the following:

SECTION 625
PIPE HAND RAIL

625-2.01 MATERIALS. Use materials that conform to the following;

Concrete	Section 501 (Class W)
Pipe	ASTM A53, Galvanized, Schedule 40

STATEWIDE SPECIAL PROVISION **01/01/16**
SSP-11

SECTION 706
CONCRETE AND PLASTIC PIPE

Insert subsection 706-2.06

706-2.06 PLASTIC PIPE. Non-perforated, semi-rigid, smooth-wall pipe meeting the following:

Polypropylene (PP)	AASHTO M330, Type S or Type D, ASTM F2736, ASTM F2764
Polyethylene (PE)	AASHTO M 294, Type S or Type D
Polyvinyl Chloride (PVC)	AASHTO M 264 or M 278
Acrylonitrile-Butadine-Styrene (ABS)	AASHTO M 264

Insert subsection 706-2.07

706-2.07 CORRUGATED POLYETHYLENE PIPE. Meet the following:

Culverts	AASHTO M 294, Type S or Type D
Underdrains	AASHTO M 252

Insert subsection 706-2.09

706-2.09 POLYPROPYLENE PIPE. Meet the following:

Storm	AASHTO M330, Type S or Type D, ASTM F2736 or ASTM F2764
Culvert	AASHTO M330, Type S or Type D, ASTM F2736 or ASTM F2764
Sanitary	ASTM F2736 or ASTM F2764

STATEWIDE SPECIAL PROVISION **01/01/16**
SSP-12

Delete subsection 724-2.02 Materials and replace with the following:

SECTION 724
SEED

724-2.02 MATERIALS. Meet applicable requirements of the State of Alaska *Seed Regulations*, 11 AAC 34, Article 1 and Article 4.

Seed which contains any prohibited noxious weeds listed in the Alaska Department of Natural Resources Division of Agriculture's Prohibited and Restricted Noxious Weeds list shall be rejected. The Prohibited and Restricted Noxious Weeds list is located at the following URL: http://plants.alaska.gov/invasive/noxious-weeds.htm.

Seed containing more than the maximum allowable tolerance of restricted noxious weeds shall be rejected. Restricted noxious weeds, with their maximum allowable tolerances are listed in the Alaska Department of Natural Resources Division of Agriculture's Prohibited and Restricted Noxious Weeds list. The Prohibited and Restricted Noxious Weeds list is located at the following URL: http://plants.alaska.gov/invasive/noxious-weeds.htm.

The Contractor shall furnish to the Engineer a statement signed by the vendor identifying the lot number or lot numbers, certifying each lot of seed has been tested within the preceding nine (9) months, by a recognized seed testing laboratory. Seed that has not been tested within the preceding nine (9) months shall be rejected. The Contractor shall not remove tags from the seed containers. Seed containers that do not have tags shall be rejected. Discrepancies in the lot numbers listed on the statement to the lot numbers indicated on the tags of the seed containers shall be grounds for rejection. Seed which has become wet, moldy, or otherwise damaged in transit or storage will not be accepted. The Contractor shall immediately remove rejected seed from the project premises.

STATEWIDE SPECIAL PROVISION **01/01/16**
SSP-13

Delete Section 205 Excavation, Backfill, and Foundation Fill for Major Structures and replace with Section 205 Excavation and Fill for Major Structures:

SECTION 205
EXCAVATION AND FILL FOR MAJOR STRUCTURES

205-1.01 DESCRIPTION. Excavate and backfill for bridges, retaining walls, concrete box culverts, and other major structures.

Furnish all resources to place and remove cribbing. Perform all required sheeting, bracing, bailing, pumping, draining, and grouting.

Replace unsuitable material encountered below the elevation of the bottom of footings.

205-2.01 MATERIALS. Use materials that conform to the following:

Selected Material, Type C	Subsection 703-2.07
Porous Backfill Material	Subsection 703-2.10
Structural Fill	Subsection 703-2.13
Controlled Low-Strength Material	Subsection 712-2.22

CONSTRUCTION REQUIREMENTS

205-3.01 EXCAVATION.

1. General. Clear and grub prior to starting excavation according to the requirements of Section 201.

   Cut all rock or other hard foundation material to a firm surface, either level, stepped, or serrated, as directed, and remove all loose material. Within areas that will be filled, bench excavated slopes not made of rock or other hard foundation material.

   Excavate to the bottom of spread footings and approach slabs or to the depth shown on the plans, whichever is lower. Do not disturb material below the bottom of spread footings or approach slabs, unless otherwise noted in the Contract.

   Excavate to the bottom of footing prior to driving piles. Do not excavate below the footing elevation unless otherwise noted in the Contract. When swell results from driving piles, excavate the footing area, to the elevation of the bottom of the footing, as shown on the Plans. When subsidence results from driving piles, backfill with structural fill material, to the elevation of the bottom of the footing, as shown on the Plans.

   Dispose of all necessary excavated material as provided in Subsection 203-3.01.

   Do not alter streambed channel and do not place excavated materials in natural stream channels, unless shown on the Plans or approved in writing.

   Give the Engineer in writing no less than 15 days advance notice prior to beginning excavation for spread footings to allow for inspection of the excavated surface. With this notification, identify the location and specify a time period of no less than two days for the Department to inspect the excavated surface. Dewater and remove all debris from the surface prior to the Department's inspection. Obtain the Engineer’s approval of the excavated

surface prior to the placement of any formwork or foundation materials. Account for the time required by the Department to perform the inspection in the progress schedule submitted under Subsection 108-1.03. Pausing work to allow for inspection is not a suspension of work per Subsection 108-1.06 and additional contract time will not be allowed.

2. Foundations on Bedrock. Excavate for footings founded on bedrock, to the neat lines of the footings. Fill overbreak areas outside the neat lines of footings, with Class A concrete, at no additional cost to the Department.

205-3.03 BACKFILL. Unless otherwise noted, reuse excavated material for backfill where shown on the Plans. If additional backfill is required, use material meeting Selected Material, Type C, or as approved by the Engineer. Place backfill material in layers and compact to meet Subsection 205-3.05.

Place underwater backfill in natural stream channels without compaction or layer requirements.

Place backfill as uniformly as possible on all sides of structural units. Avoid unbalanced loading of backfill which could damage the structure. When placed against concrete, place backfill according to the requirements of Section 501.

No ponding or jetting of backfill is allowed.

205-3.04 POROUS BACKFILL MATERIAL. Place porous backfill material continuously within a vertical plane 1 foot behind retaining walls and abutments, unless otherwise shown on the Plans. Compact to the satisfaction of the Engineer.

Where weep holes are shown on the Plans or required by the Specifications, place not less than 1 cubic foot of porous backfill material in the fill at each hole, securely tied in a burlap bag, or wrapped with an acceptable geotextile fabric. Extend the wrapped porous backfill material at least 6 inches above the hole.

205-3.05 COMPACTION. Compact material in conformance with the following, using moisture and density control unless the Engineer determines that such controls are not feasible.

1. Compaction With Moisture and Density Control. The maximum density will be determined by ATM 207 or ATM 212.

   Water or aerate as necessary to provide the approximate optimum moisture content for compaction. Compact each layer to not less than 98% of the maximum density. Acceptance densities will be determined by ATM 213 and ATM 214.

2. Compaction Without Moisture and Density Control. Compact by routing construction equipment and/or rollers uniformly over the entire surface of each layer before the next layer is placed. Compact to the satisfaction of the Engineer.

   Keep dumping and rolling areas separate. Do not cover any lift by another until the Engineer has determined the required compaction is obtained.

205-3.06 CONTROLLED LOW-STRENGTH MATERIAL. Acceptance will be based on a certificate of compliance. Provide a certificate of compliance for each batch of controlled low-strength material (CLSM) in accordance with Subsection 106-1.05.

Do not place CLSM on frozen ground, in standing water, or during wet weather conditions. Do not place CLSM if ambient air temperature is expected to be less than 40°F within 48 hours. Ensure the material temperature is at least 50 °F while being placed.

Do not apply loads to the CLSM until the compressive strength reaches 50 psi.

205-4.01 METHOD OF MEASUREMENT. Section 109 and the following:

1. Excavation. By the actual volume of material removed, excluding the following:

    a. Material removed prior to measurement of the original ground surface.

    b. Material outside of the vertical planes 18 inches outside of and parallel to the neat lines of the footings, except that the limit will be vertical planes coinciding with the neat lines of the seals when seals are shown on the Plans.

    c. Material outside of vertical planes coinciding with the neat lines of footings excavated in solid rock.

    d. Embankment material placed above the elevation of the bottom of footings.

    e. Material within the staked limits of other types of excavation for which payment is otherwise provided.

2. Structural Fill. By the actual volume of material accepted in final position.

3. Porous Backfill Material. By the actual volume of material accepted in final position.

4. Controlled Low-Strength Material. By the actual volume of material accepted in final position.

205-5.01 BASIS OF PAYMENT. Backfill material, obtained from within the limits of structure excavation, is subsidiary to item 205(1). Any backfill material from sources other than excavation for structures will be paid for at the contract unit price for the material being used, or as extra work if no unit price has been established.

Porous backfill material includes all materials and construction operations for making weep holes. When Item 205(4), Porous Backfill Material, does not appear in the bid schedule, porous backfill material is subsidiary.

Excavation for Structures includes removal, and disposal of unsuitable.

Excavation for footings ordered by the Engineer, at a depth greater than 3 feet below the bottom of such footings shown on the Plans will be paid for as extra work.

When controlled low-strength material is used as an alternative to structural fill, controlled low-strength material is paid for at the Contract price for structural fill.

Payment will be made under:

Pay Item	Pay Unit
205(1) Excavation for Structures	Cubic Yard
205(2) Cofferdam	Lump Sum
205(4) Porous Backfill Material	Cubic Yard
205(5) Controlled Low-Strength Material	Cubic Yard
205(6) Structural Fill	Cubic Yard

Delete Section 501 Structural Concrete and replace with Section 501 Concrete for Structures:

SECTION 501
CONCRETE FOR STRUCTURES

501-1.01 DESCRIPTION. Furnish, place, finish, and cure Portland cement concrete for structure construction. Use the class of concrete noted on the Plans unless otherwise specified.

CLASSES OF CONCRETE

Class A:	General use concrete
Class A-A:	Concrete where improved strength and durability is required
Class P:	Concrete where strength in excess of 5000 psi is required
Class DS:	Concrete for drilled shaft foundations

501-1.02 DEFINITIONS.

ADMIXTURE. A material other than water, aggregate, hydraulic cement, pozzolan, and fiber reinforcement, added to the batch before or during mixing, used as an ingredient of a cementitious mixture to modify its freshly mixed, setting, or hardened properties.

AIR-ENTRAINING ADMIXTURE. An admixture causing the development of a system of microscopic air bubbles in concrete, mortar, or cementitious material paste during mixing, usually to improve its workability and resistance to damage by freezing and thawing.

SET-ACCELERATING ADMIXTURE. An admixture causing an increase in the rate of hydration of the hydraulic cement and shortens the time of setting, increases the rate of strength development, or both.

SET-RETARDING ADMIXTURE. An admixture causing a decrease in the rate of hydration of the hydraulic cement and lengthens the time of setting, decreases the rate of strength development, or both.

WATER-REDUCING ADMIXTURE. An admixture either increasing slump of freshly mixed mortar or concrete without increasing water content or maintaining slump with a reduced amount of water, due to factors other than air entrainment.

AGITATION. The process of providing motion in mixed concrete just sufficient to prevent segregation or loss of plasticity.

BLEED WATER. The autogenous flow of water emerging from newly placed concrete, and caused by the settlement of the solid materials within the mass. The relative quantity of mix water that will bleed can be estimated by AASHTO T 158.

CAMBER. For prestressed concrete members, camber is the net upward deflection of an eccentrically prestressed concrete member due to the combined loads, shrinkage, creep, and eccentricity of the prestress force. For non-prestressed members, camber is a deflection intentionally built into a structural element or form to improve appearance or to nullify the deflection of the element under the effects of loads, shrinkage, and creep.

CEMENT. A binding material that sets and hardens by hydration and is capable of doing so underwater, sometimes called hydraulic cements.

CEMENTITIOUS MATERIAL. Hydraulic cements and pozzolans with cementing properties.

CHAMFER. A beveled edge or corner formed into finished concrete.

COMPRESSIVE STRENGTH TEST. The average strength test of concrete, from at least two 6.0 x 12.0 inch or at least three 4.0 x 8.0 inch compressive strength test cylinders sampled according to AASHTO T 141 or ATM 501, cured according to AASHTO R 39 or ATM 506, and tested according to AASHTO T 22 or sampled, cured, and tested to equivalent ASTM test methods. Or the average strength test of grout, from at least three specimens sampled and tested according to ATM 507, AASHTO T 106, or ASTM C 109. Unless otherwise noted, tested at an age of 28 days.

COMPRESSIVE STRENGTH, (f_c). The measured maximum resistance of a concrete, grout, or mortar specimen to axial compressive loading; expressed as force per unit cross-sectional area; or the specified resistance used in design calculations.

CONCRETE ANCHOR. Cast-in-place or post-installed fastening device installed in the concrete for the purpose of transferring loads to the concrete. See ASTM E2265 for standard terminology.

CONSOLIDATION. The process of inducing a closer arrangement of the solid particles in freshly mixed concrete during placement by the reduction of voids, usually by vibration, rodding, tamping, or some combination of these actions.

CONSTRUCTION JOINT. The surface where two successive placements of concrete meet.

CURING COMPOUND. A liquid applied as a coating to the surface of newly placed concrete to retard the loss of water and, in the case of pigmented compounds, reflects heat to provide an opportunity for the concrete to develop its properties in a favorable temperature and moisture environment.

CURING PERIOD. The length of time in which continuous curing operations are maintained thereby allowing the concrete to properly hydrate and develop its required strength and durability.

CURING. Action taken to maintain moisture and temperature conditions in a freshly placed cementitious mixture to allow hydraulic cement hydration and (if applicable) pozzolanic reactions to occur so the desired properties of the mixture develop.

DURABILITY. The ability of concrete to resist weathering action, chemical attack, abrasion, and other conditions of service.

EVAPORATION RATE REDUCER. A material generating a continuous thin film when spread over water on the surface of fresh concrete to retard the evaporation of bleed water.

FIELD TEST RECORD. A record of compressive strength test results from concrete used on prior projects and produced by the concrete production facility.

FINAL CURING PERIOD. The time period after the concrete achieves final set in which deliberate action is taken, without damaging or marring the concrete surface, to maintain satisfactory moisture content and temperature in concrete.

FINAL SET. Attainment of significant rigidity in which rainfall, foot traffic, and curing materials contacting the concrete surface do not damage or mar the concrete surface and do not alter the properties of the finished surface.

INFORMATIONAL FIELD TEST. A compressive strength test, determined by the Engineer, from field test cylinders cured on the site under temperature and moisture conditions similar to the

concrete in the structure; except, the compressive strength test may consist of one 6.0 x 12.0 inch or one 4.0 x 8.0 inch compressive strength test cylinder.

INITIAL CURING PERIOD. The time period between placement and implementation of final curing methods in which deliberate action is taken to reduce the loss of moisture from the surface of the concrete.

INITIAL SET. The first stiffening of concrete.

KEYWAY. A recess or groove in one lift or placement of concrete and filled with concrete of the next lift or grout, giving shear strength to the joint.

LAITANCE. A layer of weak material derived from cementitious material and aggregate fines either: 1) carried by bleeding to the surface or to internal cavities of freshly placed concrete; or 2) separated from the concrete and deposited on the concrete surface or internal cavities during placement of concrete underwater.

MORTAR. A mixture of cementitious material paste and fine aggregate occupying the space between particles of coarse aggregate.

REQUIRED AVERAGE COMPRESSIVE STRENGTH, (f'_{cr}). The 28-day compressive strength, used as the basis for selection of concrete proportions in the mix design process, sufficiently greater than the Specified Compressive Strength to ensure the acceptance criteria are met.

RETEMPER. To add water and remix concrete or mortar to restore workability to a condition in which the mixture is placeable or usable.

ROCK POCKET. A porous, mortar-deficient portion of hardened concrete consisting primarily of coarse aggregate and open voids.

SCREED. To strike off concrete lying beyond the desired plane or shape. A tool for striking off the concrete surface, sometimes referred to as a strikeoff.

SET. The condition reached by a cementitious material paste, mortar, or concrete that has lost plasticity to a degree of stiffening generally stated as the time in hours and minutes required for cementitious material paste to stiffen sufficiently to resist the penetration of a weighted test needle as prescribed by AASHTO T 197,

SPECIFIED COMPRESSIVE STRENGTH, (f'_c). The 28-day compressive strength used in structural design and specified in the Contract documents.

TREMIE. A pipe or tube with a hopper for filling at its upper end through which concrete is deposited.

501-2.01 MATERIALS. Use materials conforming to the following:

1. Cementitious Materials

Portland Cement	Subsection 701-2.01
Blended Hydraulic Cement	Subsection 701-2.02
Fly Ash	Subsection 701-2.04
Ground Granulated Blast-Furnace Slag	Subsection 701-2.05
Silica Fume	Subsection 701-2.06

2. Aggregate Materials

Fine Aggregate	Subsection 703-2.01
Coarse Aggregate	Subsection 703-2.02
Aggregate for Abrasive Finish	Subsection 703-2.14

3. Water, Admixtures and Curing Materials

Curing Materials	Subsection 711-2.01
Chemical Admixtures	Subsection 711-2.02
Water and Ice	Subsection 712-2.01

4. Anchors and Inserts

Concrete Anchor Inserts and Bolts	Subsection 712-2.20
Utiliduct, HDPE	Subsection 706-2.08
Utiliduct, Steel	Section 716
Structural Steel	Section 716
Asphalt Felt	ASTM D226, Type I (No. 15 Asphalt Felt)

5. Grout and Epoxy

Grout	Subsection 701-2.03
Epoxy Adhesive for Crack Sealing	Subsection 712-2.20.2
Epoxy Adhesive for Crack Injection	Subsection 712-2.20.3
Low-Viscosity Resin	Subsection 712-2.19
Epoxy Bonding Agents	ASTM M235, Type V

501-2.02 COMPOSITION OF MIXTURE - JOB MIX DESIGN. Provide a Job Mix Design, for each required class of concrete and Specified Compressive Strength (f'_c), which meets the requirements of this Subsection and provides workability and consistency so the concrete can be worked readily into the forms and around reinforcement without segregation or bleeding. Determine proportions using the absolute volume method according to ACI 211.1.

1. Water-Cement Ratio and Cementitious Materials. Provide a Job Mix Design meeting the water-cement ratio requirements in Table 501-1.

   Calculate the water-cement ratio based on the total weights of water and cementitious material. The weight of water includes all water as defined in Subsection 501-3.01.2c. The following are considered cementitious materials: Portland cement, blended hydraulic cement, fly ash, ground granulated blast-furnace slag, and silica fume.

   Fly ash, ground granulated blast-furnace slag, silica fume, and combinations of these materials may be used as a substitute for Portland cement provided the quantity meets the limits of Table 501-2 and the total quantity of combined fly ash, ground granulated blast-furnace slag, and silica fume does not exceed 40 percent of the total cementitious material by weight. Do not use Type III Portland cement for cast in place concrete decks and approach slabs.

TABLE 501-1
WATER-CEMENT RATIO REQUIREMENTS

Class of Concrete	Water-Cement Ratio, maximum
	lbs/lbs
A	0.45
A-A	0.40
P	0.35
DS	0.45

TABLE 501-2
SUPPLEMENTARY CEMENTITIOUS MATERIAL LIMITS

Cementitious Material	Percent of Total Cementitious Material by Weight[1]
	Maximum
Fly Ash	35%
Ground Granulated Blast-Furnace Slag	40%
Silica Fume	10%

[1] The maximum percent includes initial quantities in blended hydraulic cement plus additional supplementary cementations materials.

2. Aggregate Gradations. Provide a Job Mix Design meeting the fine aggregate gradation requirements in Subsection 703-2.01 and the coarse aggregate gradation requirements in Table 501-3. Alternative sizes of coarse aggregate, as shown in Table 1 of AASHTO M 43, may be used only when approved in writing.

TABLE 501-3
COARSE AGGREGATE GRADATION REQUIREMENTS

Class of Concrete	Coarse Aggregate Size Number
	AASHTO M 43
A	No. 57 or 67
A-A	No. 57 or 67
P	No. 67
DS	No. 7 or 8

3. Air Content. Provide a Job Mix Design with a total air content of 6.0 +/- 0.5 percent for Class A, Class A-A and any Class P with a water/cement ratio equal to or greater than 0.33. Provide a Job Mix Design with a minimum total air content of 3.0 for Class P concrete having a water/cement ratio less than 0.33. Use air-entrained concrete in the deck portion of precast, prestressed concrete decked girders. Air-entrained concrete is not required for Class DS concrete.

4. Slump. Provide a Job Mix Design meeting the slump requirements in Table 501-4.

TABLE 501-4
SLUMP REQUIREMENTS

Condition	Slump
Concrete without a water-reducing admixture	4" max.
Concrete with a Type A, D, or E water-reducing admixture	6" max.
Concrete with a Type F or G high-range water-reducing admixture	9" max.
Class DS concrete, wet-shaft process	7" min. 9" max.
Class DS concrete, dry-shaft process	6" min. 9" max.

5. Chloride Ion Content. Provide Job Mix Designs with water-soluble chloride ion contents determined by percent weight of cementitious material according to ASTM C1218 for the concrete mixture aged between 28 and 42 days. For Class P and Class A-A Concrete the limit is 0.06%. For Class A and DS concrete the limit is 0.08%.

6. Required Averaged Compressive Strength. Provide a Job Mix Design meeting a Required Average Compressive Strength (f'_{cr}) established from either the Empirical Method or the Statistical Method.

   If the Specified Compressive Strength (f'_c) is not designated on the Plans, use a Specified Compressive Strength listed in Table 501-5.

TABLE 501-5
COMPRESSIVE STRENGTH REQUIREMENTS

Class of Concrete	Specified Compressive Strength (f'_c)
	(psi)
A	4000
A-A	5000
P	8000
DS	4000

   a. Empirical Method. Establish the Required Average Compressive Strength from the following equations:

      $f'_{cr} = f'_c + 1200$ for $f'_c \leq 5000$ psi

      $f'_{cr} = 1.1f'c + 700$ for $f'_c > 5000$ psi

      Where: f'_{cr} = Required Average Compressive Strength, psi
      f'_c = Specified Compressive Strength, psi

   b. Statistical Method. If the production facility has field test records of compressive strength tests, establish the Required Average Compressive Strength based on the calculated standard deviation of the field test records and using the largest result of the following equations:

$f'_{cr} = f'_c + 1.34ks$ for all f'_c

or,

$f'_{cr} = f'_c + 2.33ks – 500$ for $f'_c \leq 5000$ psi,

$f'_{cr} = 0.90f'_c + 2.33ks$ for $f'_c > 5000$ psi,

Where: f'_{cr} = Required Average Compressive Strength, psi
f'_c = Specified Compressive Strength, psi
k = 1.16 if 15 total tests are considered
1.08 if 20 total tests are considered
1.03 if 25 total tests are considered
1.00 if 30 or more total tests are considered
s = standard deviation, psi

Use linear interpolation to determine *k* for intermediate number of tests.

Use field test records performed within the past 12 months and spanning a period of more than 60 days for a class of concrete within 1000 psi of the Specified Compressive Strength. Use field test records from concrete produced at the production facility, which represent materials, quality-control procedures, and climatic conditions similar to those expected in the work. Do not use field test records from concrete in which acceptance requirements for materials or concrete proportions were more closely restricted than those in the proposed work. Use field test records meeting one of the following:

(1) <u>One Group of Field Test Records</u>. Use field test records representing a group of at least 15 consecutive compressive strength tests in which all concrete was produced using the same mixture proportions. Calculate the standard deviation using the following equation:

$$s = \sqrt{\frac{\sum_{i=1}^{n} (X_i - \bar{X})^2}{(n-1)}}$$

Where: s = standard deviation, psi
n = number of compressive strength test results considered
X_i = individual compressive strength test result, psi
$\bar{X}$ = average of *n* compressive strength test results, psi

(2) <u>Two Groups of Field Test Records</u>. Use field test records representing two groups of consecutive compressive strength tests totaling at least 30 tests. Ensure each group is comprised of at least 10 consecutive compressive strength tests, and all concrete in each group was produced using the same mixture proportions. Calculate the standard deviation using the following equation:

$$s = \sqrt{\frac{(n_1-1)s_1^2+(n_2-1)s_2^2}{(n_1+n_2-2)}}$$

Where: s = standard deviation for the two groups combined, psi
s_1, s_2 = standard deviation for groups 1 and 2, respectively, calculated according to Subsection 501-2.02.6.b.(1), psi
n_1, n_2 = number of test results in groups 1 and 2, respectively

7. Job Mix Design Verification.

   a. Required Average Compressive Strength. Verify the Job Mix Design satisfies the Required Average Compressive Strength by meeting at least one of the following requirements:

      (1) Field Test Records. Use field test records that:

         (a) use materials of the same brand and type and from the same manufacturer as the materials used in the work;
         (b) were from concrete produced at the production facility;
         (c) use quality-control procedures, and had climatic conditions similar to those expected in the work; and
         (d) encompass a period of not less than 60 days.

         Do not use field test records from concrete in which acceptance requirements for materials or concrete proportions were more closely restricted than those in the proposed work.

         For a single group of at least 10 consecutive compressive strength tests for one mixture, verify the average of the compressive strength tests equals or exceeds the Required Average Compressive Strength.

         For two groups, each having at least 10 consecutive compressive strength tests, for two mixtures representing classes of concrete within 1000 psi of the Specified Compressive Strength, plot the average strength of each group versus the water-cementitious material ratio of the corresponding mixture proportions and interpolate between them to determine the compressive strength corresponding to the water-cementitious material ratio of the Job Mix Design. Verify the interpolated compressive strength equals or exceeds the Required Average Compressive Strength.

      (2) Laboratory Trial Mixtures. Use materials and material combinations for trial mixtures of the same brand and type and from the same manufacturer as the materials used in the work.

         Record the temperature of the freshly mixed concrete according to ASTM C1064 and ensure the temperature is within 10°F of the intended maximum temperature of the concrete as mixed and delivered.

         For each trial mixture, make and cure at least two 6.0 x 12.0 inch or at least three 4.0 x 8.0 inch compressive strength test cylinders for each test age according to AASHTO R 39. Test for compressive strength according to AASHTO T 22 at test ages of 3, 7 and 28 days.

         For a single trial mixture, verify the compressive strength test equals or exceeds the Required Average Compressive Strength.

         For a group of trial mixtures, make at least three trial mixtures with each mixture having a different cementitious material content. Select water-cement ratios producing a range of compressive strengths encompassing the Required Average Compressive Strength. From the results of the 28-day compressive strength tests, plot a curve showing the relationship between water-cement ratio and compressive strength. From the curve of water-cement ratio versus compressive strength, determine the compressive strength corresponding to the water-cementitious material ratio of the Job Mix Design. Verify the compressive strength equals or exceeds the Required Average Compressive Strength.

b. Flowability Requirements for Class DS Concrete (Wet-Shaft Process). Verify the Job Mix Design satisfies the concrete flowability requirements of Subsection 501-3.05.6.a.1. Develop a slump loss table showing the slump at 1 hour intervals since batching until the concrete takes initial set.

c. Plasticity Requirements for Class DS Concrete (Dry-Shaft Process). Verify the Job Mix Design satisfies the concrete plasticity requirements of Subsection 501-3.05.6.b.1. Ensure initial set occurs after placement operations are complete.

8. Job Mix Design Submittal. Submit a written mix design, signed and sealed by a Professional Engineer registered in the State of Alaska, for each specified class of concrete and for each Specified Compressive Strength, to the Engineer at least 45 days prior to scheduled production. Submit the mix design on Form 25D-203. Include the following:

   a. Job Mix Design Proportions and Test Results. Submit concrete mixture proportions per cubic yard and test results for the proposed Job Mix Design. Include the following information:

      (1) Weights of cementitious materials
      (2) Weights of aggregates in saturated surface dry condition
      (3) Volume or weight dosage range of each admixture.
      (4) Weight of water
      (5) Water-cement ratio
      (6) Percentage of air by volume
      (7) Total water soluble chloride ion content
      (8) Wet unit weight
      (9) Expected slump
      (10) Expected 3, 7 and 28-day compressive strength (Include 1-day compressive strength for Class P concrete.)
      (11) Slump loss table for Class DS concrete (if applicable)
      (12) Time of initial set for Class DS concrete (if applicable) and for other classes where extending Time for Placement (Subsection 501-3.02.2) will be requested
      (13) Compressive strength test results showing the Required Average Compressive Strength is met or exceeded.

   b. Materials Documentation. Submit the following:

      (1) For each cementitious material, include:

         (a) Type/Class
         (b) Brand
         (c) Producer
         (d) Plant location
         (e) Certified test reports confirming the cementitious material meets these Specifications.

      (2) For aggregates, include:

         (a) Pit or quarry location(s)
         (b) Bulk dry specific gravity, bulk saturated surface dry specific gravity, and apparent specific gravity
         (c) Absorption values
         (d) AASHTO size number for coarse aggregates
         (e) Gradations for aggregates

(3) For each admixture, include:

(a) Type
(b) Manufacturer
(c) Manufacturer's product data sheet giving the procedure for admixture use and confirming the admixture meets these Specifications.
(d) The batching process step and mixing instructions when each admixture is added.
(e) Manufacture's certificates demonstrating admixture compatibility and manufacture's recommended dosage range.

(4) Include the source of supply for water and ice.

c. Materials Samples. The Engineer may require samples of aggregate, cementitious materials, and admixtures to verify the mix design. If requested, furnish representative samples (330 pounds each) of both coarse and fine aggregates, 94 pounds of each cementitious material, and enough admixture to allow for Job Mix Design verification testing. Ensure the Department receives these samples at least 45 days before the mixture's scheduled production for the project.

d. Basis of Required Average Compressive Strength. If the Statistical Method is used, submit the following for each field test record:

(1) Compressive strength test results of the tested concrete.
(2) Standard test method used for determining compressive strength.
(3) Date the compressive strength tests were performed
(4) Aggregate source used for the tested concrete.
(5) Specified strength of the tested concrete.
(6) Batched weights of constituent materials or the producer's mix design identification number for the concrete used for each compressive strength test.

e. Documentation of Required Average Compressive Strength. Submit documentation indicating the proposed concrete proportions will produce an average compressive strength equal to or greater than the Required Average Compressive Strength meeting one of the following requirements:

(1) Field Test Records. If field test records were used to verify the Required Average Compressive Strength, submit the following for each field test record:

(a) Compressive strength test results of the tested concrete.
(b) Standard test method used for determining compressive strength.
(c) Date the compressive strength tests were performed
(d) Aggregate source used for the tested concrete.
(e) Specified strength of the tested concrete.
(f) Batched weights of constituent materials or the producer's mix design identification number for the concrete used for each compressive strength test.

(2) Trial Mixtures. If a single or group of trial mixtures were used to verify the Required Average Compressive Strength, submit concrete mixture proportions per cubic yard and test results for each trial mixture. Include the following information:

(a) Weights of cementitious materials
(b) Weight of aggregates in saturated surface dry condition
(c) Volume or weight of each admixture
(d) Weight of water
(e) Water-cement ratio

(f) 3-day, 7-day, and 28-day compressive strength test results (Include 1-day compressive strength test results for Class P concrete)
(g) Percentage of air by volume
(h) Wet unit weight
(i) Slump

9. Approval. Obtain the Engineer's approval of each mix design prior to use. Approval of the Job Mix Design does not constitute acceptance of produced concrete and will not obligate the Department to accept or pay for concrete that does not meet the mix acceptance requirements of Subsection 501-3.03.

10. Changes. Provide a new Job Mix Design and obtain the Engineer's approval according to Subsection 501-2.02 for a change in approved Job Mix Design proportions, materials, aggregate gradation, aggregate quality, or admixtures. A change in Type A, D, E, F, and G admixture proportions does not require a new Job Mix Design, if the admixtures proportions are within the dosage ranges identified in the approved Job Mix Design.

CONSTRUCTION REQUIREMENTS

501-3.01 BATCHING. Batch concrete, in proportioned amounts, according to the approved Job Mix Design.

1. Certification and Calibration. Batch concrete using a certified batch plant.

   Use concrete batch plants certified according to the requirements of a. or b. of this subsection for cast-in-place concrete, and for precast or prestressed concrete where the concrete is supplied from a batch plant that is not located at the casting facility.

   Use concrete batch plants certified according to the requirements of a., b., or c. of this subsection for precast and prestressed concrete where the concrete is supplied from a batch plant located at the casting facility.

   Use concrete batch plants certified according to the requirements of a., b., or d. of this subsection for non-prestressed precast concrete where the concrete is supplied from a batch plant located at the casting facility.

   Use and maintain calibrated weighing and measuring devices for concrete batching and for adding material on-site, meeting the requirements of this Subsection..

   a. Plant Certification by the National Ready Mix Concrete Association. Certification may be obtained from the National Ready Mix Concrete Association (NRMCA). Information concerning NRMCA certification may be obtained from the NRMCA, 900 Spring Street, Silver Springs, MD 20910, or online at www.nrmca.org. The NRMCA certification is valid for 2 years from the date of inspection.

   b. Plant Certification by a Professional Engineer. Certification may be obtained by independent inspection and evaluation by a Professional Engineer:

      (1) registered in the State of Alaska,
      (2) qualified by NRMCA for concrete plant certification, and
      (3) who uses and completes the NRMCA Plant Certification Check List.

      Correct deficiencies to the satisfaction of the Professional Engineer. The Professional Engineer must sign and seal the completed NRMCA Plant Certification Check List

certifying all applicable items have been met. The certification by a Professional Engineer is valid for 2 years from the date of inspection.

c. Plant Certification by Precast/Prestressed Concrete Institute. Certification may be obtained from the Precast/Prestressed Concrete Institute (PCI) for fabrication of precast and prestressed concrete if the batching plant is located at the concrete casting facility. Information concerning PCI certification may be obtained from the Precast/Prestressed Concrete Institute, 200 W. Adams St. #2100, Chicago, IL 60606, or online at www.pci.org.

d. Plant Certification by National Precast Association. Certification may be obtained from the National Precast Association (NPCA) for fabrication of non-prestresed precast concrete if the batching plant is located at the concrete casting facility. Information concerning NPCA certification may be obtained from the National Precast Concrete Association, 1320 City Center Drive, Suite 200, Carmel, IN 46032, or on-line at http://precast.org.

e. Calibration of Weighing and Measuring Devices. Use weighing and measuring devices meeting the requirements of the NRMCA *Plant Inspector's Guide*, calibrated by a commercial scale service, using equipment traceable to the Alaska State Standards of Weight and Measure as adopted by AS 45.75.020.

Verify calibration of all weighing and measuring devices used in concrete production:

(1) no more than 6 months before commencing concrete work,
(2) after each relocation,
(3) at least once every 6 months until the work is completed, and
(4) when, in the opinion of the Engineer, the accuracy or adequacy of the device is in question.

f. Certification and Calibration Submittals. Submit documentation required for plant certification and weighing and measuring device calibration meeting the requirements of this Subsection before commencing concrete work.

If the Plant Certification is by NRMCA, PCI or NPCA submit a copy of the Certificate of Conformance. Include the most recent date of inspection and the calibrated accuracy for each weighing and measuring device.

If the Plant Certification is by a Professional Engineer, submit a copy of the signed and sealed completed NRMCA Plant Certification Check List and calibration and/or verification worksheets for each weighing and measuring device. Include the most recent date of inspection and the calibrated accuracy for each weighing and measuring device.

2. Measuring Materials.

a. Cementitious Materials. Use cementitious materials of the same brand, type, and from the same plant of manufacture as the cementitious materials used to verify the approved Job Mix Design according to Subsection 501-2.02.7. Ensure the quantity of the Portland cement and the cumulative quantity of Portland cement plus other cementitious materials is proportioned in amounts required by the Job Mix Design and meets the mix acceptance requirements.

Measure cementitious materials by weight. When other cementitious materials, including fly ash, ground granulated blast-furnace slag, or silica fume, are specified in the concrete proportions, the material may be cumulatively weighed with the Portland cement. Weigh

cementitious materials on a weighing device that is separate and distinct from those used for other materials. Weigh the Portland cement before other cementitious materials.

Portland cement is permitted to be measured in bags of standard weight (94 pounds). Do not use a fraction of a bag of cementitious materials unless its weight has been determined by calibrated weighting devices.

b. Aggregates. Use aggregates from the same sources and gradations as the aggregates used in the trial mixtures or field test records used to verify the required average compressive strength. Ensure the quantity of the aggregates is proportioned in amounts required by the Job Mix Design.

Measure aggregates by weight. Establish batch weight measurements on dry materials and adjust the actual scaled weight for the required dry materials weight plus the total weight of moisture, both absorbed and surface, contained in the aggregate.

c. Water. The total quantity of mixing water includes water added to the batch, ice added to the batch, and water occurring as surface moisture on the aggregates. Measure the added water by weight or volume. Measure added ice by weight. Discharge the flush water (wash water) prior to loading the next batch of concrete. Do not use flush water (wash water) as a portion of the mixing water.

d. Admixtures. Use concrete admixtures according to the manufacturer's instructions and as approved in the Job Mix Design. Measure powdered admixtures by weight. Measure paste or liquid admixtures by weight or volume.

3. Materials Storage and Handling.

a. Cementitious Materials. Keep cementitious materials dry and free from contaminants. Do not use cementitious materials which have become partially hydrated or which contain lumps of caked cementitious material.

b. Aggregates. Do not allow segregation of the aggregates or contamination with foreign materials. Separate aggregate to prevent intermixing of specified gradations.

Drain aggregate so the moisture content is uniform and is accounted for during the batching process.

Do not use aggregates that contain ice, are frozen, or have been heated directly by combustible materials. Use direct steam, steam-coil, or water-coil heating when heating aggregates. When direct steam is used to thaw aggregate piles, drain aggregates to uniform moisture content before batching.

c. Admixtures. Protect admixtures from contamination, evaporation, or damage. Store admixtures according to the manufacturer’s instructions. Protect liquid admixtures from freezing and from temperature changes affecting the admixture’s performance.

501-3.02 MIXING AND DELIVERY. Mix concrete, in proportioned amounts, according to the approved Job Mix Design. Mix ingredients into a thoroughly combined and uniform mixture. Do not retemper concrete mixtures. Do not use concrete that has developed initial set prior to placement

1. Addition of Water. Additional water may be added on-site provided the following are met:

a. The volume of concrete in the mixer after the additional water is added does not exceed the maximum mixing capacity.
b. The water measuring device is calibrated according to Subsection 501-3.01.1.e.
c. The total quantity of mixing water, including water added according to Subsection 501-3.02.1 is within the proportion requirements in Subsection 501-3.03.4.
d. Water additions are completed within 30 minutes after the introduction of the mixing water to the cementitious materials.

The addition of water is not prohibited from being several distinct additions of water. Inject additional water into the mixer under pressure and direction of flow to allow for proper distribution within the mixer. Provide additional mixing to ensure a thoroughly combined and uniform mixture is attained.

2. Time for Placement. Discharge the concrete within 1.5 hours of the following:

a. after adding the mixing water to the cementitious materials, and
b. after adding the cementitious materials to the aggregates.

The time to complete discharging the concrete may be extended 2 minutes for every degree the concrete temperature is below 70°F, measured at the point of discharge, to a maximum total time of 2 hours. The Engineer may extend the Time for Placement if Time of Initial Set information is provided in the approved Job Mix Design submittal.

501-3.03 EVALUATION OF MATERIAL FOR ACCEPTANCE. All concrete in the work will be evaluated for acceptance.

The Engineer may reject a batch or load of concrete failing to meet the requirements for proportions, slump, total air content, or temperature. Prior to sampling, the Engineer may reject a batch or load of concrete that appears defective in composition.

1. Sampling. The Department will take samples at the discharge point of the placement system, except Class DS concrete will be sampled at the truck discharge.

Provide adequate and representative fresh concrete for sampling and testing as directed by the Engineer. The Engineer will sample the concrete after a minimum of 1/2 cubic yard of concrete has discharged from the placement system. Do not add water or admixtures to the mix after the concrete has been sampled for acceptance testing.

The Engineer will determine aggregate gradation for acceptance based on random samples taken at the plant.

2. Sampling and Test Methods. The Department will sample and test according to the following:

ATM 301	Sampling of Aggregates
ATM 304	Sieve Analysis of Fine and Coarse Aggregates, and Materials Finer Than No. 200 Sieve in Mineral Aggregate by Washing
ATM 501	Sampling Freshly Mixed Concrete
ATM 502	Temperature of Freshly Mixed Portland Cement Concrete
ATM 503	Slump of Hydraulic Cement Concrete

ATM 504	Density (Unit Weight), Yield, and Air Content (Gravimetric) of Concrete
ATM 505	Air Content of Freshly Mixed Concrete by the Pressure Method
ATM 506	Method of Making and Curing Concrete Test Specimens in the Field
AASHTO T 231	Capping Cylindrical Concrete Specimens
AASHTO T 22	Compressive Strength of Cylindrical Concrete Specimens
ATM 507	Field Sampling and Fabrication of 50-mm (2-in) Cube Specimens using Grout (Non-Shrink) and or Mortar

3. Batch Tickets. Provide a printed ticket with each batch of concrete delivered to the project. Include the following information:

   a. Manufacturer plant (batching facility)
   b. Department contract number
   c. Date
   d. Batch number
   e. Time batched
   f. Time batch plant discharge is completed
   g. Truck number
   h. Quantity (quantity batched this load)
   i. Type of concrete by class and producer's mix design identification number
   j. Weights of every type of cementitious material
   k. Weights of each aggregate type
   l. Weight or volume of each admixture
   m. Weight or volume of water added at the plant
   n. Total moisture and absorption percentage for each aggregate
   o. Volume or weight of any water added after batching
   p. Signature of Contractor's representative, affirming the accuracy of the information provided

4. Proportion Requirements. Meet the proportion requirements of the approved Job Mix Design within the proportion tolerances:

   a. Total Cementitious Material, weight ±1%
   b. Aggregates, weight ±2%
   c. Total Water, weight or volume ±3%
   d. Admixtures, weight or volume, according to the dosage range in the approved Job Mix Design.

      If the total cementitious material weight is made up of different components, keep the component weights within the following tolerances:

      (1) Portland Cement ±1%
      (2) Fly Ash ±5%
      (3) Ground Granulated Blast-Furnace Slag ±5%
      (4) Silica Fume ±10%

Proportion tolerance will be calculated using consistent units for M_{JMD} and M_A as follows:

$$P = \frac{(M_A - M_{JMD})}{M_{JMD}} \cdot 100$$

Where: P = Proportion tolerance, percentage
M_{JMD} = Weight or Volume of component according the approved Job Mix Design
M_A = Weight or Volume of actual batched component

5. Slump Requirements. Do not deviate from the approved mix design slump.

6. Total Air Content Requirements. Provide concrete with total air content within +/-1.5% of the approved Job Mix Design at delivery time.

7. Temperature Requirements. Unless otherwise noted, ensure the concrete temperature is between 50°F and 90°F when placed in the forms.

8. Compressive Strength Requirements. Meet the strength requirements for the Specified Compressive Strength. Concrete of the approved Job Mix Design will be considered to meet the Specified Compressive Strength requirements when both of the following conditions are met:

   a. The lowest individual compressive strength test result is not less than the Specified Compressive Strength minus 500 psi, or 90.0 percent of the Specified Compressive Strength, whichever is lower.

   b. The lowest averaged result of three consecutive compressive strength tests meets or exceeds the Specified Compressive Strength.

501-3.04 PREPARATION FOR CONCRETE PLACEMENT. Allow time for inspection prior to concrete placement.

Remove debris, concrete splatter, oil, paint, and other foreign substances from the surfaces of forms and reinforcing steel, against which the concrete is to be placed.

Remove soil and other debris from pipe piles to the bottom of concrete elevation shown on the Plan.

Prepare foundations according to Section 205.

Moisten foundations and forms with water before the concrete is placed. Remove standing water on the foundation, in the pile, and in the forms before placing concrete.

501-3.05 PLACING CONCRETE. Do not begin concrete placement without the Engineer's authorization. Place concrete conforming to the approved Job Mix Design. Place and consolidate each layer within 30 minutes and before the preceding layer takes initial set.

If concrete placement operations are delayed so initial set occurs before placement of the succeeding section or layer, place a joint according to Subsection 501-3.11. The resulting joint will be considered a construction joint. If, in the opinion of the Engineer, the location of the construction joint will affect the strength or durability of the concrete, the Engineer may reject the concrete, the structure, or a portion of the structure.

Place concrete in a sequence to obtain a well-consolidated concrete and to prevent cracks. Place concrete as near as possible to final position. Prevent segregation of the mix, displacement of

reinforcing steel, and spattering of mortar on the reinforcing steel and forms above the elevation of the layer being placed. Do not deposit a large quantity of concrete at any point and run or work the concrete along the forms. Do not allow concrete to slide down the sides of the forms.

Regulate concrete placement so the pressures do not exceed the load capacity of the forms. Limit layer thickness to no more than 2.5 feet, or the capacity of the vibrators to consolidate and merge the concrete with the previous layer, whichever is less.

Unless otherwise specified, use a tremie, tube, or other such device to limit the free-fall height to less than 5.0 feet when placing operations would otherwise allow concrete to drop more than 5.0 feet. When using a tremie to place concrete, use a watertight tremie with an inside diameter of at least 10 inches. When using a concrete pump to place concrete, use concrete pump lines that are watertight with an inside diameter of at least 5 inches.

Concrete placed in piles or in dry-shaft process may free-fall more than 5 feet without use of tremie, tube or other such device, provided the falling concrete does not contact rebar or other objects before reaching the top surface of the placed concrete. When free-falling concrete more than 5 feet, use a drop chute at least 3 feet long.

After initial set, prevent movement of forms, projecting ends of reinforcing steel, and other embedded items.

Do not use aluminum components in contact with fresh concrete.

Place concrete in the superstructure only after substructure forms are removed and the substructure has been inspected.

1. Concrete Placement Plan. Submit a concrete placement plan to the Engineer, for concrete decks and drilled shafts. Submit each concrete placement plan to the Engineer, at least 30 days before placing concrete. Do not place concrete until after the Engineer has approved the plan. Include the following in each concrete placement plan:

    (1) concrete placement sequence,
    (2) schedule of concrete placement and curing,
    (3) estimated concrete volume of each section,
    (4) placement rate and duration,
    (5) description of finishing equipment,
    (6) placement procedure,
    (7) name of the concrete foreman,
    (8) curing materials, equipment, and procedure.

2. Pre-concreting Conference. Hold a pre-concreting conference for concrete decks and Drilled Shafts, at least 5 working days before placing concrete. Include the Engineer, the Superintendent and foremen in charge of placing reinforcing steel, placing concrete, finishing concrete, and curing operations. Discuss construction procedures, personnel, and equipment to be used.

    If the project includes more than one concrete placement operation, and if key personnel change between concreting operations, hold additional conferences to include replacement personnel before placing successive concrete sections.

3. Pumping Concrete. Use a pump producing a continuous stream of concrete without air pockets. When pumping is completed, the concrete remaining in the pipeline, if used, must eject without contaminating the concrete or separating the ingredients. Discard concrete contaminated by priming or cleaning the pump.

4. Conveying Concrete. Concrete may be conveyed if the equipment will handle the class of concrete, with the slump and air content specified and without segregation of the aggregate, and no equipment vibrations will damage freshly placed concrete or reinforcing steel. Limit the length of conveyor belts to prevent aggregate segregation or 300 feet, whichever is less. Cover the belt to protect the concrete from heat, evaporation, precipitation, or when the Engineer determines precipitation is likely.

5. Piles. Do not place concrete underwater in piles.

6. Drilled Shaft Foundations. Place concrete following either the wet-shaft process or dry-shaft process, as applicable.

   The dry-shaft process may be used where the ground water level and soil and rock conditions are suitable to permit construction of the shaft in a relatively dry excavation, and where the sides and bottom of the shaft can be visually inspected by the Engineer prior to placing the concrete. Relatively dry excavation conditions exist when excavation fluids have been removed from the shaft and the rate of water intrusion is less than 6 inches of water accumulating above the base in a 1-hour period without pumping or other methods to drain or remove water. Suitable soil and rock conditions exist when the sides and bottom of the hole remain stable without caving, sloughing, or swelling between completion of excavation and concrete placement; and loose material and water can be satisfactorily removed prior to inspection and concrete placement. Do not begin concrete placement if there is more than 1 inch of water in the bottom of the shaft excavation. Use wet-shaft process if the requirements for dry-shaft process cannot be satisfied.

   Provide process control testing during concrete placement. Test slump and air content before placing each batch of concrete in the drilled shaft. Perform sampling and testing according to Subsection 501-3.03.2 using a WAQTC qualified concrete testing technician or ACI certified concrete field testing technician. Test every batch of concrete before placement. Record the time when each sample is collected. Submit test results in writing to the Engineer immediately after completing each test.

   a. Wet-Shaft Process. Place concrete using a tremie or concrete pump. Place concrete continuously until good quality concrete, as determined by the Engineer, is evident at top of the shaft or nearest construction joint. Good quality concrete is considered concrete of the same consistency, appearance, and quality as the concrete being delivered and meeting the applicable mix acceptance requirements. Remove a sufficient volume of concrete to ensure elimination of contaminated concrete at the top of shaft before continuing with subsequent construction operations.

      Remove concrete laitance during or immediately after concrete placement operations have ended.

      Do not allow water, fluids, drilling aids, or concrete from the top of the shaft to enter streams or other waterways.

      Construct the discharge end of the tremie or pump line to prevent water intrusion and permit the free flow of concrete during concrete placement. Use caps, bottom plates, pigs, or other such devices inserted into or attached to discharge pipe to separate the concrete from the excavation fluid during initial charging of the discharge pipe. Ensure the discharge pipe has sufficient length and weight to rest on the shaft base before starting concrete placement.

      When using a tremie, provide adequate support so the tremie can be raised to increase the discharge of concrete and lowered to reduce the discharge of concrete. Do not

shake, vibrate, or rapidly raise or lower the tremie to increase the discharge of the concrete.

Maintain a positive head of concrete inside the tremie or pump line relative to the excavation fluid level. Position the discharge orifice within one pipe diameter of the shaft base. Do not re-position the discharge pipe until the orifice is at least 8 feet below the concrete surface. Maintain at least 8 feet of concrete above the discharge orifice during concrete placement. Monitor the concrete level during placement to ensure the tremie or pump line discharge orifice remains at least 8 feet below the concrete surface throughout placement.

If the discharge orifice rises above the concrete surface before concrete placement is complete, the shaft will be considered defective. Immediately terminate concrete placement operations and notify the Engineer.

(1) Concrete Flowability Requirements. Ensure concrete placed in the shaft remains flowable throughout placement operations by maintaining a slump of at least 6 inches until placement is completed. Collect samples from the first batch of concrete. Test slump from the first batch of concrete at the beginning of the concrete placement operations and immediately after concrete placement operations are complete. Record the time when samples are collected and when tests are performed. Submit test results in writing to the Engineer immediately after completing each test.

b. Dry-Shaft Process. Place concrete continuously until concrete is evident at top of the shaft or nearest construction joint. Concrete may be permitted to free-fall into place if the concrete does not contact the sides of the shaft, reinforcing steel, or other objects while free falling.

Remove concrete laitance during or immediately after concrete placement operations have ended.

(1) Concrete Plasticity Requirements. Ensure concrete placed in the shaft remains plastic throughout placement operations by completing placement operations before initial set occurs.

7. Concrete Decks and Approach Slabs. Before placing concrete, operate the finishing machine over the entire length of the deck to check screed deflection, reinforcing steel clearance, and concrete thickness.

Limit the rate of placing concrete to what can be finished before initial set.

a. Placement Sequence. Place the concrete deck in the sequence shown on the Plans. The Engineer may approve a revised placement sequence for casting the concrete deck continuously from one end to the other provided the following:

(1) Stockpile the materials necessary to complete the placement and have the equipment, incidentals, and workers on the site before beginning concrete placement operations.

(2) Ensure the continuous concrete placement and finishing operation proceeds at a minimum rate of 30 feet per hour, measured longitudinally along the axis of the span.

(3) The Engineer determines the revised placement sequence will not reduce the stability during construction and will not reduce the quality, capacity, or durability of the completed structure.

If the Engineer approves the proposal for a continuous concrete placement operation, the Department will observe and evaluate performance to the first planned construction joint in the sequence. At this point, the Engineer may authorize you to proceed with the continuous concrete placement operation or suspend the placement and install a construction joint. The Engineer's decision will be based on whether the concrete can be produced, delivered, and finished at a continuous rate permitting the structure to accommodate final dead load deflections while the concrete is plastic.

If the Engineer suspends the continuous concrete placement operations after the first sequential placement, submit modifications for improving the continuous concrete placement operations, beginning at the other end of the deck. If a second attempt at continuous concrete placement is authorized, the placement will be evaluated and allowed or terminated based on the same criteria as the first sequential placement.

If the Engineer suspends the continuous concrete placement operation after the second attempt, additional attempts will not be permitted. Follow the deck placing sequence shown on the Plans.

501-3.06 CONSOLIDATION OF CONCRETE. Consolidate concrete to make a dense homogeneous mass free of voids and rock pockets. Consolidate each layer to leave a compact, dense, and impervious concrete with smooth faces on exposed surfaces with no visible line of separation between adjoining layers.

Consolidate concrete, except underwater or other exempted placements, by mechanical vibration at the point of deposit. Use vibrators capable of visibly affecting concrete with a 1-inch slump for a distance of at least 18 inches from the vibrator.

Use vibrators and regulate placement in order to consolidate the fresh concrete within 15 minutes of placement and before initial set. Effectively vibrate the full depth of each layer.

For immersion-type vibrators, insert vibrators vertically to a depth penetrating into the previous layer. Withdraw vibrators slowly to avoid segregation or grout pockets. Vibrate in a uniform pattern spaced less than 1.5 times the radius of visible effectiveness.

Avoid vibration of initially set layers and reinforcing steel below the succeeding placement. Do not hold vibrators against reinforcing steel or use them to flow or spread the concrete into place. Manipulate vibrators to produce concrete free of voids, with proper texture on exposed faces, and maximum consolidation. Do not allow the concrete to segregate, form pools of mortar, or form laitance on the surface.

When immersion-type vibrators are used to consolidate concrete around epoxy-coated reinforcing steel, use rubber or nonmetallic vibrator heads that will not damage epoxy coatings.

Concrete may be placed directly into drilled shaft foundations and piles without mechanical vibration; except, vibrate the top 5 feet of concrete. For drilled shaft foundations, consolidate the top 5 feet of concrete after good quality concrete is evident at the top of the shaft and after water, slurry, drilling aids, and other materials other than concrete have been removed.

501-3.07 FINISHING CONCRETE SURFACES. After the concrete is consolidated and prior to the application of curing materials, strike off unformed concrete surfaces to the required elevation and slope. Finish the surface by floating the surface to remove local irregularities and leave sufficient mortar to seal the concrete surface. Do not use mortar topping for concrete surfaces. Do not use aluminum finishing equipment.

Complete initial floating operations before bleed water or excess moisture is present on the surface and before the concrete takes initial set. Complete final finishing before final set occurs.

Do not use finishing aids or additional water to assist in finishing concrete surfaces. Do not finish concrete surfaces if bleed water, excess moisture, or curing materials are present.

Provide formed concrete surfaces with an ordinary finish unless otherwise noted.

1. Ordinary Finish. An ordinary finish is the finish left on a surface after removing the forms, filling the holes left by the form ties, and repairing defects. Ensure the surface is true and even and free from rock pockets and depressions or projections.

   Immediately after removing the forms, remove the metal devices holding the forms in place and passing through the body of the concrete, or cut them back at least 1 inch beneath the surface of the concrete. Remove fins of mortar and irregularities caused by form joints.

   Patch cavities produced by form ties, depressions, holes, and voids greater than 1/4 inch. Fill the cavity with stiff mortar composed of one part of Portland cement to two parts of fine aggregate. Proportion the mortar by loose volume with only enough water to form a small ball when squeezed gently by hand. Clean the cavity and saturate the concrete with water before filling the cavity. Thoroughly tamp the mixture into place. Float the surface of the mortar before initial set to make the surface neat in appearance. Cure the patch according to Subsection 501-3.08.

   Do not repair concrete with rock pockets, cracks, or other defects until the concrete is inspected by the Engineer. Concrete repaired prior to inspection by the Engineer may be rejected. If, in the opinion of the Engineer, the defect will affect the strength or durability of the concrete, the Engineer may reject the concrete, the structure, or portion of the structure. If the defect is greater than 3/4 inch in depth, submit a repair plan including complete details of the method, materials, and equipment proposed for use in repairing the concrete. Obtain the Engineer's approval of the repair plan before repairing the defect. A repair plan is not required if the defect is less than 3/4 inch in depth.

   Repair broken corners and edges, rock pockets, and other defects. If the defect is greater than 3/4 inch in depth, repair the defect according to the approved repair plan. If the defect is less than 3/4 inch in depth, chip away coarse or broken material according to Subsection 501-3.16 to obtain a dense, uniform surface of concrete exposing solid coarse aggregate. Cut feathered edges to form faces perpendicular to the surface. Apply an epoxy bonding agent to the concrete mating surfaces according the manufacturer's instructions. Patch the repaired area with stiff mortar composed of one part of Portland cement to two parts of fine aggregate. Proportion the mortar by loose volume with only enough water to form a small ball when squeezed gently by hand.

   Perform repairs prior to releasing falsework, prestressing, or applying additional loads to the concrete.

2. Rubbed Finish. Provide a rubbed finish at locations shown on the Plans. When forms can be removed, wet the surface and then rub with a wooden float until irregularities and form marks are removed and the surface is covered with a lather composed of cement and water. A thin grout composed of one part Portland cement and one part fine aggregate may be used. Allow this lather to set for at least 5 days. Then, smooth the surface by lightly rubbing with a fine carborundum stone.

   If the concrete has hardened before being rubbed, use a medium coarse carborundum stone to finish the surface at least 4 days after placing the concrete. Spread a thin grout composed of one part Portland cement and one part fine aggregate over a small area of the surface. Immediately rub the surface with the stone until form marks and irregularities are removed and the surface is covered with a lather. Allow this lather to set for at least 5 days. Then, smooth the surface by rubbing lightly with a fine carborundum stone.

Complete ordinary finish work before applying the rubbed finish.

3. Concrete Decks and Approach Slabs. Obtain a smooth riding surface of uniform texture, true to the required grade and cross section.

   Use a self-propelled mechanical finishing machine

   a. capable of forward and reverse movement,
   b. with a rotating cylindrical single or double drum screed,
   c. with necessary adjustments to produce the required cross-section, line, and grade,
   d. allowing screeds to be raised and lowered, and
   e. with an upper vertical limit of screed travel permitting the screed to clear the finished concrete surface.

   When placing concrete abutting previously placed concrete, equip the finishing machine to travel on the existing concrete.

   The Engineer may approve hand-operated motorized roller screeds (friction screeds) where jobsite conditions prohibit the use of conventional configuration finishing machines described above, for small areas less than 12 feet wide, and on approach slabs in which conventional configuration finishing machines are not used to finish the concrete deck. Do not use vibratory screeds.

   Use equipment capable of striking off the full placement width without intermediate supports or rails. Use rails resting on adjustable supports that can be removed with the least disturbance to the concrete. Place the supports on structural members or on forms rigid enough to resist deflection. Use supports that are removable to at least 2 inches below the finished surface. If possible, place rails outside the finishing area. If not possible, place them above the finished surface.

   Use rails (with their supports) that are strong and stiff enough for operation of the equipment without excessive deflection. Place and secure rails for the full length of the deck before placing concrete. Set the rails to the proper grade and elevations to ensure the required profile is provided.

   After placing and consolidating the concrete, carefully strike off the concrete surface. Correct imperfections left on the deck. Provide a float finish to surfaces receiving a waterproof membrane. Texture other surfaces with a heavy-broom finish perpendicular to the direction of traffic.

   Do not place finishing machines or other loads on the screed rail supports or on features supporting fresh concrete after the concrete has initially set and before the concrete attains at least 80 percent of the Specified Compressive Strength.

   Do not release falsework or wedges supporting concrete on either side of a joint until each side has cured as specified.

4. Curb, Sidewalk, and Concrete Barrier Surfaces. Finish exposed faces of curbs, sidewalks, and concrete barriers to true surfaces and provide a broom finish. Broom finish sidewalks perpendicular to the direction of traffic.

5. Sandblasted Finish. Sandblast the cured concrete surface with hard, sharp abrasive media to produce an even fine-grained surface in which the mortar has been cut away, leaving the aggregate exposed.

6. Trowel Finish. Trowel the surface smooth and free of trowel marks.

501-3.08 CURING CONCRETE. Maintain a satisfactory moisture content and temperature in the concrete immediately after finishing operations are completed.

1. Initial Curing Period. Before final curing, ensure the surface of the concrete is kept moist. Concrete surface is beginning to dry when no bleed water is present and the surface color changes. If the concrete surface begins to dry before the final curing method can be applied, prevent further loss of moisture by one or more of the following methods:

    a. Fog Spray. Use equipment producing a fog spray from an atomizing nozzle with sufficient velocity to cover the entire concrete surface. Direct the atomized water spray above the concrete surface to allow the fog to drift down to the concrete surface. Do not apply the discharge of the atomized water spray directly at the concrete surface. Continue fogging to maintain the reflective appearance of the damp concrete. Do not allow the surface to dry, or to undergo cycles of drying and wetting. Keep the concrete surface damp, but do not accumulate water until after final set has occurred. Use water meeting the requirements of Subsection 712-2.01.

    b. Evaporation Rate Reducer. Apply a monomolecular film intended specifically as an evaporation rate reducer to entrap bleed water or excess moisture on the concrete surface. Apply the evaporation rate reducer according to the manufacturer's written instructions. Do not use the evaporation rate reducer during finishing operations or as a finishing aid. Do not use evaporation rate reducers on concrete surfaces receiving a waterproofing membrane such as concrete decks, approach slabs, end diaphragms and decked precast concrete members.

2. Final Curing Period. Unless otherwise noted, employ the final curing method immediately following finishing operations.

    Use wet curing on construction joints, concrete with a mix design water-cement ratio less than 0.40, concrete decks, approach slabs, and other concrete surfaces subject to tire contact in the completed structure. For other concrete, use wet curing, liquid membrane-forming curing, forms-in-place curing, or a combination of these curing methods.

    Do not use liquid membrane-forming curing compounds on concrete surfaces to which other materials will be cast against or bonded such as concrete and waterproofing membranes.

    In addition to the requirements in this section, precast concrete members may use accelerated curing.

    a. Wet Curing. Until the end of the curing period, provide continuous moisture by:

        (1) watering a covering of heavy burlap blankets or quilted cotton mats,
        (2) keeping concrete surfaces wet with water continuously,
        (3) wetting the outside surfaces of wood forms.

        Wait to install curing materials until the concrete has sufficiently hardened to permit such operations without damaging the concrete or marring the finish. While waiting to employ curing materials, maintain the concrete surface moisture as specified for the initial curing period.

        Uniformly distribute absorbent materials across the entire concrete surface. Apply water in a manner that will not displace the curing materials or erode the concrete surface. Keep the concrete surfaces continuously wet. Do not allow concrete surfaces to dry or alternate with wetting and drying cycles. Cover the concrete, wooden forms and

absorbent material with impermeable sheeting. Use white reflective impermeable sheeting if direct sunlight is present, or if the Engineer determines direct sunlight may be present during the curing period.

Do not use absorbent materials containing harmful substances such as sugar or fertilizer, or materials that may discolor the concrete.

b. Liquid Membrane-Forming Curing Compounds. Apply liquid membrane-forming compounds immediately after final finishing and as soon as the free water has disappeared, no water sheen is visible, and bleeding has essentially ceased. Apply two coats of liquid membrane-forming compound with the second coat at right angles to the first. Apply both coats of liquid membrane-forming compounds uniformly until the original color of the concrete is obscured. Apply liquid membrane-forming compound according to the manufacturer's instructions.

Do not apply the liquid membrane-forming compound to dry concrete surfaces. Moisten the concrete surface, without standing water, before applying the liquid membrane-forming compound. Protect the membrane from damage for the duration of the curing period. Re-apply the liquid membrane-forming compound if the membrane is cracked or damaged during the curing period.

c. Forms-In-Place Curing. Formed concrete surfaces may be cured by retaining the forms in place for the entire curing period. Keep the forms moisture tight. Do not loosen forms. For wooden forms, keep the forms wet as required for wet curing. If gaps develop between the forms or between the forms and concrete:

(1) remove the forms and implement another curing method
(2) keep the gaps continuously filled with water for the remainder of the curing period.

d. Accelerated Curing. Accelerated curing may be used only for precast concrete members with Class P Concrete.

During the curing period, keep the concrete in a saturated curing atmosphere until the concrete achieves the required release strength.

The curing period may be accelerated by using saturated low-pressure steam, convection-heat, or radiant-heat in a suitable curing chamber to contain the live steam or heat. Provide at least 3 inches of clearance between the enclosure and forms to allow adequate circulation.

If accelerated curing methods are used, embed at least one temperature-recording device in the concrete to verify concrete temperatures are within the specified limits. Install one temperature-recording device, accurate to ±5°F, near the member's midpoint, 6 to 8 inches from the top or bottom, and along the member's centerline. Monitor the concrete temperature with the temperature-recording device sensor arranged and calibrated to continuously record, date, and identify the concrete temperature throughout the heating cycle. Begin recording temperatures once concrete is placed in the forms. Stop recording temperatures after the heating cycle is complete and when the concrete temperature is within 20°F of the air temperature to which the concrete will be exposed. Upon request, submit the temperature record to the Engineer for each precast concrete member.

While waiting to begin the heating cycle, maintain the concrete temperature between 50°F and 90°F and maintain concrete surface moisture as specified for the initial curing period. Do not apply steam, convection-heat or radiant-heat prior to initial set except to

maintain the concrete temperature. Determine the time of initial set according to AASHTO T 197.

Begin the heating cycle immediately after the initial set. Prevent hot air and steam from blowing directly onto the concrete or forms. Increase the concrete temperature at an average rate not exceeding 40°F per hour until the curing temperature is reached. Limit curing temperature within the concrete to 175°F maximum. Decrease the concrete temperature not more than 40°F per hour until reaching a temperature 20°F above the temperature of the air to which the concrete will be exposed.

Apply radiant heat by pipes circulating steam, hot oil, or hot water, or by electric heating elements.

3. Curing Temperature. Maintain concrete temperature at or above 50°F for the first 6 days after placement. After 6 days you may choose to maintain concrete temperature between 32°F and 50°F with the addition of curing time as specified under 501-3.08.4a.

4. Ending Curing Operations. Continue curing operations uninterrupted until the required concrete properties, strength, and durability have developed or until there is reasonable assurance these properties will be achieved after the curing operations have been terminated.

   Curing operations may be terminated after both 501-3.08.4.a and 501-3.08.4.b are satisfied:

   a. The concrete has cured for:
      (1) at least 7 days.
      (2) at least 10 days when fly ash or ground granulated blast furnace slag in excess of 10 percent by weight of the Portland cement are used in the mix.

      Add one additional day of curing to the requirements of 501-3.08.4.a.(1) and 501-3.08.4.a.(2), for each day or portion of a day the concrete temperature falls below 50°F during the curing period.

   b. The compressive strength from informational field tests reaches the following:

      (1) 70 percent of the Specified Compressive Strength if post curing concrete temperature is expected to remain at or above 50°F until 100 percent of the Specified Compressive Strength is attained.

      (2) 100 percent of the Specified Compressive Strength, if post curing conditions are expected to allow the concrete temperature to fall below 50°F before 100 percent of the Specified Compressive Strength is attained.

501-3.09 PROTECTION OF CONCRETE. Protect concrete from damage. Do not apply loads to the concrete until the end of the curing period and until the Engineer determines the concrete has attained sufficient strength to safely carry the applied loads without damage. Unless otherwise noted, sufficient strength is attained when the concrete has attained a compressive strength, determined from informational field tests, of at least 80 percent of the Specified Compressive Strength.

Release forms and falsework according to Section 512.

During the curing period, protect concrete from damaging mechanical disturbances. Protect concrete surfaces from damage by construction traffic, equipment, materials, rain or running water, and Cold Weather Conditions, and other adverse weather conditions. Meet the vibration limits during pile driving of Section 505.

Do not backfill against concrete structures until the end of the curing period and until the concrete has attained a compressive strength, determined from informational field tests, of at least 80 percent of the Specified Compressive Strength.

Obtain authorization from the Engineer before driving vehicles or equipment, or storing materials on the structure. Keep the structure closed to traffic until the end of the curing period and until the concrete has attained a compressive strength determined from informational field tests, of at least 100 percent of the Specified Compressive Strength. Obtain authorization from the Engineer before opening the structure to traffic.

1. Rain Protection. Provide materials and equipment on site to protect concrete until final set. During precipitation, or when the Engineer determines precipitation is likely before final set, employ materials and equipment to protect the concrete until final set occurs. Do not expose the concrete to rain or flowing water before final set occurs.

2. Cold Temperature Protection. Place and cure concrete according to an approved cold temperature concreting plan whenever Cold Weather Conditions will occur or are expected, or in the opinion of the Engineer, air temperature is likely to be less than 40°F within 24 hours.

   Prevent damage to concrete throughout the curing period. Prevent concrete from freezing, rapid cooling of concrete surfaces, or from large temperature differences within the concrete. Have materials and equipment ready to protect concrete from exposure to cold during placement and throughout the curing period. Maintain the concrete temperature with methods such as insulated forms, enclosures, and indirect heat. Vent flue gases to the outside of the enclosure when using combustion heaters. Prevent overheating areas or drying of concrete during the curing period by directing heaters and ducts away from the concrete surface. Do not heat the curing concrete to a temperature more than 90°F except as permitted in Subsection 501-3.08.2.d.

   Measure and record air temperature in the work area, away from sunlight and artificial heat, at approximate 12 hour intervals, at least twice each 24-hour period. Air temperature measurement is not required when air temperature is expected to remain above 40°F throughout concrete placement and the curing period.

   a. Cold temperature concreting plan submittals. Submit cold temperature concreting plan to the Engineer at least 5 days before beginning concrete placement when Cold Weather Conditions are present or expected.

   For each concrete placement include:

      (1) Procedures for the production, transport and placement
      (2) Considerations for section size and outside air temperature during the pour
      (3) Concrete placement temperatures
      (4) Methods that ensure adequate curing conditions are maintained as required in Subsection 501-3.08
      (5) Procedures for measuring and reporting concrete temperatures
      (6) Procedures for abrupt changes in weather conditions and equipment failures
      (7) Methods for verification of in-place strength

   b. Temperature of Concrete During Batching and Placement. Obtain concrete batching and placement temperatures by heating the mixing water and/or aggregates. Avoid overheating aggregates so spot temperatures of aggregates do not exceed 212°F and average temperature of aggregates does not exceed 150°F when added to the batch.

Ensure temperature of combined ingredients does not exceed 85°F when cementitious materials and admixtures are added. Ensure concrete is between 50°F and 90°F during placement.

c. Preparation. Remove snow, ice, and frost from all surfaces that will touch fresh concrete. Thaw the subgrade to at least 2 feet below the concrete to be placed before beginning concrete placement.

Preheat surfaces that will be in contact with placed concrete. Maintain these temperatures to no more than 10°F greater or 15°F less than that of the concrete during placement.

d. Ending Cold Temperature Protection. Cold temperature protection may be terminated when the air temperature in the shade, away from artificial heat, is rising, above 40°F, and is expected to remain above 40°F until the end of the curing period. At the end of the protection period, remove the protection so the concrete surface drops in temperature gradually at a rate not more than 1.25°F per hour until the concrete temperature is within 20°F of the air temperature in the shade, away from artificial heat. If water curing is used, terminate the addition of water to the surface and allow the concrete surface to dry prior to exposure of the concrete to freezing temperatures.

3. Hot Temperature Protection. Do not begin concrete placement when air temperatures are expected to exceed 90°F during concrete placement without an approved hot temperature concreting plan. When air temperatures are expected to, have materials and equipment in place to prevent the concrete temperature from exceeding 90°F before final set and exceeding 150°F during the final curing period. Implement the hot temperature concreting plan when the air temperature in direct sunlight is greater than 90°F.

a. Submittals. Submit a hot temperature concreting plan to the Engineer at least 5 days before placing concrete when the air temperature is expected to exceed 90°F during the concrete placement. Submit detailed procedures for the production, transport, placement, protection, curing, and temperature monitoring of concrete during hot temperatures for each concrete placement. Include procedures for abrupt changes in temperature conditions or equipment failures.

b. Preparation. Prior to placing concrete, plan to minimize the exposure of the concrete to hot temperatures and direct sunlight. Cool surfaces that will touch the concrete to less than 90°F.

Do not sprinkle fine aggregate piles with water. If sprinkling coarse aggregates, monitor the moisture content and adjust the mixing water for the free water in the aggregate.

If replacing all or part of the mixing water with crushed ice, then ensure the ice is completely melted and thoroughly mixed with the other concrete materials before beginning concrete placement.

c. Temperature of Concrete Before Placement. Ensure concrete being placed in forms is between 50°F and 90°F. Obtain these temperatures by cooling the mixing water and/or aggregate.

d. Temperature of In-place Concrete. Protect the concrete from damage due to hot weather immediately after concrete placement and ensure adequate curing conditions are maintained as required in Subsection 501-3.08.

Provide extra protection in areas especially vulnerable to temperatures above 90°F such as exposed top surfaces, corners and edges, thin sections, and concrete placed against steel.

Protection may be terminated when the air temperature in direct sunlight drops below 90°F and is expected to remain below 90°F for at least 24 hours.

501-3.10 TOLERANCES. Produce concrete elements conforming to the following tolerances:

1. Length: ±3/4 inch for members 100' and shorter. ±1 inch for members longer than 100'

2. Cross-sectional Dimensions:

   a. For dimensions 6 inches or less: -1/8 inch to +1/4 inch.
   b. For dimensions over 6 inches but not over 18 inches: -1/8 inch to +3/8 inch.
   c. For dimensions over 18 inches: -1/4 inch to +3/8 inch.

3. Distortion of Cross-section: Limit the slope with respect to the specified surface, plane, or line to less than ±1/16 inch per foot, but not to exceed ±1/4 inch measured perpendicular to the long axis of member.

4. Surface Irregularities (deviation from a 10-foot straight edge):

   a. For surfaces receiving a topping or are buried: ±1/4 inch.
   b. For surfaces not receiving a topping or are visible in the completed work: ±1/8 inch.

5. Camber: Do not vary from the approved camber more than ±1/8 inch per 10 feet of length, but not to exceed 1 inch. In addition, the camber of each girder may not differ from the camber or the other girders by more than 1 inch.

6. Lateral Sweep (deviation from a straight line parallel to centerline of member):

   a. For member length 40 feet or less: ±1/4 inch.
   b. For member length over 40 feet but not over 60 feet: ±3/8 inch.
   c. For member length over 60 feet: ±1/2 inch.

7. Deck Width (measured out-to-out): Zero to +2 inches, except not more than +1/2 inch where more precision is dictated by the substructure details such as anchor bolts, parallel wing walls, etc.

8. Position and Alignment:

   a. Bottom of footing elevation: ±0.1 feet.
   b. Profile grade: ±0.05 feet.
   c. Lateral position: ±0.1 feet.
   d. Skew: ±0.05 degrees.

9. Bearing Seats:

   a. Elevation: ±0.01 feet
   b. Variation between bearing seats: Do not vary from a straight line coincident with the centerline of bearings and parallel to the surface of the bottom flanges more than 0.01 feet.
   c. Grade and cross slope: ±0.005 feet per foot.

10. Openings:

    a. Size of opening: ±1/4 inch.
    b. Location of centerline of opening: ±1/2 inch.

11. Embedded Items:

    a. Bolts: ±1/4 inch.
    b. Utility hangers: ±1/2 inch.
    c. Weld Plates: ±1/2 inch measured along the length of the member, ±1/8 inch measured perpendicular to the length of the member.
    d. Inserts: ±1 inch.
    e. Rail post anchor plates: ±1/4 inch.
    f. Expansion joints: ±1/8 inch.
    g. Electrical conduits: ±1/2 inch.
    h. Deck drains: ±1/2 inch.
    i. Other embedded items: ±1/2 inch.

501-3.11 CONSTRUCTION JOINTS. Unless otherwise noted, locate construction joints where specified in the Contract documents. Obtain approval before adding, deleting, or relocating construction joints specified in the Contract documents. Make requests for such changes in writing, accompanied by a drawing depicting the joint. The Engineer will evaluate the proposed construction joint to determine if the joint will affect the strength or durability of the concrete. Joints noted as "permissible" do not need the Engineer's approval before deleting. When permitted, place the joints where they will not be exposed to view in the finished structure.

At horizontal construction joints, place gage strips 1-1/2 inches thick inside the forms along exposed faces to give the joints straight lines.

Do not use wire mesh forming material.

If the Plans require a roughened surface on the joint, create grooves at right angles to the length of the member. Make grooves that are 1/2 to 1 inch wide, 1/4 to 1/2 inch deep, and spaced equally at twice the width of the groove. Terminate the grooves within 1-1/2 to 2 inches from the edges of the joint.

If the Plans require a smooth surface on the joint, provide a trowel finish.

Include shear keys at the joint when the Contract documents do not require a roughened surface or a smooth surface. Make shear keys of formed depressions with slight beveling to ensure ready form removal. Do not use raised shear keys. Make shear keys that meet the following:

1. For tops of beams, at the tops and bottoms of boxed girder webs, in diaphragms, and in crossbeams, use shear keys 1-1/2 inches deep, 8 inches long, and spaced at 16 inches.

2. In other locations, use shear keys at least 1-1/2 inches deep and 1/3 of the joint width.

Terminate the shear keys within 1-1/2 to 2 inches of the joint edge.

Clean construction joints of surface laitance and other foreign materials before fresh concrete is placed against the surface of the joint. Flush construction joints with water and allow the joint to dry to a surface-dry condition immediately prior to placing concrete.

501-3.12 FORMS AND FALSEWORK. Use forms and falsework designed and constructed according to Section 512.

501-3.13 PRECAST CONCRETE MEMBERS. In addition to the requirements listed in this Section, conform to Section 502 when fabricating prestressed concrete members.

1. Shop Drawings. Provide shop drawings for precast concrete members. Include details not provided in the Plans for the construction and erection of the members. Cast members only after shop drawings are approved. Use precast methods for cast-in-place elements when approved. Submit shop drawings, showing construction joint details and other required information.

2. Manufacture. Prestress concrete according to Section 502. Fabricate and install reinforcing steel according to Section 503.

   Unless otherwise noted, use Class P concrete for precast concrete members meeting the Specified Compressive Strength noted on the Plans.

3. Storage and Handling. Handle and move precast concrete members without damage. Store and transport precast concrete members in an upright position with the directions of the support reactions on the member during storage or transport as if in the final position. Locate support points during transport and storage within 30 inches of their final position, or as shown on approved shop drawings. Ship only after the member has cured at least 7 days and has a compressive strength not less than 100 percent of the Specified Compressive Strength.

4. Erection. Maintain member stability during transport, lifting, and erection operations. Limit concrete tension stresses due to transport, lifting, and erection operations to less than 500 psi.

   Set interchangeable precast concrete members so the initial difference between the top surfaces of the edges of adjacent precast concrete members is no more than 1/2 inch at midspan and no more than 1/4 inch at the bearings.

   Set and securely brace precast concrete members within a span before making shear connections. Secure the member to the structure, and provide temporary braces necessary to resist wind or other loads immediately after erecting each precast concrete member.

   Provide and use forcing devices as shown in the Plans or as recommended by the precast concrete member manufacturer. Use devices maintaining the top edges of adjacent members at the same elevation while casting or welding diaphragms, welding shear connector plates, and while placing and curing grout in the shear keys.

   Make field welds according to Section 503 and Section 504.

   Install cast-in-place diaphragms within 2 weeks after setting precast concrete members on their bearings.

   If cast-in-place diaphragms cannot be placed within the prescribed time limit, ensure the members are adequately braced to resist movement and rotation. Submit a bracing plan including complete details and substantiating calculations, sealed by a Professional Engineer registered in the State of Alaska.

   Erect and place precast deck panels so the mating surfaces do not allow grout leakage. Seal joints where grout leakage may occur.

   When the Plans require filling keyways between adjacent concrete members with grout, place grout according to the manufacturer's written instructions. Clean joints of surface laitance and other foreign material before placing grout. Do not place loads on the grouted members until the grout compressive strength has reached 5000 psi.

Tightly pack and rod the grout in the keys and spaces. Keep the grout surface smooth and neat. Ensure the grout surface meets the member edges throughout their lengths and matches the surface elevation of the members with a tolerance of ±1/8 inch.

501-3.14 PLACING ANCHOR BOLTS. Secure anchor bolt assemblies where shown on the Plans.

When casting anchor bolts in concrete, secure anchor bolts before placing concrete in the forms. Do not disturb anchor bolts after concrete has been placed.

When installing anchor bolts in pipe sleeves, pre-cast holes, cored holes, or drilled holes, completely fill the cavity with grout. Do not allow water to freeze in the cavity. Do not allow foreign material in the cavity.

501-3.15 UTILIDUCTS, PIPES, CONDUITS, DUCTS, AND UTILITY HOLES. When utiliducts, pipes, conduits, and ducts will be encased in concrete, install them in the forms before placing the concrete. Support the utiliducts, pipes, conduits, and ducts to prevent displacement during concrete placement.

Install utiliducts and utility holes parallel to the roadway centerline unless noted otherwise. Prevent bond between the utiliducts and concrete by tightly wrapping the utiliducts with at least two layers of asphalt felt.

501-3.16 REMOVING CONCRETE. Do not damage other portions of the structure remaining in place when removing concrete.

Determine and delineate the extent of removal area. Outline the area with a 3/4-inch deep saw cut to form faces perpendicular to the surface prior to the removal of concrete. Do not cut or damage existing reinforcing steel or prestressing steel. During the course of removal, the Engineer may suspend removal or may require additional removal and outline saw cut.

Use any combination of mechanical methods, water-blast cleaning, or abrasive-blast cleaning to remove coarse or broken concrete until a dense, uniform surface of concrete exposing solid coarse aggregate is obtained. When using mechanical methods for removal of concrete, meet the following:

1. Use impact tools weighing less than 15 lbs.
2. Operate impact tools at an angle less than 45 degrees relative to the surface of the concrete being removed.
3. Use hand tools such as hammers and chisels or small air chisels, water blast cleaning, or abrasive blast cleaning to remove final particles of unsound concrete.

During the removal operation do not damage existing reinforcing steel, prestressing steel, or concrete to remain in place.

Before applying the repair material, clean the surface according to ASTM D4258 within 24 hours of applying the repair material.

Use water meeting the requirements of Subsection 712-2.01 for removal operations.

501-3.17 CRACK EVALUATION. The Engineer will evaluate concrete that is cracked during execution of the Contract. Measure cracks at their widest point.

For concrete decks and approach slabs, allow the Engineer to inspect any surface cracking immediately after termination of concrete curing operations, before prestressing (if applicable),

and before releasing falsework. If any 500 square foot portion of the concrete deck or approach slab has cracks, whose width exceeds 0.020 inches and combined lengths total more than 16 feet, treat the surface by performing low-viscosity resin crack repair.

For other concrete, cracks will be evaluated based on the crack width.

1. For crack widths equal to and greater than 0.060 inches, the concrete will be considered unacceptable.

2. For cracks widths equal to and greater than 0.013 inches but less than 0.060 inches, the Engineer will evaluate the cracked concrete for structural adequacy and durability. If the Engineer determines the crack may affect structural adequacy or durability, the Engineer may reject the concrete, the structure, or a portion of the structure. If the Engineer determines the cracked concrete is acceptable, repair the crack by performing low-pressure crack repair according to Subsection 501-3.18.

3. For cracks widths less than 0.013 inches wide, the crack will be considered acceptable with no additional evaluation or repairs required.

501-3.18 CRACK REPAIR. Perform crack repairs and replace unacceptable concrete at no cost to the Department. No contract time extension will be given for repairing, removing, and replacing unacceptable material.

1. Low-Pressure Crack Repair. Repair cracked concrete according to the following requirements:

    a. Crack Repair Plan. Submit a crack repair plan to the Engineer. Do not repair the crack until the Engineer has approved the crack repair plan. Include the following in the crack repair plan:

        (1) Experience of the injection equipment technicians
        (2) Evaluation of the crack width and the recommended epoxy viscosity allowing the epoxy to achieve and maintain the penetration requirements
        (3) Material information including manufacturer's product data sheets
        (4) Equipment
        (5) Crack preparation, injection procedures, and injection sequence
        (6) Cleanup procedures

    b. Experience. Provide epoxy injection technicians who have a minimum of 2 years experience in performing repairs using the methods and materials of the selected system.

    c. Materials. Use epoxy adhesive for crack injection with viscosity capable of filling at least 90 percent of the crack volume. Use epoxy adhesive for crack sealing capable of containing the epoxy adhesive for crack injection.

    d. Equipment. Use positive displacement plural component pumps, specifically designed to meter, mix, and to inject epoxy, and capable of filling at least 90 percent of the crack volume.

    e. Surface and Crack Preparation. Remove contaminants and other foreign material reducing the effectiveness of the surface seal and repaired crack. Allow adequate time for drying. If cleaning solutions are used, perform trial tests to verify the contaminants can be removed. Prepare the surface and crack according to the epoxy manufacturer’s instructions.

f. Entry and Venting Ports. Install entry/venting ports spaced equal to the thickness of the concrete member along one face of the crack. Acceptable types of entry/venting ports are fittings inserted into drilled holes, bonded flush fittings, and gasket devices covering unsealed portions of interrupted seals, allowing injection of epoxy directly into the crack without leaking epoxy.

g. Mixing Epoxy for Crack Sealing. Mix the epoxy adhesive for crack sealing to the volume ratio prescribed by the manufacturer.

h. Surface Sealing. Seal the surface of the crack with epoxy adhesive for crack sealing.

i. Mixing Epoxy for Crack Injection. Mix the epoxy adhesive for crack injection to the volume ratio prescribed by the manufacturer.

j. Epoxy Injection. Assure the crack seal is cured and capable of containing the crack injection epoxy. Inject the epoxy according to the epoxy manufacturer's instructions. Do not inject epoxy until the air, substrate, and epoxy are within the manufacturer's application temperature range. Limit injection pressure to prevent propagation of the crack, prevent additional damage, and injection pressure in excess of 50 psi.

   Inject the epoxy in the sequence noted in the approved crack repair plan. Ensure at least 90 percent of the crack volume is filled.

   Maintain the epoxy temperature within the manufacturer's application temperature range during injection operations and until the epoxy is cured.

k. Finishing and Cleanup. After the injected epoxy is cured, remove ports and surface seal flush with the concrete surface. Do not damage the injected epoxy and do not heat the surface seal to aid in removal.

2. Low-Viscosity Resin Crack Repair. When concrete deck or approach slab crack repair is required, the Engineer will define the repair area with the following boundary limits:

   a. Beginning and ending on straight lines perpendicular to the direction of traffic and extending across the entire width of the concrete deck or approach slab, between the concrete barriers or curbs.

   b. Beginning and ending at least 5 feet beyond the furthest opposing cracks, measured from where the crack widths exceeds 0.020 inches

   If grinding is required, treat the concrete before grinding.

   Before treatment, ensure the concrete surface is clean, sound and free of foreign materials that may reduce the effectiveness of the repaired cracks. If the concrete surface becomes contaminated before placing the resin, repeat the cleaning process.

   Apply low-viscosity resin to the repair area. Protect barriers, railing, joints, and drainage facilities to prevent contamination by the treatment material.

   Completely cover the deck surface with resin so the resin penetrates and fills cracks. Ensure the relative humidity is less than 80 percent, the prepared area is dry, and the surface temperature is at least 50°F and not more than 90°F when the resin is applied. Apply the resin and distribute excess material within the manufacturer's listed pot life. For textured surfaces, including grooved surfaces, remove excess material from the texture indentations.

For concrete decks and approach slabs not receiving a waterproofing membrane, apply aggregate for abrasive finish within 20 minutes of resin application and before setting occurs. Broadcast the aggregate for abrasive finish evenly over the entire treated area at a rate of 1.5 to 2.5 pounds per square yard.

501-3.19 CLEANUP. Remove concrete splatter, paint marks, laitance, rust staining, chamfer strips, and other material not providing a uniform texture and color to the concrete surface.

501-4.01 METHOD OF MEASUREMENT. Section 109 and the following:

Cubic Yard. The lesser of the actual volume or neat line volume of each class of concrete accepted in place in the finished structure.

Class DS Concrete. The sum of the lengths of drilled shafts complete in place, measured along the centerline of the drilled shaft from the bottom to the top.

Precast Concrete Members. Measured per unit, complete in place.

Crack repair for unacceptable concrete will not be measured for payment.

501-5.01 BASIS OF PAYMENT.

Material not appearing in the Bid Schedule and contained within, embedded, or attached to concrete elements is subsidiary.

Crack repair for unacceptable concrete is subsidiary.

Precast Concrete Member. Payment for precast concrete member includes materials and work for the following items: Class P concrete, reinforcing steel contained in the member, prestressing steel, plates, nuts, inserts contained within the concrete member, bolts, studs, anchor bars, blockouts, elastomeric bearing pads, grout, drains, and other miscellaneous steel embedded in or attached to the precast concrete member.

Payment will be made under:

Pay Item	**Pay Unit**
501(1) Class A Concrete	Lump Sum
501(2) Class A-A Concrete	Lump Sum
501(4) Class A Concrete	Cubic Yard
501(7) Precast Concrete Member (identification)	Each
501(9) Class DS Concrete (identification)	Linear Foot

STATEWIDE SPECIAL PROVISION **01/01/16**
SSP-15

Delete Section 502 Prestressing Concrete and replace with the following:

SECTION 502
PRESTRESSING CONCRETE

502-1.01 DESCRIPTION. Prestress precast or cast-in-place concrete by furnishing, placing, tensioning, and bonding prestressing steel by using either pretensioning or post-tensioning methods or a combination of the two methods according to the Contract documents.

For pretensioning, this work also includes furnishing and installing the materials and equipment necessary to prestress concrete as designated in the Contract documents.

For post-tensioning, this work includes furnishing and installing all post-tensioning systems and other pertinent items necessary for the particular prestressing system used, including but not limited to ducts, anchorage assemblies, supplementary reinforcement, and grout used for pressure grouting ducts.

502-1.02 DEFINITIONS.

ANCHORAGE. An assembly of various hardware components that secure a tendon at its ends after it has been stressed imparting the tendon force into the concrete.

ANTICIPATED SET. The set that was assumed to occur in the design calculation of the post-tensioning forces immediately after load transfer.

BEARING PLATE. Hardware that transfers the prestressing force directly into concrete.

BLEED. The autogenous flow of mixing water within or its emergence from newly placed grout caused by the settlement of the solid materials within the mass and filtering action of strands.

DUCT. Material forming a conduit to accommodate prestressing steel installation and provide an annular space for the grout that protects the prestressing steel.

FLUIDITY. A measure of time, expressed in seconds, necessary for a stated quantity of grout to pass through the orifice of a flow cone.

GROUT. A mixture of cementitious materials and water with or without admixtures proportioned to produce a pumpable consistency without segregation of the constituents when injected into the duct to fill the space around the prestressing steel.

GROUT CAP. A device that contains the grout and forms a protective cover sealing the post-tensioning steel at the anchorage.

POST-TENSIONING. A method of prestressing in which the tendons are tensioned after the concrete has reached a specified strength.

POST-TENSIONING SCHEME OR LAYOUT. The pattern, size and locations of post-tensioning tendons.

POST-TENSIONING SYSTEM. An assembly of proprietary post-tensioning hardware, including but not limited to anchorage assembly, local zone reinforcement, wedge plate, wedges, bearing

plate, prestressing steel, duct, duct connections, vents and grout cap, used to construct a tendon of a particular size and type.

PRESTRESSING STEEL. The steel element of a post-tensioning tendon, which is elongated and anchored to provide the necessary permanent prestressing force.

SET (Also Anchor Set or Wedge Set). The total movement of a point on the strand outside the anchoring wedges during load transfer from the jack to the permanent anchorages. Set movement is the sum of slippage of the wedges with respect to the anchorage head and the elastic deformation of the anchor components.

STRAND. An assembly of several high-strength steel wires wound together. Strands usually have six outer wires helically wound around a single straight wire of a similar diameter.

STRAND COUPLER. An assembly by which the prestressing force may be transmitted from one partial length prestressing tendon to another. (Strand couplers are not permitted.)

TENDON. A single or group of prestressing steel elements and their anchorage assemblies that imparts prestress to a structural member. Also, included are ducts, grouting attachments, grout and corrosion protection filler materials or coatings.

TENDON SIZE. The number of individual strands of a certain strand diameter.

THIXOTROPIC. The material property exhibited by certain grouts that enable material to stiffen, achieve a higher viscosity, in a short time while at rest, but to become liquid, acquire a lower viscosity, when mechanically agitated.

VENT. Tubing or pipe used for injection of grout into the duct and to allow escape of air, water, grout and bleed water from the duct.

WEDGE. A conically shaped device that anchors the strand in the wedge plate.

WEDGE PLATE. The hardware that holds the wedges of a multi-strand tendon and transfers the tendon force to the anchorage assembly.

502-2.01 MATERIALS. Use materials that conform to the following:

Concrete	Section 501
Water	Subsection 712-2.01
Reinforcing steel	Subsection 709-2.01
Epoxy-Coated Reinforcing Steel	Subsection 709-2.01
Prestressing Steel and Fittings	Section 721
Post-tension Grout	Section 701
Prime Coat	Subsection 708-2.01.1
Epoxy Bonding Agents	AASHTO M 235, Type V

CONSTRUCTION REQUIREMENTS

502-3.01 PRETENSIONING METHODS. Select a pretensioning method that provides the magnitude and distribution of prestressing force specified in the Contract documents.

1. Shop Drawings. Before casting members to be prestressed, submit for approval shop drawings including complete details and substantiating calculations of the method, materials, and equipment proposed for use in the prestressing operations, any additions or rearrangement of reinforcing steel, and any revision in concrete dimensions.

Include an outline of the method and sequence of stressing, complete specifications and details of the prestressing steel and anchoring devices to be used, anchoring stresses, strand release sequence, and other data pertaining to the prestressing operations, including the proposed arrangement of the prestressing units in the members.

Compute the anticipated camber at the time of prestressing force transfer and at other significant times. Show the values on the shop drawings as a time/deflection curve, subject to approval.

Include on shop drawings embedded items such as reinforcing steel, lifting devices, coil anchors, anchor bolts, drainage systems, utility conduits and other such items. Ensure there will be no conflict between the planned positions of any embedded items and that concrete cover will be adequate.

2. Quality Control Plan. Submit a quality control plan that verifies that all materials and workmanship incorporated into the prestressed concrete members conform to the requirements.

   Perform pretensioning operations under the direct supervision and control of a qualified pretensioning technician. Provide a pretensioning technician, skilled in the prestressing method, to aid and instruct in using the prestressing equipment and in installing the materials to obtain required results.

3. Protection of Prestressing Steel. Protect prestressing steel and anchor assemblies against physical damage and corrosion. Keep prestressing steel and anchor assemblies clean and free of deleterious material such as grease, oil, wax, paint, or other foreign materials. The Engineer will reject prestressing steel that has at any time sustained physical damage. The Engineer will reject prestressing steel that has developed visible rust pitting or other results of corrosion, other than rust stain.

   Protect prestressing steel and anchorage assemblies against physical damage and corrosion during shipping and storage by packaging the prestressing steel and anchorage assemblies in containers or shipping forms. Place a corrosion inhibitor in the package or form, incorporate a corrosion inhibitor carrier-type packaging material, or apply a corrosion inhibitor directly to the steel. Do not use corrosion inhibitors that have deleterious effect on the steel or concrete or bond strength of steel to concrete. Immediately replace packaging or forms damaged from any cause or restore packaging to original condition.

   Clearly mark the shipping package or form with a statement that the package contains high-strength prestressing steel, and the type of corrosion inhibitor used, including the date packaged.

4. Prestressing Equipment. Use hydraulic jacks to tension prestressing steel strands so the force in the prestressing steel will not be less than the value specified in the Contract documents or as approved by the Engineer.

   Equip each jack used to stress strands with either:

   a. two calibrated pressure gages, or
   b. one calibrated pressure gage and one calibrated load cell

   In the event that any uncertainty exists regarding jack calibration, pressure gage usage, strand elongation or any other prestressing strand tensioning issue, provide and use a calibrated load cell when prestressing steel strands.

Permanently mark the jack body with the ram area. Ensure each pressure gage is fully functional, calibrated and has an accurately reading dial at least 6 inches in diameter.

Calibrate the jack and each gage, used to stress strands, as a unit within 6 months prior to use and after each repair. If used, provide a load cell calibrated within the past 12 months with an indicator that may be used to determine the prestressing force in the strand. The range of the load cell shall be such that the lower 10 percent of the manufacturer's rated capacity will not be used in determining the jacking stress.

Use the following calibration procedure; Perform three calibration test cycles with the cylinder extension of the jack in various positions (i.e. 2 inch, 4 inch, 8 inch stroke). At each pressure increment, average the forces from each test cycle to obtain an average force. Perform the calibration with the equipment setup in the same configuration that will be used at the job site. Use load cells calibrated within the past 12 months to calibrate stressing equipment.

For each jack and gauge unit used on the project, provide certified calibration curves prior to the start of the work and every 6 months thereafter, or as requested by the Engineer. If used, supply documentation denoting the load cell calibration date prior to the start of the work and every 6 months thereafter. Furnish certified calibration charts prior to stressing.

Recalibrate jacks requiring repair, such as replacing seals or changing the length of the hydraulic lines. No extra compensation will be allowed for the initial or subsequent calibrations.

5. Placing Reinforcing Steel and Prestressing Steel. Place reinforcing steel according to Section 503, except as modified by this Section.

   Place prestressing steel in the position required in the Contract documents or on the approved shop drawings.

6. Girder Inserts. Provide threaded inserts, coil anchors, or approved equal in the girder as required in the Contract documents.

   With the written approval of the Engineer, additional inserts in the girder may be provided to accommodate diaphragm forms or other construction related requirements.

   Provide holes in the girder web as indicated on the plans to accommodate reinforcing steel. Verify that the hole size is sufficient to accommodate reinforcement placement procedures.

7. Pretensioning. Stress strands to the magnitude specified in the Contract documents by either single strand stressing or multiple strand stressing. Prior to applying full pretensioning, bring all strands to be stressed in a group (multiple strand stressing) to a uniform initial tension that is sufficient to eliminate all slack and equalize the stresses in the strands. Limit the strand stress in pretensioned members before seating (jacking stress) to 70 percent of the minimum breaking strength (0.70 f_{pu}) of the prestressing steel.

   Ensure that the tension load indicated by the gauge(s) is within 5 percent of the calculated tension load based on elongation measurements for each strand.

   Use approved low-friction devices at points of change in slope of strand trajectory when tensioning harped strands.

   Tension harped strands from both ends of the bed if the prestressing force, as determined by elongation measurements, is less than 95 percent of that indicated by the jack gauges. Ensure the computed load from the sum of elongation at both ends is within 5 percent of that indicated by the jack gauges.

When splicing strands, locate splices outside of the prestressed units. Account for additional elongation due to the splice when verifying the tension load based on elongation measurements.

Keep the temperature of the strands during tensioning and concrete placement within 25 °F of the concrete temperature during placement. During the interval between tensioning and concrete placement, do not let temperature changes alter the stress level in the strands more than 5 percent of the jacking stress, nor cause the stress in the strand to exceed 75 percent of the minimum breaking strength.

8. Placing Concrete. Produce and place concrete according to the requirements of Section 501, except as modified by this section.

   Before depositing concrete in the forms, obtain an inspection of the reinforcing steel, enclosures, anchorages, and prestressing steel by an authorized Department representative.

   Consolidate the concrete using any combination of internal and external vibration that does not displace the reinforcing steel or other items embedded in the concrete.

9. Release. Do not release prestressing strands or transfer prestressing forces to the member until concrete cylinder tests, manufactured according to AASHTO T 23 and tested according to AASHTO T 22 using the same concrete and maintained in the same curing conditions as the member, indicate that the concrete has attained the minimum initial compressive strength (release strength, f'_{ci}) as indicated in the Contract documents.

   Cut or release the elements in an order that minimizes the lateral eccentricity of the pre-stress. Cut all prestressing strands to a depth of at least 1 inch from the concrete surface. Fill the recess with cement mortar and finish flush to the concrete surface. Alternatively, cut all prestressing strands flush with the end of the member. Clean the exposed ends of the strand and a 1-inch strip of adjoining concrete to remove all dirt and residue not firmly bonded to the metal or concrete surfaces.

   If the member's curing is accelerated according to Section 501, transfer the stressing force to the concrete immediately after the heating cycle has been discontinued, while the concrete is still moist, and before the temperature of the concrete drops below 100°F.

502-3.02 POST-TENSIONING METHODS. Select a post-tensioning system that provides the magnitude and distribution of prestressing force specified in the Contract documents.

For box girders, distribute the prestressing steel so the force in each girder stem does not vary more than 5 percent from the required force per girder stem and the required total force in the superstructure is obtained and distributed symmetrically about the centerline of the typical section.

Do not exceed 75 percent of the minimum breaking strength of the prestressing steel for maximum temporary tensile stresses (jacking stresses) in prestressing steel. Do not exceed 70 percent of the minimum breaking strength of the prestressing steel at anchorages after anchor set.

Working force and working stress will be considered as the force and stress remaining in the prestressing steel after all losses (e.g., creep and shrinkage of concrete, elastic compression of concrete, creep of steel, losses in post-tensioned prestressing steel due to sequence of stressing, friction and take up of anchorages and all other losses peculiar to the method or system of prestressing) have taken place or have been accommodated. Calculate loss of prestress using

industry recognized methods. The calculation and analysis methods are subject to approval by the Engineer.

1. Shop Drawings and Calculations. Before casting members to be prestressed, submit shop drawings and supporting calculations of the prestressing system for approval no less than 45 days prior to the placement of bridge concrete.

   Provide complete details on the shop drawings of the prestressing system and substantiating calculations of the method, materials, and equipment to be used in the prestressing operations, including any additions or rearrangement of reinforcing steel and any revision in concrete dimensions from that shown on the Plans. Outline in sufficient detail the method and sequence of stressing. Include complete specifications and details of the prestressing steel and anchoring assemblies, working stresses, anchoring stresses, type of ducts, initial prestress losses, final prestress losses and all other data pertaining to the prestressing operation. Show tendon geometry and locations complying with the plans and the limitations of the selected post-tensioning system. Show all vent locations, high point outlet inspection details, anchorage inspection details and grout caps, protection system materials and application limits. Include on the shop drawing the location of the anchorages, vents, and duct enclosures at 2-foot (maximum) intervals along the length of the member.

   Submit calculations for the anticipated camber at the time of prestressing force transfer and at other significant times. Show the values on the shop drawings as a time/deflection curve.

   Submit calculations for the anticipated tendon elongation. Utilize the modulus of elasticity, based on nominal area, as furnished by the prestressing steel manufacturer for the lot of steel being tensioned. Show a typical tendon force diagram, after friction, wobble and anchor set losses, on the shop drawings based upon the expected friction curvature and wobble coefficients and values for the post-tensioning system used. Show the coefficients and values on the shop drawings.

   Provide shop drawings, calculation, and procedures related to post-tensioning, prepared and sealed by a Professional Engineer, registered in the State of Alaska who specializes in post-tensioning concrete. Bear the signature and seal of the Professional Engineer who specializes in post-tensioning construction on all calculations, drawings, and procedures.

   Include post-tensioning system certification(s) conforming to Section 721.

2. Post-tensioning and Grouting Technicians. Perform post-tensioning field operations under the direct supervision of a qualified post-tensioning technician. Provide a post-tensioning technician with at least 5 years of experience in construction of post-tensioned prestressed concrete structures. Provide a technician, skilled in the prestressing method, to aid and instruct in using the prestressing equipment and in installing the materials to obtain required results.

   Perform grouting under the direct supervision of a certified grouting technician. Provide a technician skilled in various aspects of grouting whom the American Segmental Bridge Institute certifies as an "ASBI Certified Grouting Technician".

   Ensure the post-tensioning technician is present at all times during duct installation, tendon tensioning, and grouting operations and provides close observation and control of all post-tensioning and grouting operations, as necessary for compliance with the Contract. Submit the name of the post-tensioning technician and proof of certification no less than 30 days before the start of bridge concrete placement operations.

3. Protection of Prestressing Steel and Anchorages. Protect prestressing steel and anchor assemblies against physical damage and corrosion. Keep prestressing steel and anchor

assemblies clean and free of deleterious material such as grease, oil, wax, paint, or other foreign materials. The Engineer will reject prestressing steel that has at any time sustained physical damage. The Engineer will reject prestressing steel that has developed visible rust pitting or other results of corrosion, other than rust stain.

Protect prestressing steel and anchorage assemblies against physical damage and corrosion during shipping and storage by packaging the prestressing steel and anchorage assemblies in containers or shipping forms. Place a corrosion inhibitor in the package or form, incorporate a corrosion inhibitor carrier-type packaging material, or apply a corrosion inhibitor directly to the steel. Do not use corrosion inhibitors that have deleterious effect on the steel or concrete or bond strength of steel to concrete. Immediately replace packaging or forms damaged from any cause or restore packaging to original condition.

Clearly mark the shipping package or form with a statement that the package contains high-strength prestressing steel, and the type of corrosion inhibitor used, including the date packaged.

If prestressing steel is installed in ducts but not tensioned and grouted within the 7 days, perform Nondestructive Examination (NDE) by either videoscoping the entire length of the prestressing steel inside the ducts or visually inspecting the prestressing steel upon removing the prestressing steel from the duct for corrosion. Perform NDE inspection at least once every 7 days until the prestressing steel is tensioned and grouted. Perform NDE inspection to the satisfaction of the Engineer. Provide a report of the tendon condition following each NDE inspection for each tendon installation.

If corrosion is not found on the prestressing steel upon completion of NDE inspection, the Engineer may require protecting prestressing steel corrosion by means of a corrosion inhibitor placed in the ducts. Do not place a corrosion inhibitor inside the duct if prestressing steel installation, tensioning, and grouting is performed within 7 days. Do not use corrosion inhibitors that have deleterious effect on the steel or concrete or bond strength of steel to concrete. Submit for approval the name, manufacturer, and type of corrosion inhibitor to be used in the ducts at least 7 days before installation of any prestressing steel. Prior to grouting, flush the corrosion inhibitor from the ducts using a solution of quick lime (calcium oxide) or slaked lime (calcium hydroxide) in the amount of 0.1 lbs/gal. Use compressed air that is oil free to blow out ducts and remove flush water.

Cover and protect the anchorages against corrosion at all times from installation of the prestressing steel to placement of the concrete pour-backs.

Do not weld on or near prestressing steel, ducts, anchorages, or other assemblages. Protect prestressing steel and hardware from weld spatter or other damage. Once the prestressing steel has been installed, do not make welds or grounds for welders on the forms, reinforcing steel, or adjacent steel members.

4. Prestressing Equipment. Use hydraulic jacks to tension prestressing steel tendons so that the force in the prestressing steel will not be less than the value specified in the Contract documents or as approved by the Engineer. Do not use monostrand jacks to stress multi-strand tendons.

   Equip each jack used to stress tendons with either:

   a. two pressure gages
   b. one pressure gage and one load cell

In the event that any uncertainty exists regarding jack calibration, pressure gage usage, strand elongation or any other prestressing strand tensioning issue, provide and use a calibrated load cell when prestressing steel tendons.

Permanently mark the jack body with the ram area. Ensure each pressure gage is fully functional, calibrated and has an accurately reading dial at least 6 inches in diameter.

Calibrate the jack and each gage used to stress tendons as a unit within 6 months prior to use and after each repair. If used, provide a load cell calibrated within the past 12 months with an indicator that may be used to determine the prestressing force in the tendon. The range of the load cell shall be such that the lower 10 percent of the manufacturer's rated capacity will not be used in determining the jacking stress.

Use the following calibration procedure; Perform three calibration test cycles with the cylinder extension of the jack in various positions (i.e. 2 inch, 4 inch, 8 inch stroke). At each pressure increment, average the forces from each test cycle to obtain an average force. Perform the calibration with the equipment setup in the same configuration that will be used at the job site. Use load cells calibrated within the past 12 months to calibrate stressing equipment.

For each jack and gauge unit used on the project, provide the Engineer with certified calibration curves prior to the start of the work and every 6 months thereafter, or as requested by the Engineer. If used, supply documentation denoting the load cell calibration date prior to the start of the work and every 6 months thereafter. Furnish certified calibration charts prior to stressing.

5. Enclosures for Post-Tensioning. Accurately place enclosures (anchorages, ducts, and vents) for prestressing reinforcing according to the Plans or approved shop drawings.

   Set and hold the anchorage assemblies and block-out templates for anchorages so their axis coincides with the axis of the tendon and the wedge plates are normal in all directions to the tendon. Securely fasten anchorages and block-outs to prevent displacement during concrete placement. Unless otherwise specified in the Contract documents or shown on the approved shop drawings, recess the anchoring assemblies in formed block-outs so that the ends of the prestressing steel and all parts of the anchoring assemblies will be at least 3 inches inside of the end surface of the member. Construct block-outs in leak proof forms that create neat lines with the end surface of the member.

   Securely fasten ducts at the proper locations in the forms by ties to reinforcing steel that are adequate to prevent displacement during concrete placement. Use supplementary support bars where needed to maintain proper alignment of the duct. Use hold-down ties to prevent displacement due to duct buoyancy in the fluid concrete. Fasten ducts at 2-foot maximum intervals along the member.

   Do not damage the ducts during installation. Do not crimp, flatten, or dent the ducts. Do not perforate the ducts or provide openings in the ducts except at locations designated in the Contract documents or shop drawings. After duct installation, inspect all ducts for damage. The Engineer will reject ducts with unintentional holes or openings and ducts that are dented, crimped, or flattened. Repair duct sections to the satisfaction of the Engineer at no additional cost to the Department and no adjustment in Contract time.

   After installation in the forms, cover the ends of the ducts and anchorages at all times to prevent the entry of water or debris.

   Prior to placing forms for closing slabs of box girder cells, demonstrate that the ducts are unobstructed.

6. Location of Grout Vents. Place grout vents at locations designated in the Contract documents and shop drawings. Equip grout vents with positive shut-off devices. Extend grout tubes with sufficient distance out of the concrete member to allow for proper closing of the valves.

7. Placing Reinforcing Steel and Prestressing Steel. Place reinforcing steel according to the requirements of Section 503 and as modified by this Section.

   Place prestressing steel in the position as designated in the Contract documents or on the approved shop drawings. Install the prestressing steel in the enclosures by pushing or pulling the total number of strands in a tendon individually or as a unit.

   For strands that are pushed, round off the end of the strand and fit the end of the strand with a smooth protective cap.

   For strands that are pulled, use a special steel wire sock or other device attached to the end strands to pull the assembled tendon through the duct. Do not weld the ends of the strands together for this purpose. Round the end of the pre-assembled tendon for smooth passage through the duct. Cut strands using an abrasive saw or equal. Do not flame cut strands.

   Immediately prior to installing the prestressing steel, demonstrate that the ducts are free of water, debris, and obstructions by passing a torpedo through the ducts. Use a torpedo having the same cross-sectional shape as the duct and is 1/4 inch smaller all around than the clear, nominal inside dimensions of the duct. Make no deductions to the torpedo section dimensions for tolerances allowed in the manufacture or fixing of the ducts. For straight ducts, use a torpedo at least 2 feet long. For curved ducts, determine the length so that when both ends touch the outermost wall of the duct, the torpedo is 1/4 inch clear of the innermost wall. If the torpedo will not travel completely through the duct, the Engineer will reject the member, unless a workable repair can be made to clear the duct. Ensure the torpedo passes through the duct easily, by hand, without resorting to excessive effort or mechanical assistance.

   If the strands do not easily pass through the duct or an obstruction is encountered, do not force strands through the duct.

   Do not install the prestressing steel in the duct prior to placing and curing of the concrete.

   Straighten prestressing steel strands that are to be stressed simultaneously or when necessary to ensure proper positioning in the ducts.

8. Placing Concrete. Produce and place concrete according to the requirements of Section 501 and as modified by this section.

   Before depositing concrete in the forms, obtain an inspection and approval of the placement of reinforcing, enclosures, anchorages, and prestressing steel. Vibrate the concrete internally, externally, or both. Vibrate carefully to avoid displacing the reinforcing steel, anchorages, ducts, grout vents, or other items embedded in the concrete.

9. Post-tensioning. Do not begin tensioning operations until concrete cylinder tests, manufactured according to AASHTO T 23 and tested according to AASHTO T 22 using the same concrete and maintained in the same curing conditions as the member, indicate that the concrete has attained the minimum initial compressive strength (release strength, f'_{ci}) indicated in the Contract documents. Do not begin tensioning operations until after the Engineer approved patches or repairs have been satisfactorily completed. Do not tension the prestressing steel until all concrete in the member has been placed.

Perform stressing of tendons in conformance with the sequence shown on the approved shop drawings. Stress tendons in such a sequence that lateral eccentricity of prestress and loss of prestress will be a minimum. Stress tendons symmetrically about the center of the typical section so no more than one tendon is eccentric about the centerline at any one time. Sequence the stressing of the tendons so the individual tendon force does not exceed the tendon force in other tendons by more than 50 percent of the final jacking force of the tendon.

Stress strands in each tendon simultaneously. Stress tendons by jacking from only one end of the member unless otherwise approved by the Engineer.

Conduct the tensioning process so that tension being applied and the elongation of the prestressing steel may be measured at all times. Measure elongation to the nearest 1/16 inch. Tension tendons to a preliminary force between 5 and 25 percent of the final jacking force to eliminate any wedge slip or take-up in the tensioning system before elongation measurements are started. Record the preliminary force so that it can be used in the elongation measurement. Mark at least 25 percent of the strands in each tendon prior to final stressing to permit measurement of elongation and to ensure the anchor wedges are set properly.

For the required tendon force, ensure the observed elongation agrees within 5 percent of the theoretical tendon elongation. In the event the observed elongation is not within acceptable tolerances, determine the source of error and revise the post-tensioning operation to the satisfaction of the Engineer before proceeding. Do not overstress the tendon to achieve the theoretical elongation.

Multi-strand post-tensioning tendons having wires that fail, by breaking or slippage during stressing, will be rejected.

Cut post-tensioning steel with an abrasive saw within 1 to 2 inches from the anchoring device. Do not flame cut prestressing steel.

Provide a record of the post-tensioning operation following each tendon installation including, but not limited to, the following:

a. Project name and bridge number;
b. Contractor and / or subcontractor name;
c. Tendon location, size, type;
d. Date and time tendon was first installed in the duct;
e. Reel number for strands;
f. Tendon cross-sectional area;
g. Modulus of elasticity;
h. Date and time tendon was stressed;
i. Jack and gage numbers per end of tendon;
j. Required jacking force;
k. Gauge pressure;
l. Elongation (theoretical and actual);
m. Anchor set; (anticipated and actual);
n. Stressing sequence (i.e. tendons stressed before and after);
o. Stressing mode (one end/ two ends/ simultaneous);
p. Witnesses to stressing operation (signature); and
q. Date grouted.

Cover ends of tendons and anchorages immediately after stressing in accordance with Subsection 502-3.02.3.

502-3.03 CAMBER. Camber is the upward deflection that occurs in prestressed concrete flexural members due to the combination of stressing forces and dead load. It does not include dimensional inaccuracies from manufacturing errors.

Form girders so the roadway surface conforms to the indicated grade line with an allowance for 1/2 inch of positive camber at midspan. Form girders to adjust for the predicted long-term camber from loss of prestress and from dead load deflection. When estimating this adjustment, assume that future paving will be applied 3 years after erection.

Control the concrete properties and the placing, curing, curing times, tensioning procedures, and the storage of precast prestressed beam sections. Control these elements so that the shape and amplitude of the deflection curves for all girders will be within specified tolerances and as nearly alike as possible.

Measure camber with the girder supported at bearing points only. When it is impractical to support the girder on its bearing points, you may use alternative support points. Obtain approval of the alternative supports and submit calculations of the effects of the supports on girder camber. Measure actual camber during prestressing force transfer and compare it with computed values and tolerances.

502-3.04 TOLERANCES. Produce prestressed concrete members conforming to the following dimensional tolerances:

1. Camber: Do not vary from approved camber more than ±1/8 inch per 10 feet of length, but not to exceed 1 inch. In addition, the camber of any girder may not differ from that of any other girder by more than 1 inch.

2. Position of Strands: ±1/4 inch (±1/2 inch where harped strands exit the member).

3. Longitudinal Position of Deflection Point for Harped Strands: ±12 inches.

4. Position of Ducts and Anchorages: ±1/4 inch

5. Position of Local Zone Reinforcement: Center reinforcement on the duct and start within 1/2 inch of the back of the bearing plate.

6. Position of Weld Plates: ±1 inch measured along joint. ±1/8 inch transverse to joint.

502-3.05 BONDING AND GROUTING. Conform to the following:

1. General. Bond post-tensioned prestressing steel to the concrete by completely filling the entire void space between the duct and the tendon with grout. Grout tendons according to the procedures set forth in the approved grouting operation plan. Grout empty ducts.

2. Personnel Qualifications. Carry out grouting operations by workers trained for and experienced in the tasks required. Perform grouting under the immediate control of the post-tensioning technician as described in Subsection 502-3.02.

3. Grouting Operation Plan. No less than 30 days prior to the initiation of production grouting, submit a grouting operation plan for approval. Devise the grouting procedures to ensure the ducts will be completely filled by grout. As a minimum, address and provide procedures for the following items in the grouting operation plan:

    a. Type, quantity, and brand of materials used in the grouting including all material certifications;

b. Type of equipment furnished, including capacity in relation to demand and working condition, as well as back-up equipment and spare parts;
c. Types and locations of vents;
d. Types and sizes of grout hoses and connections;
e. Theoretical grout volume calculations;
f. General grouting procedure;
g. Duct cleaning method prior to grouting;
h. Mixing and pumping procedures;
i. Type and frequency of quality control production tests;
j. Direction of grouting;
k. Sequence of use of the vents;
l. Method to be used to control the rate of flow and pressure within the ducts;
m. Procedures for handling blockages, including flushing of ducts;
n. Procedures for possible post grouting repair; and
o. Names of the persons in charge and the other personnel who will perform the grouting operation, including their relevant certification, experience, and skill.

Do not commence production grouting until the Engineer provides written approval of the grouting operation plan.

Before initiation of production grouting, conduct a joint meeting with the grouting technician, subcontractors, grouting crew, and the Engineer to discuss the grouting operation plan, required testing, corrective procedures, and other relevant issues.

4. Grout Storage. Store all grout materials in a dry enclosure or building that is convenient to the work site. Limit on site storage of grout to a maximum period of one month.

5. Grout Production Tests. Carry out the minimum number of production grout tests as follows:

   a. Grout Strength Test. Prepare grout cube specimens according to ASTM C942. Perform a minimum of one strength test per day during grouting operations. Submit strength test results within 24 hours of test completion.

   b. Fluidity test. Perform the modified version of ASTM C939 test specified in Subsection 701-2.08. Repeat testing at least every 2 hours of grouting operations. Submit fluidity test results within 24 hours of test completion.

6. Field Trial Test. Demonstrate to the satisfaction of the Engineer that the grouting equipment, methods, and procedures are appropriate. Conduct field trial tests at least 7 days prior to initiation of production grouting or as specified by the Engineer. Perform batching and testing with the same materials, personnel, and equipment used in production grouting. Furnish all materials and labor at no cost to the Department.

7. Preparation of Enclosures. If a corrosion inhibitor or any other material other than prestressing steel is inside the duct, flush the ducts using a solution of quick lime (calcium oxide) or slaked lime (calcium hydroxide) in the amount of 0.1 lbs/gal.

   Blow duct with oil free compressed air to remove water and debris blockages that may interfere with the injection of grout.

   Inspect valves to be sure that they can be opened and closed properly. Check that the grout hose connections and inlets are free of dirt.

8. Equipment. Provide grouting equipment consisting of measuring devices for water, a high-speed shear colloidal mixer, a storage hopper (holding reservoir) and a pump with all the necessary connecting hoses, valves, and pressure gauge. Provide grouting equipment with

sufficient capacity to ensure that the post-tensioning ducts to be grouted can be filled and vented without interruption in less than 20 minutes.

Provide an air compressor, flushing equipment, and hoses with sufficient output to perform the required functions.

If voids that cannot be completely filled using grout injection equipment are present after the grouting operation is complete, then provide vacuum grouting equipment (volumetric measuring type). No additional compensation will be made in the event that vacuum grouting equipment is required.

Provide the following equipment:

a. Mixing Equipment. Provide a high speed shear colloidal mixer capable of continuous mechanical mixing producing a homogeneous and stable grout free of lumps and un-dispersed cement. Use only colloidal grout machinery that has separate charging and storage tanks. Equip the charging tank with a high shear colloidal mixer and fit the storage tank with an agitator to keep the grout moving continuously before it is pumped into the duct. Use grouting equipment with a gravity feed to the pump inlet from the storage tank.

   Include a screen having clear openings of 1/8 inch maximum size to screen the grout prior to its introduction into the grout pump or storage hopper. Locate the screen between the charging tank and the storage tank so that the screen is easily accessible for inspection and cleaning.

   Keep the holding tank agitated and at least 1/4 full at all times during the pumping operation to prevent air from being drawn into the post-tensioning duct.

   Periodically inspect the screen during grouting operations. Do not use grout if lumps of cement remain on the screen.

   Add water during the initial mixing by use of a calibrated flow meter or calibrated water reservoir with a measuring accuracy equal to one percent of the total water volume. Where water is not supplied through the public water supply system, provide a water storage tank of sufficient capacity.

b. Grout Injecting Equipment. Provide pumping equipment capable of continuous operation with little variation of pressure that includes a system for circulating the grout when actual grouting is not in progress.

   Use positive displacement type grout pumps that provide a continuous flow of grout and will be able to maintain a discharge pressure of at least 145 psi. Use grout pumps with adequate capacity so that an optimal rate of grouting can be achieved. Ensure pumps are constructed to have seals adequate to prevent oil, air or other foreign substances entering the grout and to prevent loss of grout or water.

   Use equipment capable of maintaining pressure on completely grouted ducts and fitted with a valve that can be closed off without loss of pressure in the duct.

   Install a pressure gauge having a full-scale reading of no more than 290 psi at the duct inlet. If hoses in excess of 100 feet total length are used, place and use two gauges, one at the pump and one at the inlet.

   Use grout hoses with sufficient diameter, rated pressure capacity and that are compatible with the pump output. Install a sampling tee with stopcock that minimizes the number of

bends, valves, and changes in diameter. Firmly connect grout hoses to pump outlets, pipes, and duct inlets.

Do not use compressed air to aid the pumping of grout.

c. Air Compression. Provide equipment to supply oil-free and water-free compressed air to blow out excess water and to check the free passage of the ducts.

d. Flushing Equipment. Provide standby flushing equipment using a potable water supply to facilitate complete removal of grout from the duct if difficult grouting conditions exist. This equipment is in addition to the grouting equipment. Utilize a different power source than the grouting equipment. Furnish equipment that is capable of delivering a pressure of at least 290 psi to flush out partially grouted enclosures.

e. Vacuum Grouting Equipment. Use volumetric measuring type vacuum grouting equipment with the ability to measure a void and supply a measured volume of grout to fill the void.

f. Standby Equipment. During grouting operations, provide a standby grout mixer and pump.

9. Mixing of Grout. Mix grout using the entire contents of each bag in accordance with the manufacturer's recommendations and using a metered amount of water. Mix the materials thoroughly to produce a homogeneous grout without excessive temperature increase or loss of properties. Do not mix grout longer than the manufacturer's recommended duration. Continuously agitate the grout until grouting is complete.

   Check the fluidity of the grout in accordance with Subsection 701-2.08. Do not commence grout pumping until fluidity requirements are satisfied.

   Do not add water to increase fluidity that has decreased by delayed use of the grout.

10. Injection of Grout. Use a method of injecting grout that will ensure complete filling of the ducts and complete encasement of the prestressing steel.

    Open grout vents before commencing grouting operations, unless otherwise approved by the Engineer.

    Perform grouting in one operation, maintaining a continuous, one-way flow of grout. Grout tendons from the lowest vent in an uphill direction. Unless approved otherwise by the Engineer, pump grout at a rate of 15 feet to 50 feet of duct per minute to avoid air entrapment, segregation of the grout, and to ensure complete filling of the duct. Conduct normal grouting operations at a pressure range of 10 psi to 75 psi measured at the grout inlet. Do not exceed the maximum pumping pressure of 145 psi at the grout inlet.

    Pump grout through the duct and continuously discharge grout from the first and subsequent outlets until residual water and entrapped air have been removed and the consistency of the grout is equivalent to that of the grout being pumped into the inlet. Discharge at least 1/2 gallon of grout from each outlet prior to closing the vent. Close all outlet vents in a similar manner one after another in the direction of flow except that at intermediate crests, close outlet vents placed a short distance downstream of the crest before closing their associated high point vent. Discarded grout does not represent additional cost to the Department.

    Pump grout through the duct and continuously discharge grout, to the satisfaction of the Engineer, at the anchorage and grout cap outlets until all free water and air are discharged and the consistency of the grout is equivalent to that of the grout being pumped into the inlet.

Close the anchorage outlet vent and discharge a minimum of 1/2 gallon of grout from the grout cap. Close the grout cap outlet.

After the outlets have been bled and sealed, bleed the grout pressure to 5 psi and wait a minimum of ten minutes for entrapped air to flow to the high points. After ten minutes, increase the pressure as needed and discharge grout at each high point outlet to eliminate all entrapped air or water. Complete the process by locking a pressure of 30 psi into the tendon prior to closing the inlet vent.

If the actual grouting pressure exceeds the maximum allowed, close the inlet vent and pump grout at the next outlet, which has just been or is ready to be closed, as long as one-way flow is maintained. Do not pump grout into a succeeding outlet vent from which grout has not yet flowed. If this procedure is used, equip the new inlet vent with a positive shut-off and pressure gage.

11. Temperature Considerations. Do not grout if the ambient air temperature exceeds 100°F. Do not grout if the ambient air temperature is expected to be less than 40°F within 48 hours. Ensure grout temperature upon mixing is between 50°F and 90°F.

    If the ambient air temperature is below 32°F, keep ducts free of water to avoid damage due to freezing. Do not warm ducts with steam. Blow dry air (60% humidity or less) through the ducts to extract trapped water. Ensure ducts are free of frost and ice before commencing grouting operations.

12. Post-Grouting Inspection. Do not remove or open vents until the grout has cured for at least 24 hours. After the grout has cured, remove outlets and grout caps located at anchorages and high points along the tendon to facilitate inspection. If voids are suspected or if duct grouting operations were prematurely terminated prior to completely filling the duct, explore the voided area inside the duct with an endoscope, borescope, videoscope, or other visual means approved by the Engineer. Probing is not allowed. Determine the location and extent of all voided areas.

    Depending on the location of the void, drilling may be required to penetrate the inner surface of the anchorage or duct. Use drilling equipment that will automatically shut-off when steel is encountered.

13. Repairing and Filling Voids. Repair and fill voids that occur in the ducts after the grouting operation is complete. If voids are found, submit a grouting repair plan for review and approval that describes the location and extent of the void and the method of repairing and filling the void. If the extent and location of the void is such that complete filling of the void is not possible using the grout injection equipment, repair and fill the void using a volumetric measuring vacuum grouting process utilizing the vacuum grouting equipment specified in Subsection 502-3.05.8.

14. Finishing. Remove valves, caps and pipes for each vent to a depth at least 1 inch below the surface of the concrete. Fill the void left by the vent pipe according to Subsection 501-3.07.1. Do not remove or open vents until the grout as set for at least 24 hours.

15. Protection of End Anchorages. Within 7 days upon completion of the grouting, permanently protect the anchorage of post-tensioning tendons to prevent access of water or other aggressive agents.

    Immediately before casting the concrete pour-backs (within 24 hours), mechanically clean and roughen the mating concrete surfaces to remove any laitance and to expose small aggregate. Use abrasive blast cleaning or water blasting with a pressure washer capable of at least 10,000 psi nozzle pressure at all elevations to clean the concrete surfaces. Keep the

nozzle tip no more than 12 inches from the surface during all phases of water blasting. Flush the surface with water and blow dry. Ensure surfaces are clean, sound and without standing water.

Unless otherwise specified in the Contract documents or shown on the approved shop drawings, ensure the prestressing steel and all parts of the anchoring assemblies are at least 3 inches inside of the end surface of the member. Apply an epoxy bonding agent to the concrete mating surfaces according the manufacturer's instructions. Fill the recess with concrete and finish the concrete surface to true lines according to the Contract requirements.

16. Record of Grouting Operation. Submit a written report within 72 hours after grouting. Include in this report:

    a. the date of grouting;
    b. the number of days from tensioning to grouting;
    c. the tendons grouted;
    d. the quantities and types of materials used;
    e. the volume of grout pumped into the duct
    f. a summary of problems encountered during grouting and steps taken to resolve them;
    g. the maximum pumping pressure at the inlet;
    h. the temperature measurement of the air, water, prepackaged material, mix grout, and concrete member in the duct.
    i. the results of quality control testing.

502-4.01 METHOD OF MEASUREMENT. Section 109.

502-5.01 BASIS OF PAYMENT. The lump sum payment is full compensation for furnishing, installing, stressing, grouting, repairing, and inspecting post-tensioned tendons accepted in place.

Items of the post-tensioning system embedded within the concrete including but not limited to prestressing steel, enclosures for prestressing steel, wedges, wedge plates, anchorage assemblies and associated supplemental reinforcing steel required by the supplier, grout vents, and grout gaps are subsidiary to post-tensioned concrete structural members.

Post-tensioning system hardware that is not embedded in concrete, including but not limited to jacks, gauges, wire socks, and torpedoes, is subsidiary to post-tensioned concrete structural members.

Items and equipment to fill the ducts with grout, including but not limited to mixers, gauges, flushing equipment, and production tests, are subsidiary to post-tensioned concrete structural members.

Materials for protecting the post-tensioning steel and anchorages including but not limited to corrosion inhibitors, flushing equipment, concrete bonding agents, and equipment to prepare the concrete block-outs are subsidiary to post-tensioned concrete structural members.

Labor, materials, tools, equipment and incidentals necessary for completing the work are subsidiary to post-tensioned concrete structural members.

Payment for prestressing precast concrete members is included in the Contract price paid for the precast members, as provided for under Section 501.

Payment will be made under:

Pay Item	Pay Unit
502(1) Post-Tensioning (Type)	Lump Sum

Delete Section 503 Reinforcing Steel and replace with the following:

SECTION 503
REINFORCING STEEL

503-1.01 DESCRIPTION. Furnish and place reinforcing steel for reinforced concrete structures.

503-1.02 DEFINITIONS.

BAR SIZE / DIAMETER. Nominal dimensions equivalent to those of a circular area having the same weight per foot as the AASHTO/ASTM designated bar.

COVER. The minimum distance between the surface of embedded reinforcing steel and the outer surface of the concrete.

HOOK. A bend in the end of a bar.

HOOP. A one-piece closed tie or continuously wound tie, with hooked or welded ends, enclosing the longitudinal reinforcing steel.

LATERAL REINFORCING STEEL. Reinforcing steel perpendicular to the length of a concrete member.

LONGITUDINAL REINFORCING STEEL. Reinforcing steel parallel to the length of a concrete member.

LOT. A defined quantity.

SPIRAL. Continuously wound reinforcing steel in the form of a cylindrical helix.

STIRRUP. Lateral reinforcing steel formed of individual or paired units, open or closed, used to resist shear and diagonal tension stresses in a structural member.

TIE. Reinforcing steel with hooked ends tied at right angles to and enclosing the other reinforcing steel, and used to provide confinement.

503-2.01 MATERIALS.

Reinforcing Steel Bars	Subsection 709-2.01
Epoxy-Coated Reinforcing Steel Bars	Subsection 709-2.01
Headed Reinforcing Steel Bars	Subsection 709-2.01
Epoxy Coating Patch Material	Subsection 709-2.01
Bar Supports	Subsection 709-2.03
Epoxy for Bonding Dowels	Subsection 712-2.21

CONSTRUCTION REQUIREMENTS

503-3.01 PLACING DRAWINGS. Submit placing drawings, detailed according to ACI 315, Chapter 3.

Do not substitute reinforcing steel bars of different size, material, coating, or grade without prior approval of the Engineer. When substituting epoxy-coated reinforcing steel for uncoated reinforcing steel, protect and repair epoxy-coated bars according to Subsection 503-3.02.

503-3.02 PROTECTION OF MATERIALS. Protect reinforcing steel from damage. Before placing reinforcing steel in the work, ensure that the reinforcing steel is free of salt and foreign substances that may affect the performance of the reinforcing steel.

Do not weld or tack weld reinforcing steel, unless otherwise noted.

Do not field cut reinforcing steel unless approved by the Engineer. Do not flame cut reinforcing steel.

Do not drop or drag the epoxy-coated reinforcing steel bars or bundles.

Store epoxy-coated reinforcing steel off the ground.

Protect epoxy-coated reinforcing steel from sunlight, salt spray, and weather exposure. The Engineer may reject epoxy-coated reinforcing steel when the cumulative environmental exposure time, including uncovered storage time after coating application to full embedment in concrete, exceeds 2 months.

The Engineer may reject epoxy-coated reinforcing steel when the extent of damaged coating exceeds 2 percent of the surface area in any 1-foot length of bar. When the extent of damaged coating does not exceed 2 percent of the surface area in any 1-foot length of bar, repair damaged coating. Coating damage includes cracks, abrasions, chips, bond loss (the coating can be removed with a peeling action by the finger), and exposed steel areas visible to a person with normal or corrected vision. Repair coating damage before visible oxidation appears on the steel surface.

Protect mechanical splice assemblies, headed bar assemblies, and connecting elements (including bar ends) against physical damage, corrosion, and coating damage. Keep assemblies and connecting elements clean and free of foreign materials that adversely affect the performance of the assembly.

1. Repairing Damaged Epoxy-Coating. Clean and remove disbonded areas of coating. Remove loose and deleterious materials. The Engineer may reject epoxy-coated reinforcing steel when the removed coating exceeds 2 percent in any 1-foot length of bar or if the weight, dimensions, cross-sectional area, or tensile properties are less than the minimum requirements of the applicable specification.

   Use an approved epoxy coating patch material according to the material manufacturer's recommendations. Apply patching material according to the patching material manufacturer's instructions. Allow the patching material to cure before placing concrete. The Engineer may reject epoxy-coated reinforcing steel when the surface area covered by patching material exceeds 5 percent in any 1-foot length of bar.

   Rejected epoxy-coated reinforcing steel may not be substituted for uncoated reinforcing steel or used as bar supports.

503-3.03 FABRICATION. Fabricate reinforcing steel to the size and dimension shown on the Plans. Reinforcing steel dimensions shown are out-to-out of bar, unless otherwise noted.

Meet fabrication tolerances in ACI 117, Section 2.1.

Weld reinforcing steel according to AWS D1.4.

1. Bends. Bend bars when the bar temperature is above 45°F and less than 150°F. Bend bars to the diameter shown on the Plans. If the bend diameter is not shown, bend the bar with

inside diameters as shown in Table 503-1. The Engineer may reject reinforcing steel bent with an inside diameter less than the minimum diameter shown in Table 503-1.

Do not re-bend or straighten bars without approval by the Engineer.

TABLE 503-1
BEND DIAMETER

BAR SIZE	STIRRUPS AND TIES	STANDARD HOOKS AND OTHER BENDS
No. 3	1½"	2¼"
No. 4	2"	3"
No. 5	2½"	3¾"
No. 6	4½"	4½"
No. 7	5¼"	5¼"
No. 8	6"	6"
No. 9	-	9½"
No. 10	-	10¾"
No. 11	-	12"
No. 14	-	18¼"
No. 18	-	24"

Fabricate bar end hooks meeting the following requirements:

a. Stirrup and Tie Hooks.

(1) 90° Hook: 90° bend plus:

(a) For No. 5 bar and smaller, a 6.0 nominal bar diameter extension at the free end of the bar.

(b) For No 6, No. 7, and No. 8 bars, a 12.0 nominal bar diameter extension at the free end of the bar.

(2) 135° Hook: 135° bend plus a 6.0 nominal bar diameter extension, but not less than 2.5 inches, at the free end of the bar.

b. Standard Hooks.

(1). Std 180° Hook: 180° bend plus a 4.0 nominal bar diameter extension, but not less than 2.5 inches, at the free end of the bar.

(2). Std 90° Hook: 90° bend plus a 12.0 nominal bar diameter extension at the free end of the bar.

2. Bar Repairs. The Engineer will evaluate improperly bent bars and bars bent at locations not required by the Plans for structural adequacy and durability. Do not repair improperly bent bars until the bars are inspected by the Engineer and the Engineer approves repairing the bar. Bars repaired prior to inspection by the Engineer may be rejected. If, in the opinion of the Engineer, the bend is of such extent or character as to affect the strength or durability of the bar, the Engineer may reject the bar. Otherwise, the bar may be re-bent or straightened by means meeting the requirements of this Section and in a manner that will not damage the material, coating, or concrete.

If the Engineer approves repairing the bar, preheat the reinforcing steel before bending. Apply heat by any method that does not damage the reinforcing steel or concrete. Preheat the reinforcing steel at least 5.0 nominal bar diameters in each direction from the center of the bend but do not extend preheating below the surface of the concrete. Insulate concrete within 6 inches of the heated bar area. Do not allow the temperature of the reinforcing steel at the concrete interface to exceed 500°F. Preheat the reinforcing steel to at least 1100°F. Ensure the maximum reinforcing steel temperature never exceeds 1200°F. Maintain a uniform temperature throughout the thickness of the bar by using at least 2 heat tips simultaneously at opposite sides of bars larger than No. 6. Maintain the preheat temperature of the reinforcing steel until bending or straightening is complete. Make the bend gradually with smooth continuous application of force. When straightening, move a bender progressively around the bend. When bending or straightening is complete, gradually reduce the temperature of the reinforcing steel to the ambient air temperature. Do not artificially cool the bars with water, forced air, or any other means.

503-3.04 PLACING AND FASTENING. Place reinforcing steel in the position as shown on the Plans. Secure the reinforcing steel to prevent movement during concrete placement. Do not place bars in addition to those shown on the Plans without prior approval of the Engineer. Do not place bars of different size, material, or grade without prior approval of the Engineer. Space reinforcing steel evenly unless noted otherwise. Provide 2 inches of concrete clear cover, measured from the surface of the reinforcing steel to the outside surface of the concrete, unless noted otherwise.

Do not place bars on layers of fresh concrete or adjust bars while placing concrete.

1. Fastening Requirements. Tie the bars with No. 14 or No.16 gauge steel wire. When the spacing between bars is 1 foot or more, tie the bars at all intersections. When the bar spacing is less than 1 foot, tie every other intersection. If the Plans require bundled bars, tie bundled bars together at not more than 6-foot centers. Tie all intersections of epoxy-coated reinforcing steel in the top mat of concrete decks and approach slabs. Use wire coated with plastic, epoxy, or similar non-conductive material when tying epoxy-coated reinforcing steel. Obtain the Engineer's written authorization before welding reinforcing steel. Provide at least 1 inch clear cover to the tie wire by turning the tie wire away from concrete surfaces.

   For slip-formed concrete, tie reinforcing steel at all intersections. Provide additional reinforcing steel cross bracing to keep the cage from moving during concrete placement. Place cross bracing both longitudinally and transversely.

2. Bar Supports. Maintain distances from the forms using approved precast mortar blocks, metal supports, or plastic supports strong enough to resist permanent movement under construction loads. If supports extend to exposed concrete surfaces, use metal or plastic supports. To support and fasten epoxy-coated reinforcing steel, use plastic supports or metal supports coated with plastic, epoxy, or similar non-conductive material. Do not use wooden or aluminum supports.

   Place supports at frequent intervals to maintain the cover between the reinforcing and the surface of the concrete. Space supports under concrete deck reinforcing steel and approach slab reinforcing steel not more than 4 feet apart in each direction.

503-3.05 SPLICING. Splice reinforcing steel bars at locations shown on the Plans and specified in this Section. Obtain the written approval of the Engineer before splicing bars at other locations. The Engineer will evaluate splices at locations not designated in the Contract documents for structural adequacy.

Splice reinforcing steel bars using lap splicing, welded butt joints, electric resistance butt welded joints, welded lap splicing, mechanical butt splicing, or mechanical lap splicing, unless noted

otherwise. Do not splice reinforcing steel bars at locations where splices in the reinforcing steel are not allowed.

Splices will not be permitted in bars 40 feet or less in plan length, unless otherwise noted in the Contract documents. For bars exceeding 40 feet in plan length, ensure the distance center-to-center of splices is not less than 30 feet, with no individual bar length less than 10 feet. Stagger splices in adjacent bars, unless otherwise noted. Stagger lap splices a distance greater than the lapped splice length. Stagger butt splices at least 2 feet.

Reinforcing steel may be continuous at locations where splices are noted in the Contract documents.

Do not use lap splicing for No. 14 or No. 18 bars.

Do not lap splice spiral reinforcing steel. Anchor each end unit of reinforcing steel spiral by lapping the free end of the spiral to the continuous spiral and using either a welded lap splice or a mechanical lap splice.

Do not field weld epoxy-coated reinforcing steel bars.

1. Lap Splicing.

   a. General. Place reinforcing steel bars in contact and securely tie the bars together. Provide a minimum clear distance of 2 inches between the spliced bars and the nearest adjacent bar. Do not reduce the minimum clearance to the surface of the concrete.

      Use lapped splices meeting the minimum lengths as shown in Table 503-2, unless otherwise noted:

TABLE 503-2
LAPPED SPLICE LENGTH

BAR SIZE	UNCOATED	EPOXY-COATED
No. 3	1' - 4"	1'- 11"
No. 4	1' - 9"	2' - 7"
No. 5	2' - 2"	3' - 3"
No. 6	2' - 7"	3' - 10"
No. 7	3' - 5"	5' - 2"
No. 8	4' - 6"	6' - 9"
No. 9	5' - 9"	8' - 7"
No. 10	7' - 3"	10' - 10"
No. 11	8' - 11"	13' - 4"

   b. Qualifications and Submittals. No qualifications apply when lap splicing.

   c. Testing/Inspection. Field verify lap splice length.

2. Electric Resistance Butt Welded Joints.

   a. General.

      Produce electric resistance butt welds by a fabricator listed on the Caltrans Pre-Qualified Products List.

      Correct deficiencies in materials and workmanship without additional compensation.

Do not weld or tack brackets, clips, shipping devices or other material not required by the Contract documents to the reinforcing steel, unless shown on the approved working drawings.

b. Qualifications and Submittals. At least 30 days prior to welding, submit for approval the fabricator's signed Evaluation Letter on Caltrans letterhead and the following:

(1) Welding procedure (WPS) and pertinent welding information and calibration
(2) Equipment operators' name and qualifications
(3) Equipment name and serial number
(4) Description of identification and tracking system
(5) Quality control inspector's name and qualifications
(6) Quality control manual and procedures
(7) Type and extent of Nondestructive Examination (NDE) to be conducted, as required in the specifications
(8) Nondestructive testing personnel qualifications
(9) Sample QC and Test Reports

c. Testing/Inspection.

Perform job control tests using a testing laboratory with experience with ASTM A370 and California Test 670. A job control test consists of the fabrication, under the same conditions used to produce the splice, and the physical testing of 4 sample splices for each lot of splices. An authorized Department representative will designate when samples for job control tests are to be fabricated and will determine the limits of the lot represented by each job control test.

A lot of shop produced resistance welded butt joints is defined as no more than 150 splices of the same type of welds used for each combination of bar size and bar deformation pattern that is used in the work.

The Engineer or the Engineer's authorized representative shall witness the job control tests performed by the testing laboratory. Give the Engineer at least 7 working days notice before beginning control tests.

Identify sample splices with tamper proof and weatherproof markings prior to shipment to the testing laboratory.

The sample shall consist of a resistance welded butt splice bar and a control bar that are identified and marked as a set. The same reinforcing bar (hoop) may be used to provide the test weld and control bar.

Test each sample to failure in accordance with ASTM A370 including Appendix A9, *Methods for Testing Steel Reinforcing Bars*, and Caltrans Test 670. Determine the ultimate tensile strength for all control bars by testing the bars to failure.

The production lot will be rejected if:

(1) a sample fails within one bar diameter of the splice at less than 95% of the ultimate tensile strength of the associated control bar
(2) necking of the bar prior to rupture, as defined in California Test 670, is not observed
(3) less than three sample splices achieve a minimum tensile strength of 80,000 psi
(4) all four samples reach 60,000 psi prior to yielding

3. Welded Lap Splicing.

   a. General. Use direct lap joint welds conforming to the requirements in AWS D1.4 except as noted below.

      Use the joint details and dimensions as shown in Figure 3.4 (A), "Direct Lap Joint with Bars in Contact" of AWS D1.4.

      Use electrodes classified as "Nickel-Steel" as referenced in AWS A5.5, A5.28, or A5.29.

   b. Qualifications and Submittals. Perform welds using qualified welders and qualified Welding Procedure Specifications (WPS) meeting AWS D1.4. The operator and procedure qualification tests may be performed simultaneously.

      Perform quality control inspection necessary to ensure the materials and workmanship meets the requirements of the Contract documents using an inspector currently certified as an AWS Certified Welding Inspector (CWI) according to the provisions of AWS QC1.

      Submit a welding plan stamped and signed by the CWI responsible for quality control and consisting of the following documents:

      (1) Quality control inspector qualifications including CWI number.
      (2) Welding Procedure Specifications (WPS).
      (3) Procedure Qualification Records (PQR) and test results.
      (4) Welder Performance Qualification Records (WPQR) with documentation of current welder certification.
      (5) Type and extent of Nondestructive Examination (NDE) to be conducted, as required in the specifications.
      (6) Nondestructive testing personnel qualifications.
      (7) Methods of protecting the welding area.
      (8) Certified test report(s).

      Submit quality control inspection documents, test results, and required test assemblies.

   c. Testing/Inspection. Perform inspection according to AWS D1.4.

4. Mechanical Butt Splices.

   a. Types. Use one of the following types of mechanical butt splices:

      (1) Sleeve-Threaded Mechanical Butt Splices. Use a sleeve-threaded mechanical butt splice consisting of a steel splice sleeve with tapered interior threads that joins the bars with matching tapered threads.

      (2) Sleeve-Swaged Mechanical Butt Splices. Use a sleeve-swaged mechanical butt splice consisting of a seamless steel sleeve applied over the ends of the reinforcing steel bars and swaged to the bars by means of a hydraulic press.

      (3) Sleeve-Lock Shear Bolt Mechanical Butt Splices. Use a sleeve-lock shear bolt mechanical butt splice consisting of a seamless steel sleeve with serrated steel strips welded to the inside of the sleeve, center hole with centering pin, and bolts tightened until the bolt heads shear off and the bolt ends are embedded in the reinforcing steel bars.

(4) Two-Part Sleeve-Forged Ends Mechanical Butt Splices. The two-part sleeve-forged ends bar type of mechanical butt splices consists of a shop machined two-part threaded steel sleeve coupling forged ends of the reinforcing steel bar.

b. General. Conform to the manufacturer's instructions when splicing.

Cut the reinforcing steel bars perpendicular to the long axis of the bar.

Provide a clear cover of not less than 1-1/2 inches measured from the surface of the concrete to the outside of the splice sleeve. Adjust stirrups, ties and other reinforcing steel if necessary to provide clear cover.

For epoxy-coated bars, use epoxy-coated mechanical splices.

Mark each splice with the lot, heat, or batch number that identifies the splice.

c. Qualifications and Submittals. A splice will be considered qualified if the splice can develop a minimum tensile strength of 80000 psi, based on the nominal bar area, and the bars within the splice do not exceed a total slip shown in Table 503-3, when tested according to ASTM A370, including Appendix A9 and California Test 670.

TABLE 503-3
TOTAL SLIP LENGTH

Reinforcing Bar No.	Total Slip (inch)
4	0.020
5	0.020
6	0.020
7	0.028
8	0.028
9	0.028
10	0.036
11	0.036
14	0.048
18	0.060

Submit the following information:

(1) the manufacturer's name;
(2) the name of the product or assembly;
(3) the lot, heat, or batch number that identifies the splice;
(4) the bar grade and size number to be spliced by the material;
(5) a complete description of the splice and installation procedure; and,
(6) test results indicating the splice, used according to the manufacturer's procedures, complies with the minimum tensile strength requirements and the total slip requirements.

d. Testing/Inspection. Perform job control tests consisting of the fabrication, under conditions used to produce the splice, and tensile testing of 6 sample splices for each lot of splices. The Engineer will designate when samples for job control tests are to be fabricated and will determine the limits of the lot represented by each job control test.

A lot of mechanical butt joints is defined as no more than 150 splices of the same type of mechanical butt splice used for each combination of bar size and bar deformation pattern that is used in the work.

Make splice samples using the same splice materials, position, equipment, and following the same procedures as used to make splices in the work. Make splice samples at least 5 feet long with the splice at mid-length. Shorter sample splice bars may be used if approved by the Engineer.

Perform job control tests in the presence of the Engineer. Splices tested in the absence of the Engineer may be rejected. Notify the Engineer, in writing, at least 7 working days prior to performing testing.

Identify sample splices with weatherproof markings prior to shipment to the testing laboratory.

Test each sample according to ASTM A370, including Appendix A9. Tensile test each sample until partial or total fracture of the parent bar material, mechanical splice material, or bar-to-splice connection.

All splices in the lot represented by a test will be considered to meet the tensile strength requirements when the minimum individual tensile strength of the sampled splices is not less than 80000 psi, based on the nominal bar area.

5. Mechanical Lap Splices.

   a. General. Conform to the manufacturer's instructions when splicing.

      Provide a clear cover of not less than 1-1/2 inches measured from the surface of the concrete to the outside of the splice sleeve. Adjust stirrups, ties and other reinforcing steel if necessary to provide clear cover.

      For epoxy-coated bars, use epoxy-coated mechanical splices.

      Mark each splice with the lot, heat, or batch number that identifies the splice.

   b. Qualifications. A splice will be considered qualified if the splice can develop a minimum tensile strength of 75000 psi, based on the nominal bar area, when tested according to ASTM A370, including Appendix A9.

      Submit the following information:

      (1) the manufacturer's name;
      (2) the name of the product or assembly;
      (3) the lot, heat, or batch number that identifies the splice;
      (4) the bar grade and size number to be spliced by the material;
      (5) a complete description of the splice and installation procedure; and,
      (6) test results indicating the splice, used according to the manufacturer's procedures, complies with the minimum tensile strength requirements.

   c. Testing/Inspection. Perform job control tests consisting of the fabrication, under conditions used to produce the splice, and tensile testing of 6 sample splices for each lot of splices. The Engineer will designate when samples for job control tests are to be fabricated and will determine the limits of the lot represented by each job control test.

      A lot of mechanical butt joints is defined as no more than 150 splices of the same type of mechanical butt splice used for each combination of bar size and bar deformation pattern that is used in the work.

Make splice samples using the same splice materials, position, equipment, and following the same procedures as used to make splices in the work. Make splice samples at least 5 feet long with the splice at mid-length. Shorter sample splice bars may be used if approved by the Engineer.

Perform job control tests in the presence of the Engineer. Splices tested in the absence of the Engineer may be rejected. Notify the Engineer, in writing, at least 7 working days prior to performing testing.

Identify sample splices with weatherproof markings prior to shipment to the testing laboratory.

Test each sample according to ASTM A370, including Appendix A9. Tensile test each sample until partial or total fracture of the parent bar material, mechanical splice material, or bar-to-splice connection.

All splices in the lot represented by a test will be considered to meet the tensile strength requirements when the minimum individual tensile strength of the sampled splices is not less than 75000 psi, based on the nominal bar area.

503-3.06 HEADED BAR REINFORCING STEEL. Use headed bar reinforcing steel consisting of deformed reinforcing steel bars with a head attached to one or both ends. Attachment can be accomplished through welding or forging of heads onto the bar ends, by internal threads in the head mating to threads on the bar end or by a separate threaded nut to secure the head to the bar. Heads may be forge formed, machined from bar stock, or cut from plate.

Perform production control tests consisting of the installation, using the same procedure as used in the work, and tensile testing of 3 sample splices for each lot of heads.

A production lot of headed bar reinforcing steel is defined as no more than 150 splices of the same bar size, with heads of the same size and type, and manufactured by the same method, produced from bar material of a single heat number and head material of a single heat number. For bars having heads on both ends, the bar will be counted as 2 reinforcing steel bars for the purposes of establishing and testing production lots.

Test each sample according to ASTM A970.

All splices in the lot represented by a test will be considered to meet the tensile strength requirements when the minimum individual tensile strength of the sampled splices meets the tensile strength requirements of ASTM A970.

503-3.07 DRILLING AND BONDING DOWELS. Install dowels at locations shown on the Plans or as authorized by the Engineer. Drill holes by methods that do not shatter or damage the concrete adjacent to the holes. Do not damage reinforcing steel or prestressing steel when drilling through reinforced concrete members, unless approved by the Engineer. The Engineer will evaluate holes in which reinforcing steel or prestressing steel is encountered during drilling for structural adequacy and durability.

Drill each hole to the diameter and depth recommended by the manufacturer to develop the ultimate strength of the dowel or to the depth shown on the Plans, whichever is greater.

Prepare each hole according to the manufacturer’s instructions before placing the epoxy and the dowels. Fill the hole with epoxy and install the dowel according to the manufacturer's instructions. Completely fill drilled holes with epoxy using a method that will not trap air or create voids. Support dowels and prevent movement during curing. Do not disturb the dowels until the epoxy has cured.

Do not use dowels made from epoxy-coated reinforcing steel, except as noted on the Plans.

503-3.08 PLACEMENT TOLERANCES. When placing reinforcing steel, do not reduce the total number of bars specified. Place reinforcing steel within the following tolerances:

1. Clear Cover: +1/4 inch, -3/8 inch, but not reducing the clear cover to less than 1 inch.

2. Placement of Reinforcing Steel: ±1/2 inch.

3. Spacing of Reinforcing Steel: ± One-quarter of the specified spacing, but not to exceed 1 inch.

4. Spacing for Bundled Reinforcing Steel: 1 inch or 2 times the individual nominal bar diameter between bundles, whichever is greater.

5. Embedment Length and Length of Lap Splices: -1 inch for No. 3 through No. 11 bars, -2 inches for No. 14 and No. 18 (embedment only).

6. Location of Bends in Bars and Ends of Bars: ±2 inch.

503-4.01 METHOD OF MEASUREMENT. Section 109 and the following:

Drill and Bond Dowels. Measured per dowel, complete in place.

503-5.01 BASIS OF PAYMENT.

Reinforcing Steel. Reinforcing steel will be paid for at the Contract lump sum price. The lump sum price is full compensation for furnishing, fabricating, placing, splicing, heading, inspecting and testing reinforcing steel as indicated in the Contract documents. Increase in weight of reinforcing due to splices, heads, and additional support bars will not be paid for.

Payment for reinforcing steel used in precast concrete members is included in the Contract price for the precast members, as provided in Section 501.

Drill and Bond Dowels. Payment for Drill and Bond Dowels includes materials and work for installing dowels.

Payment for reinforcing steel used in minor structures is subsidiary.

Payment will be made under:

Pay Item	Pay Unit
503(1) Reinforcing Steel	Lump Sum
503(2) Epoxy-Coated Reinforcing Steel	Lump Sum
503(3) Drill and Bond Dowels	Each

Delete Section 504 Steel Structures and replace with the following:

SECTION 504
STEEL STRUCTURES

504-1.01 DESCRIPTION. Construct steel structures and the structural metal portions of composite structures according to the Plans.

Furnish, fabricate, erect, and coat structural metals shown on the Plans, including structural steel of all grades, bolts and fasteners, stud shear connectors, welding, special and alloy steels, metallic electrodes, steel forgings and castings, and iron castings. Furnish, fabricate, and install incidental metal construction and elastomeric material not otherwise provided for, according to the Contract.

504-2.01 MATERIALS. Use materials that conform to the following:

Paint	Subsection 708-2.01
Structural Steel	Section 716
Arc Welding Electrodes	Section 716
Fasteners	Section 716
Steel Grid Floors	Section 716
Steel Pipe	Section 716
Galvanizing	Section 716
Steel Forgings	Section 718
Steel Pins & Rollers	Section 718
Castings	Section 719

With written approval, substitute a grade of steel, for that specified, for a particular application where it is desired. Substituted steel must be equal or superior in both physical and chemical properties.

CONSTRUCTION REQUIREMENTS

504-3.01 FABRICATION.

1. Shop Inspection. Furnish 30 days notice of when work will begin at the fabrication shop to allow for an inspection.

   Furnish 4 signed copies of mill reports covering all steel used on the project.

2. General. Fabricate steel bridge members, except for rolled shapes, at a plant certified under the American Institute of Steel Construction (AISC) Certification Program for Steel Bridge Fabricators at the “Advanced Bridge” level with a Fracture Critical Endorsement.

   Protect structural steel from corrosion, dirt, grease, or other foreign matter. Store structural steel at least 12 inches above the ground.

   Ensure that rolled material is straight before being laid off or worked. If straightening is necessary, use methods that will not injure the metal. Do not use material with sharp kinks or bends.

   Steel or wrought iron may be flame cut provided a mechanical guide is used to secure a smooth surface. Flame cut by hand only where approved, and smooth the surface by planing,

chipping, or grinding. Manipulate the cutting flame to avoid cutting beyond the prescribed lines. Fillet re-entrant cuts to a radius of at least 3/4 inch.

Ensure that finished members are true to line and free from twists, bends, and open joints.

Plane sheared edges of plates more than 5/8 inch thick and carrying calculated stresses to a depth of 1/4 inch deep. Fillet re-entrant cuts before cutting.

Make sure the surface finish of bearing and base plates and other bearing surfaces that will contact each other or concrete meets the surface roughness requirements as defined in ANSI/ASME B-46.1, surface roughness, waviness and lay, Part I:

Steel slabs	ANSI 2,000
Milled ends of compression members, stiffeners, and fillers	ANSI 500
Slide bearings	ANSI 125

Face and bring to an even bearing abutting joints in compression members and girder flanges, and in tension members where specified on the drawings. Where joints are not faced, keep the opening at 1/4 inch or less.

Build floor beams, stringers, and girders with end construction angles to the exact length shown on the Plans, as measured between the heels of the connection angles. The permissible tolerance is plus 0 inch to minus 1/16 inch. Where continuity is required, face end connections.

Cold bend load-carrying rolled-steel plates as follows:

Take the rolled-steel plates from the stock plates so that the bend line is at right angles to the direction of rolling.

Bend until the radius of the bends, measured to the concave face of the metal, is not less, and preferably more, than shown in the following table, where T is the thickness of the plate.

Angle Through Which Plate is Bent	Minimum Radius
61-90 degrees	1.0 T
91-120 degrees	1.5 T
121-150 degrees	2.0 T

If a shorter radius is essential, bend the plates when hot, but not shorter than a radius of 1.0 T.

Before bending, round the edges of the plate to a radius of 1/16 inch throughout the portion of the plate to be bent.

Fit up and attach end and intermediate stiffeners as shown on the Plans. Do not weld ends of stiffeners and other attachments to flanges unless shown on the Plans. Submit shop drawings in one complete submittal package. Partial or incomplete submittals will not be reviewed or considered. Partial or incomplete submittals will be rejected. No additional contract time will be permitted due to partial, incomplete, or inadequate submittals.

3. Shop Splices. In addition to those shown on the Plans, girder webs and flanges may contain a maximum of 2 shop splices per plate per span. Indicate all splices on the shop drawings. These splices are subject to approval and are subject to the following limitations:

   Make splices complete penetration butt welds. Grind flange splices flush. Grind web splices flush on the outside face of exterior girders only. Grind parallel to the longitudinal axis of the girder.

   Do not place a bottom flange splice within the middle third of any span. Use tension flange splices only as shown on the Plans or as approved.

   Completely weld each element of a girder, such as flange or web, before attaching it to another element.

   Make all splices at least 6 inches from the nearest stiffener plate. Offset web and flange splices at least 6 inches.

4. Bolt Holes. Either drill or punch bolt holes. Make finished bolt holes 1/16 inch larger than the nominal diameter of the bolt. Ensure holes are clean cut and without burrs or ragged edges. Material with poorly matched holes will be rejected.

   When material forming parts of a member is composed of not more than 5 thicknesses of metal, and whenever the thickness of the metal is not greater than 3/4 inch for structural carbon steel or 5/8 inch for alloy steel, either punch or drill the holes to full size.

   When there are more than 5 thicknesses or when any of the main material is thicker than 3/4 inch in carbon steel, or 5/8 inch in alloy steel, or when required under paragraph 7 below, subpunch or subdrill the holes 3/16 inch smaller. After assembling, ream them to size or drill them from the solid to full size.

   For punched holes, the diameter of the die must not exceed the diameter of the punch by more than 1/16 inch. Ream any holes that must be enlarged to admit bolts.

   Ream holes cylindrical and perpendicular to the member. Direct reamers mechanically, where practicable.

   Ream and drill using twist drills. Assemble connecting parts requiring reamed or drilled holes and securely hold them while reaming or drilling them. Match mark them before disassembling.

   Subpunch (or subdrill if required) holes for field connections and field splices of arch members, continuous beams, towers (each face), bents, plate girders, and rigid frames while assembled in the shop. Obtain approval of the assembly, including camber, alignment, and accuracy of holes and milled joints before beginning reaming.

   Subpunch and ream holes for floor beam and stringer field end connections to a steel template, or ream them while assembled. When partial assembly is permitted ream holes for web member connections with steel templates.

   When using templates to ream field connections of web members of an arch, bent or tower, mill or scribe at least one end of each web member normal to the long axis of the member. Accurately set the templates at both ends from this milled or scribed end.

   Ream or drill the full size of the field connection through templates after carefully locating the templates as to position and angle and firmly bolting them. Use exact duplicate templates used to ream matching members or the opposite faces of one member. Accurately locate

templates for connections that duplicate so that like members are duplicates and require no matchmarking.

Accurately punch holes full-size, subpunch them, or subdrill them so that after assembling (before reaming), a cylindrical pin 1/8 inch smaller in diameter than the nominal size of the punched hole may be entered perpendicular to the face of the member, without drifting, in at least 75% of the contiguous holes in the same plane. If the requirement is not fulfilled, the badly punched pieces will be rejected. If any hole will not pass a pin 3/16 inch smaller in diameter than the nominal size of the punched hole, the material will be rejected.

Ream or drill holes so that 85% of the holes in any contiguous group after being reamed or drilled show no offset greater than 1/32 inch between adjacent thicknesses of metal.

Provide in steel templates hardened steel bushings in holes accurately dimensioned from the center lines of the connection as inscribed on the template. Use the center lines to locate accurately the template from the milled or scribed ends of the members.

5. Shop Assembling. Completely shop assemble the entire structure, including the floor system. When the Contract Documents indicate "partial assembly," assemble continuous beams and plate girders in lengths of 3 or more abutting panels. The assembled length must be at least 150 feet.

   Clean metal surfaces in contact before assembling them. Assemble, pin well, and firmly draw together the parts of a member with bolts before beginning reaming. Make milled ends of compression members in full bearing before starting reaming. Take apart assembled pieces, if necessary, to remove burrs and shavings produced by reaming. Keep the members free of twists, bends, and other deformities.

   To prepare to shop bolt material punched full-size, spear-ream the bolt holes, if necessary, to admit the bolts. Make the reamed holes no more than 1/16 inch larger than the nominal diameter of the bolts.

   Secure end connection angles, stiffeners, and similar parts using shipping bolts to prevent damage in shipment and handling.

   Furnish a camber diagram showing the camber at each panel for each truss. Take the camber from actual measurement while the truss is assembled, or base it on calculated values when full assembly is not required.

   Allow holes to drift during assembly only as needed to position the parts, and not enough to enlarge the holes or distort the metal. To enlarge holes to admit the bolts, ream them.

   Match mark connecting parts assembled in the shop to allow for reaming holes in field connections. Furnish a diagram showing the marks.

6. Bolted Connections, High-Strength Bolts. Determine bolt lengths by adding the values given in Table 504-1 to the total thickness of connected material. These values compensate for thickness of nut, bolt point, and washers. Add 5/32 inch to the grip length per each additional flat washer. Adjust the total length to the next longer 1/4 inch increment up to a 5 inch length and to the next longer 1/2 inch increment for lengths over 5 inches.

   Fit bolted parts solidly together when assembling them and do not separate them by gaskets or other interposed compressible material. Place hardened washers under the turned element.

TABLE 504-1
BOLT LENGTH DETERMINATION

Bolt Diameter (inches)	Added Length (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

Keep assembled joint surfaces, including those adjacent to washers, free of scale except tight mill scale. Clean off dirt, loose rust, burrs, and other defects that would prevent the parts from seating. Keep contact surfaces free of oil, paint, or lacquer.

When the outer face of the bolted parts has a slope of more than 1:20, use a smooth beveled washer in contact with the sloped surface.

Tighten fasteners to give at least the required minimum tension values shown in Table 504-2 when the joint is completed. Use bolts and nuts made by the same manufacturer in a connection.

TABLE 504-2
REQUIRED BOLT TENSION

Bolt Size (inches)	Required Minimum Tension (pounds)
3/4	28,400
7/8	39,250
1	51,500

Use zinc coated load indicating washers. Demonstrate the suitability of the device by testing a representative sample of at least three devices for each diameter and grade of fastener used in the structure. Test with a calibration device capable of indicating bolt tension. Include in the test assembly flat, hardened washers, if required in the actual connection, arranged as those in the actual connection to be tensioned. Demonstrate with the calibration test that the device indicates a tension at least 5% greater than that required by Table 504-2. Follow manufacturer's installation procedures when installing bolts in the calibration device and in all connections. Be careful to properly install flat, hardened washers when using load indicating devices with bolts installed in oversized or slotted holes and when using the load indicating devices under the turned element. The load indicating device will count as one washer for the purpose of determining bolt length.

Place the load indicating device under the bolt head and turn only the nut when tightening the bolt. The device must indicate full tensioning of the bolt when the opening reaches zero.

Install bolts in all holes of the connection and bring them to a snug tight condition. Then, tighten fasteners, progressing systematically from the most rigid part (usually near the center) of the connection to the free edges, or as directed. Keep previously tightened fasteners from relaxing. Multiple systematic tightening cycles may be required.

Do not reuse high-strength bolts. Remove previously fully tightened bolts that were loosened by tightening adjacent bolts. Replace them with new bolts, nuts, and load indicating devices.

7. Welding. Perform all welding and Nondestructive Examination (NDE) as specified or shown on the Plans. Conform to ANSI/AASHTO/AWS *Bridge Welding Code* D1.5 when welding new steel bridge girders, beams, and stringers. Conform to the *Structural Welding Code* AWS D1.1 when welding all other steel structures.

   At least 30 days prior to welding, submit for approval a welding plan stamped and signed by a Certified Welding Inspector (CWI) responsible for the Quality Control (QC) and consisting of the following documents:

   a. Quality control personnel qualifications including CWI number
   b. Welding Procedure Specifications (WPS) using forms in AWS D1.1, Sample Welding Forms
   c. Procedure Qualification Records (PQR) when applicable, using forms in AWS D1.1, Sample Welding Forms
   d. Welder Performance Qualification Records (WPQR) using forms in AWS D1.1, Sample Welding Forms with documentation of current welder certification
   e. Type and extent of NDE to be conducted, as required in the specifications

   Using a CWI, perform all quality control inspection necessary to ensure the materials and workmanship meet the requirements of the contract documents.

   Correct all deficiencies in materials and workmanship revealed by Quality Control and Quality Assurance inspections without additional compensation.

   Furnish all completed quality control inspection documents.

   Do not weld or tack brackets, clips, shipping devices or other material not required by the Contract documents to the permanent structure, unless shown on the working drawings and approved by the Engineer.

504-3.02 ERECTION.

1. General. Provide the falsework and all tools, machinery, and appliances, including driftpins and fitting-up bolts, needed to perform the work efficiently. Erect the structural steel, remove the temporary construction, and do the work to complete the structure, as required by the Contract Documents. Make temporary field welds to structural steel according to the procedures required by these Specifications. Steel with sharp kinks or bends will be rejected.

2. Handling and Storing Materials. Store material on skids above the ground. Keep it clean and properly drained. Place girders and beams upright and shore them. Adequately support long members, such as columns and chords, on skids to prevent injury from deflection.

3. Falsework. Use falsework according to Section 512.

4. Erection Plan. Submit an erection plan for approval. Submit the erection plan not less than 30 days prior to erecting the structural steel. Do not erect structural steel without the written approval of the Engineer.

   The erection plan must include, but is not limited to the following:

   a. Drawings indicating geometry, member sizes, material properties, foundations capacities, design assumptions, and other relevant information required to erect the structural steel.
   b. Support and lifting reactions for each stage of the erection procedure.

c. Equipment type, size, capacity, position, work radius and other relevant information.
d. Schedule, duration of each portion of work and other timing considerations.

If multiple segments will be connected and supported or lifted as a single member, the following additional information is required:

e. Stress sheets for each state of the erection procedure.
f. Deflection diagrams including camber effects and adjustments.
g. Bolted field splice stress calculations
h. Falsework, if required, details and supporting calculations in accordance with Section 512.

The erection plan shall conform to the requirements of the most recent edition of the AASHTO *LRFD Bridge Design Specifications* and the Contract Documents. Do not exceed the permissible stresses defined in the most recent edition of the AASHTO *LRFD Bridge Design Specifications* using a construction load factor of 1.25 for essentially static loads and 1.50 for dynamically applied loads. The Engineer will make the determination which loads shall be designated as static and dynamic loads.

Do not induce buckling or other instabilities at any time during shipping, handling or erection.

Submit changes needed to accommodate the erection plan for approval. Do not submit shop drawings until the Engineer has approved the erection plan.

Submit plans and calculations for the erection plan in one complete submittal package. Partial or incomplete submittals will not be reviewed or considered. Partial or incomplete submittals will be rejected. No additional contract time will be permitted due to partial, incomplete, or inadequate submittals.

Do not deviate from the approved erection plan without the written permission of the Engineer.

5. Assembling Steel. Accurately assemble the parts as shown on the Plans and follow match-marks. Handle the material carefully to avoid bending, breaking, or otherwise damaging the parts. Do not hammer if doing so will injure or distort the members. Clean bearing surfaces and surfaces to be in permanent contact before assembling the members.

6. Attachment of Formwork. When approved, use 1-inch maximum diameter holes in steel girder webs for attaching formwork. Place holes 6 inches minimum clear distance from all horizontal or vertical welds and space them at least 4 feet center to center. Drill or subpunch and ream holes. They may be left open.

   Include in the request enough detail of the formwork for determining the stresses that will be imposed on the girder.

504-3.03 PAINTING.

1. Preparing Metal Surfaces for Painting. Prepare metal surfaces according to Specification SSPC-SP 10, Near White Blast Cleaning to a profile depth of 1 to 3 mils. Use a profile comparator to ensure minimum profile depth. Do not reuse sand or flint abrasives.

   Clean grit or shot of contamination before reusing it. Blow dust and grit from the surface with clean dry air. Remove weld spatter and round sharp edges to a smooth curve. To remove contamination, jet wash or scrub with a stiff brush and clear water or brush blast. Remove light rust with a steel brush or mechanical tool.

2. Schedule of Paint Coats for Metals. Unless otherwise specified, if structural steel will be exposed to weathering, shop-paint it at least 3 coats: prime coat, intermediate coat, and finish coat.

3. Painting Metal Surfaces.

   a. Time of Application. Apply 1 or more applications of prime coat. Apply the initial application within 4 hours after blast cleaning. Allow the manufacturer's recommended drying time between primer applications. Before painting and after preparing the surface, remove any oil, grease, soil, dust, or foreign matter on the surface. If rusting occurs after the surface is prepared, clean the surface again.

      Avoid contaminating cleaned surfaces with salts, acids, alkali, or other corrosive chemicals before applying the prime coat and between applications of the remaining coats of paint. Remove any contamination from the surface.

   b. Storage of Paint and Thinner. Store paint and thinner in a separate building or in a room that is well ventilated and free from excessive heat, sparks, flame, or direct sun rays. Keep paints susceptible to damage from freezing in a heated storage space when necessary.

      Leave paint containers unopened until required for use. Use open containers first. Seal left-over, partial containers.

      Do not use paint that has begun to polymerize, solidify, gel, or deteriorate.

   c. Mixing and Thinning. Mix paint thoroughly before use and agitate often during application.

      Do not transfer paint mixed in the original container until all settled pigment is incorporated into the vehicle. Pouring off part of the vehicle temporarily to simplify mixing, is permitted.

      Mix by mechanical methods, except use hand mixing for containers up to 5 gallons.

      Do not use an air stream bubbling under the paint surface to mix paint or keep it in suspension. Remove and discard any skin that has formed in the container. Do not use the paint if the skin exceeds 2% of the paint volume.

      When mixing paint, break up all lumps, completely disperse settled pigment, and create a uniform composition. If mixing by hand, pour off most of the vehicle into a clean container.

      Lift the pigment in the paint from the bottom of the container using a broad, flat paddle. Break up lumps and thoroughly mix the pigment with the vehicle. Return the poured-off vehicle to the paint by simultaneously stirring or pouring repeatedly from one container to another until the composition is uniform. Inspect the bottom of the container for unmixed pigment.

      Wet tinting pastes or colors with a small amount of thinner, vehicle, or paint and thoroughly mix them. Add the thinned mixture to the large container of paint and mix until the color is uniform.

      If paint does not have a limited pot life, or does not deteriorate on standing, mix it at any time before use. However, if it has settled, remix it immediately before use. Do not keep

paint in spray pots, painters' buckets, etc., overnight. Gather it into a container and remix it before use.

When the engineer deems it necessary to obtain satisfactory application, add paint thinner according to the manufacturer's instructions.

d. Application of Paint. Use the oldest of each kind of paint first. Apply paint by spraying. Use brushes, daubers, or sheepskins when no other method can properly apply paint in difficult access areas. Use dipping, roller coating, or flow coating only when authorized.

Blast clean all areas with mudcracking in the zinc-rich primer and then paint them with primer to the specified thickness.

After applying the prime coat, apply the intermediate and finish coats to exposed surfaces according to the manufacturer's recommendations.

Apply the intermediate coat in 2 applications. Apply the first application as a mist coat. Apply the second application after the mist coat has dried to a set-to-touch condition.

Apply the finish coat in 1 application.

Apply paint within the environmental limitations specified by the coating manufacturer. Do not apply paint when the temperature of the steel surface is less than 40 °F or more than 125 °F.

Do not apply paint in fog or mist, when it is raining or snowing, or when the relative humidity exceeds the manufacturer’s recommendations. Do not apply paint to wet or damp surfaces. Do not apply paint on frosted or ice-coated surfaces.

With approval, apply paint in damp or cold weather, and only under the following conditions. Paint the steel under cover and protect and shelter it, or heat the surrounding air and the steel to a satisfactory temperature. Meet the above temperature and humidity conditions. Keep the steel under cover or protected until it is dry or until weather conditions permit its exposure.

Allow to dry any applied paint exposed to freezing, excess humidity, rain, snow, or condensation. Then, remove damaged areas of paint, prepare the surface again, and repaint it with the same kind as the undamaged areas.

Stripe paint before applying each coat of paint. Spot paint edges, corners, crevices, rivets, bolts, welds, and sharp edges before applying the full coat of paint on the steel. Extend striping for at least 1 inch from the edge. Let this stripe coat dry before applying the full coat, if possible. Otherwise, set-to-touch the stripe coat before applying the full coat. However, do not permit the stripe coat to dry long enough to allow the unprimed steel to rust.

Apply each coat of paint as a continuous film of uniform thickness, free of pores. Repaint any thin spots or areas missed in the application. Allow them to dry before applying the next coat.

Wait until each coat of paint is in the proper state of cure or dryness before applying the next coat.

Ensure a minimum dry film thickness of 3 mils and a maximum dry film thickness of 5 mils for each coat of paint. The dry film thickness of the paint will be measured in place

with a calibrated magnetic film thickness gauge. If any coat of paint is thinner than specified, obtain the minimum dry film thickness by applying additional coats of paint.

A Tooke gauge may be used to perform destructive testing of each coat's dry film thickness. Repair damaged areas.

e. Brush Application. Brush paint areas inaccessible to a spray gun. Work paint into crevices and corners. Paint surfaces not accessible to brushes using daubers or sheepskins. Brush out runs or sags. Leave a minimum of brush marks in the applied paint.

f. Spray Application of Paint. To apply paint by spraying, use equipment capable of properly atomizing the paint to be applied. Use equipment with pressure regulators and gauges and use air caps, nozzles, and needles recommended by the equipment manufacturer for the material being sprayed. Keep the equipment in satisfactory condition to permit proper paint application. In closed or recirculating paint spray systems, where gas is used under pressure over the liquid, use an inert gas, such as nitrogen.

Provide adequately sized traps or separators to remove oil and water from the compressed air. Drain them periodically during operations. Ensure that the air from the spray gun impinging against the surface shows no water or oil.

Keep paint ingredients properly mixed in the spray pots or containers while applying the paint. Use either continuous mechanical agitation or frequent intermittent agitation.

Adjust the pressure on the material in the pot and adjust the air pressure at the gun for optimum spraying effectiveness. Adjust the pressure on the material in the pot when changing the elevation of the gun above the pot. Keep the atomizing air pressure at the gun high enough to atomize the paint properly but not so high as to cause the paint to fog or the solvent to evaporate, or to cause loss by overspray.

Keep spray equipment clean to avoid depositing dirt, dried paint, and other foreign materials in the paint film. Remove any solvents left in the equipment before applying paint to the surface.

Apply paint in a uniform layer, overlapping at the edge of the spray pattern. During application, hold the gun perpendicular to the surface and at a distance that will deposit a wet layer of paint on the surface. Release the gun's trigger at the end of each stroke.

Apply coats free of runs, sags, and dry spray.

g. Shop Painting. Perform shop painting after fabrication and before the surface is damaged from weather or other exposure.

Do not paint shop contact surfaces. Paint surfaces to be in contact after field erection.

Apply only a mist coat (0.5 to 0.8 mil dry film thickness) of inorganic zinc-rich primer, meeting SSPC Paint Specification No. 30, Weld-Through Inorganic Zinc Primer, Class 5, on the following surfaces:

1. High strength bolted connection contact surfaces
2. Top flange steel surfaces
3. Areas within 2 inches from the edges to be welded
4. Areas where the full 3 coats of paint will interfere with field assembly

Apply the full paint coats specified to steel surfaces that will contact wood.

Remove anti-weld spatter coatings before painting.

Before abrasive blasting, grind smooth all metal defects, fins, slivers, burrs, weld spatter, and sharp edges from shearing or similar operations, including flame hardened edges from cutting or burning. Grind flame hardened edges to a 1/16 inch minimum radius. Repair defects that become evident after abrasive blasting or prime coat application. Retexture the surface to match the blasted profile.

Copy erection marks and weight marks on areas that have been previously painted with the shop coat.

h. Field Painting. If steel surfaces have not received the full paint coats, paint them as soon as possible after erection.

Touch up metal that has been shop coated with the same type of paint as the shop coat. Touch up by cleaning and painting field connections, welds, bolts and all damaged or defective paint and rusted areas.

If concreting or other operations damage any paint, clean the surface and repaint it. Remove concrete spatter and drippings before applying paint.

Protect wet paint against damage from dust or other detrimental foreign matter.

i. Drying of Painted Metal. Allow the paint to dry before recoating or exposing it. Do not add a dryer to paint on the job unless the paint specification calls for one. Do not immerse painted metal until the paint has dried. Protect paint from rain, condensation, contamination, snow, and freezing until dry.

j. Handling of Painted Steel. Do not handle painted steel until the paint has dried except for turning it for painting or stacking it for drying. Minimize damage to paint films from stacking steel members.

Remove paint that is damaged during handling and touch it up with the same number of coats and kinds of paint previously applied.

Wait until painted steel is dry before loading it for shipment.

Repair damaged galvanized coating per ASTM A 780-01. Use organic zinc rich primer meeting Subsection 708-2.01.

k. System Durability and Certification. Have the coating manufacturer review the project and the proposed service environment and issue you written recommendations and instructions to properly prepare the surface, apply the coating, and achieve maximum durability on this project.

Certify to the Department that the system was applied according to the manufacturer's recommendations and instructions. Enclose a copy of the recommendations and instructions with the certificate.

504-3.04 CLEANUP. Upon completion and before final acceptance of the structure, remove falsework and falsework piling down to 2 feet below the finished ground line.

504-4.01 METHOD OF MEASUREMENT. Section 109 and as follows:

Structural steel measured by weight, will include castings, forgings, alloy steels, steel plates, high-strength bolts and nuts, anchor bolts and nuts, stud shear connectors, shoes, rockers, rollers, pins and nuts, expansion dams, roadway drains and scuppers, weld metal, and structural shapes for expansion joints and pier protection.

The weight of the metal in the completed structure will be computed, based on the following:

1. Unit Weights, pounds per cubic foot:

Aluminum, cast or rolled	173
Bronze or copper alloy	536
Copper sheet	558
Iron, cast	445
Iron, malleable	470
Lead, sheet	707
Steel, cast or rolled, including alloy, copper bearing, and stainless	490
Zinc	450

2. Shapes, Plates, Railing and Flooring. By their nominal weights and dimensions as shown on the contract drawings, deducting for copes, cuts and open holes, exclusive of bolt holes. The weights of plates more than 36 inches wide will include an estimated overrun computed as one-half the "permissible variation in thickness and weight" as tabulated in ASTM A 6.

   The weight of railing will be included as structural steel unless the bid schedule contains a pay item for bridge railing under Section 507.

   The weight of steel grid flooring will be computed separately.

3. Castings. From the dimensions shown on the Plans, deducting for open holes. To this weight will be added 5% for fillets and overruns. Scale weights may be used for castings of small complex parts, since it would be difficult to compute their weight accurately.

4. Welds. From the following for shop and fillet welds:

Size of weld (inches)	Pounds per linear foot
1/4	0.20
5/16	0.25
3/8	0.35
1/2	0.55
5/8	0.80
3/4	1.10
7/8	1.50
1	2.00

   The weight of other welds will be computed on the basis of the theoretical volume from dimensions of the welds, adding 50% to the weight to allow for overrun.

5. High-Strength Bolts. From the following for bolt heads and nuts for high-strength bolts:

Bolt Diameter (inches)	Pounds per 100 Heads or Nuts
5/8	15

3/4	25
7/8	37
1	50
1-1/8	75

6. Excluded Items. The weight of the following will not be measured: erection bolts, shop and field paint, galvanizing; boxes, crates, and other containers used for shipping; together with sills, struts, and rods used for supporting members during transportation; and bridge hardware connectors used for joining timber members.

504-5.01 BASIS OF PAYMENT. If no pay item is included in the bid schedule for structural steel, the quantities of metal drains, scuppers, conduits, ducts and structural shapes for expansion joints and pier protection measured as provided above, will be paid for as reinforcing steel under Section 503.

No additional payment will be made for increases in structural steel quantities due to your erection method.

Structural steel for precast or prestressed concrete bridges is subsidiary.

Payment will be made under:

Pay Item	Pay Unit
504(1) Structural Steel	Lump Sum
504(2) Structural Steel	Pound

STATEWIDE SPECIAL PROVISION **01/01/16**
SSP-18

Delete Section 507 Bridge Railing and replace with Section 507 Bridge Barriers and Railing:

SECTION 507
BRIDGE BARRIERS AND RAILING

507-1.01 DESCRIPTION. Construct concrete, timber, or steel bridge railing, pedestrian railing and safety railing as shown on the Plans. Furnish and install bridge number plates as shown on the Plans.

507-2.01 MATERIALS. Use materials that conform to the following:

Steel Railing	Section 722
Timber Railing	Section 506
Concrete	Section 501
Epoxy-Coated Reinforcing Bars	Subsection 709-2.01
Grout	Section 701
Cable	Use ¼ inch galvanized wire rope with a minimum breaking force of 7,000 pounds.
Bronze	ASTM B98, UNS Alloys C65100 or C65500 or ASTM B584, UNS Alloy C92200

CONSTRUCTION REQUIREMENTS

507-3.01 CONSTRUCTION REQUIREMENTS.

1. General. Construct railing to the line and grade shown on the Plans. Ensure that the rail does not reflect any unevenness of the bridge structure. Set rail posts plumb. Place railing after all falsework is removed and the span is self-supporting. Do not paint bridge railing.

   Furnish and install concrete curbing, associated reinforcing steel, and the approach rail transition bracket for steel bridge railing.

2. Steel. Erect steel railing in conformance with Section 504, except do not use load indicating washers. Weld in conformance with Section 504. Complete welding before galvanizing the railing.

3. Timber. Fabricate and install timber railing according to Section 506.

4. Concrete. Construct concrete barriers to meet applicable requirements of Sections 501 and 503. Use Class A concrete with a specified compressive strength of 4000 psi. Apply a rubbed finish to exposed surfaces of concrete.

507-4.01 METHOD OF MEASUREMENT. Section 109.

507-5.01 BASIS OF PAYMENT. The contract price includes all rail elements, rail posts, brackets, spacers, fastenings and anchors required to attach the railing to the structure; concrete and associated reinforcing steel included or partially contained within the limits of the concrete rail section or within the limits of the concrete curb for the steel bridge rail section; and bridge number plates.

Payment will be made under:

Pay Item	Pay Unit
507(1) Steel Bridge Railing	Linear Foot
507(2) Pedestrian Railing	Linear Foot
507(3) Thrie Beam Bridge Railing	Linear Foot
507(4) Concrete Barrier	Linear Foot
507(5) Timber Bridge Railing	Linear Foot
507(6) Cable Safety Railing	Linear Foot

Delete Section 512 Forms and Falsework and replace with the following:

SECTION 512
FORMS AND FALSEWORK

512-1.01 DESCRIPTION. Design, construct, maintain and remove forms and falsework used to form or temporarily support structural concrete until the structure is self supporting.

512-1.02 DEFINITIONS.

COMPRESSIVE STRENGTH. See definitions in Subsection 501-1.02.

FALSEWORK. A temporary structure erected to support the permanent structure, in the process of construction, until the permanent structure attains adequate strength to become self-supporting and capable of supporting other imposed loads.

FORMS. Also known as formwork, are a temporary structure or mold used to retain the plastic concrete in its designated shape while the concrete is curing and gaining sufficient strength to maintain its designated shape.

HAUNCH. A thickened portion of a concrete deck filling the space between the top of the girder and the bottom of the roadway slab.

INFORMATIONAL FIELD TEST. See definitions in Section 501-1.02.

512-2.01 MATERIALS. As specified or approved.

DESIGN AND CONSTRUCTION REQUIREMENTS

512-3.01 SUBMITTALS.

1. Falsework Plan. When complete details for falsework are not shown on the Plans, prepare and submit a falsework plan, prepared and sealed by a Professional Engineer registered in the State of Alaska. When the structure is not open to traffic and is not over or adjacent to railroads or roadways, a falsework plan and independent design check are not required.

   Include detailed working drawings, material specifications, and supporting calculations to allow for complete review of the falsework plan. For manufactured or proprietary falsework components, include the manufacturer's information, technical bulletins, design data, and other necessary information used in the calculations.

   Include an independent design check to verify that the design satisfies the Contract requirements. Perform the independent design check by a Professional Engineer registered in the State of Alaska. Independent means the Professional Engineer performing the independent design check is not associated as a subordinate, subsidiary, employee, or member of the business employing the Professional Engineer sealing the falsework design.

   Submit an independent design check letter, sealed by the Professional Engineer performing the independent design check, certifying the falsework plan meets the Contract requirements of this Section. Include the independent design check letter with the falsework plan submittal.

2. Falsework Inspection Verification. Prior to placing reinforcing steel or other loads, perform a falsework inspection by the Professional Engineer sealing the falsework design. Do not place

reinforcing steel until a written verification, signed by the Professional Engineer sealing the falsework design, stating that the falsework meets the design and construction requirements is provided to the Engineer.

3. Concrete Deck Haunch Dimensions. Prior to placing falsework, submit the girder elevations, required haunch dimensions, and supporting calculations for review. Ensure the haunch dimensions meet the requirements of Subsection 512-3.05.

512-3.02 FALSEWORK DESIGN. Design falsework according to the AASHTO Guide Design Specifications for Bridge Temporary Works and these specifications. When the structure is supported by falsework and is open to traffic, also design the falsework for highway loads according to the AASHTO Standard Specifications for Highway Bridges.

1. Falsework Foundations. Where spread footing type foundations are used, determine the bearing capacity of the soil and include the bearing capacity on the plans.

   Design and construct pile type foundation according to this specification and Section 505.

2. Falsework Over Or Adjacent to Roadways. Provide a minimum vertical clearance of 17.5 feet through falsework, unless otherwise shown on the Plans. Install advance warning devices and vertical clearance signs at falsework openings according to the Alaska Traffic Manual. When the vertical clearance is less than 18.5 feet, post a W12-2 low clearance sign with a vertical clearance as 3 inches less than the minimum clearance.

3. Falsework Over Or Adjacent to Railroads. Meet the clearance requirements of the American Railway Engineering and Maintenance-of-Way Association Manual for Railway Engineering.

512-3.03 FALSEWORK CONSTRUCTION. Construct falsework to conform to the approved falsework plan. Do not begin falsework construction without an approved falsework plan. Do not modify or alter the structure to accommodate falsework unless otherwise noted or authorized by the Engineer.

When welding falsework, meet the welding requirements of Section 504.

Build camber into the falsework to compensate for falsework deflection and anticipated structure deflection. Camber shown on the Plans or specified by the Engineer is for anticipated structure deflection only.

Do not use driven devices to attach falsework to concrete. Do not modify or alter the structure to attach falsework unless otherwise noted or authorized by the Engineer.

512-3.04 FORMS. For surfaces that are exposed in the completed work, use plywood forms meeting the requirements of the American Plywood Association (APA) grade High Density Overlaid (HDO) Plyform Class I or other approved material that will produce an equivalent smooth and uniform concrete surface. For other surfaces, use plywood forms meeting the requirements of the American Plywood Association (APA) grade B-B Plyform Class I. Use only form panels in good condition free of defects on surfaces in contact with concrete.

Furnish and place form panels for exposed surfaces in uniform widths of not less than 3 feet and in uniform lengths of not less than 6 feet except where the width of the member formed is less than 3 feet.

Arrange form panels in symmetrical patterns conforming to the general lines of the structure. Place panels for vertical surfaces with the long dimension horizontal and with horizontal joints level and continuous. For walls with sloping footings that do not abut other walls, placement of panels with the long dimension parallel to the footing is permitted.

Follow the manufacturer's written recommendations when using form liners.

Increase the thickness of concrete members that receive an architectural finish to maintain the specified cover to reinforcing steel.

Bevel exposed corners and edges with 3/4 inch chamfers built into the forms.

Do not modify or alter the structure to attach forms unless otherwise noted or authorized by the Engineer. Form ties, anchors, and other devices may be cast into the concrete for supporting forms or for lifting precast members. Ensure form ties and anchors can be removed without damaging the concrete surface. Do not use driven devices to attach forms to concrete. Do not use anchors coated with materials that will stain the concrete for supporting forms. Construct metal ties or anchorages within the forms to permit their removal to a depth of at least 1 inch from the concrete surface without damage to the concrete.

Construct concrete forms mortar-tight. Clean the inside surfaces of forms free of contaminants that affect the concrete finish. When forms are supported by existing concrete, ensure the forms fit tightly against the existing concrete and mortar will not pass through the joint.

Forms may be omitted when the sides of a footing excavation is in rock. If the excavation is larger than the plan dimensions, any additional concrete placed will be at the Contractor's expense.

Coat forms to be removed with form release agent prior to use. Use a commercial quality product, designed specifically to release forms, and that will not discolor the concrete surfaces.

512-3.05 FORMS AND FALSEWORK FOR CONCRETE DECKS. Use forms and falsework that span between adjacent girders without altering or damaging the supporting girders. Hangers may be cast into the concrete for supporting deck falsework. Do not use driven devices to attach forms or falsework to concrete. Do not use materials that will stain the concrete to support the falsework. Construct hangers to permit their removal to a depth of at least 1 inch from the concrete surface without damage to the concrete.

Adjust the falsework haunch dimensions to accommodate the camber and elevation of the installed girders. Measure the installed girder elevations along the centerline of the girders at locations shown on the Plans after erection but before installing falsework, forms, reinforcing steel, or applying other loads. Determine the required haunch dimensions accounting for the variations in the girder elevations and anticipated deflection due to additional dead loads.

Prestressed concrete girder elevations shown on the Plans are based on estimated girder deflections at 40 and 120 days after release of the prestressing strands. The girder elevations shown in the Plans are intended to advise the Contractor as to the expected range of girder deflection at the time of deck forming.

Construct falsework supporting concrete work on steel structures so that loads applied to girder webs are applied within 6 inch of the flange or stiffener. Construct Falsework to distribute loads so that local distortion of the web is not produced.

1. Forms. Do not use permanent forms including metal, wood, or precast concrete for concrete deck construction, unless otherwise noted. Provide concrete deck forms meeting the following requirements:

    a. Maintain the deck thickness despite irregularities in and between the girders.
    b. Accommodate haunch variation along the length and between the girders.

2. Haunches. Limit haunch dimensions to meet the following requirements:

a. 1/2 inch maximum embedment of the top flange into the deck measured at the edge of the flange.
b. 2-1/2 inch minimum clearance between the top of deck and shear stud or shear stirrup.
c. 2 inch minimum penetration of shear stud or shear stirrup into the deck.
d. 4 inch maximum haunch measured at the centerline of the girder.

512-3.06 REMOVAL OF FORMS AND FALSEWORK. Remove forms and falsework without damaging the concrete member.

Forms may be removed after the concrete has cured for at least 24 hours, will not be damaged, and has a compressive strength of at least 1400 psi as determined from informational field test cylinders cured on the site under temperature and moisture conditions similar to the concrete in the structure. Protect exposed concrete surfaces from damage. Maintain curing operations according to Section 501 if forms are removed before curing operations may be terminated.

Completely remove forms, including the roadway deck forms, from cells of box girders which have permanent access. Unless otherwise shown in the Plans, the roadway slab interior forms in cells where no permanent access is available may be left in place.

Falsework may be removed after the concrete has a compressive strength, determined from informational field test cylinders cured on the site under temperature and moisture conditions similar to the concrete in the structure, as specified in Table 512-1. If informational field test cylinders are not available, meet the minimum number of curing days specified in Table 512-1.

Do not release falsework for cast-in-place prestressed portions of structures until the prestressing steel has been tensioned.

TABLE 512-1
FALSEWORK RELEASE CRITERIA

Structural Element	Percent of Specified 28-Day Strength (f'_c), min.	Curing Days, min.[1]
(a) Concrete decks	70	10
(b) Simple span girders, slab bridges, cross beams, pier caps, struts, and top slabs of concrete box culverts	80	14
(c) Box girders	90	21
(d) Continuous span girders	90	21
(e) Other elements	80	14

[1] *Cured according to Section 501.*

512-3.07 CLEANUP. Upon completion of the structure and before final acceptance, leave the structure and entire site in a clean and orderly condition. Remove temporary structures, equipment, unused materials, debris, forms, and falsework. Remove falsework piling at least 2 feet below the finished ground line, unless noted otherwise.

512-4.01 METHOD OF MEASUREMENT. Forms and Falsework will not be measured for payment.

512-5.01 BASIS OF PAYMENT. When either Item 512(1) Forms or 512(2) Falsework, does not appear in the bid schedule, the work required for that item is subsidiary.

Payment will be made under:

Pay Item	Pay Unit
512(1) Forms	Lump Sum
512(2) Falsework	Lump Sum

Insert New Section 515 Drilled Shafts:

SECTION 515
DRILLED SHAFTS

515-1.01 DESCRIPTION. Construct drilled shaft foundations where indicated in the plans. This work includes all labor, materials, equipment, incidentals and services necessary to perform all operations to complete drilled shaft installation.

515-1.02 QUALITY CONTROL. Provide a Quality Control Inspector to ensure that all materials, techniques and methods are suitable to meet or exceed the minimum requirements of the contract.

The Quality Control Inspector shall submit daily reports during drilled shaft installation and testing operations verifying the Contractor's compliance with requirements of the contract. Include field measurement data, procedural discrepancies, installation problems, and names of personnel, equipment usage data, and all other significant information in the daily reports.

515-1.04 QUALIFICATIONS. Experience is required for constructing drilled shafts of at least 8 feet in diameter and lengths similar to those indicated on the plans for three separate projects during the previous five years. Experience must include drilling in deep water (greater than 30 feet), drilling in soils with ground water, in soils with large boulders, and in rock.

515-1.05 GENERAL REQUIREMENTS AND SUBMITTALS. Submit the following documents for review and approval no more than one week after the Notice to Proceed:

1. Project Experience. Provide a list of 3 drilled shaft projects performed by the Drilled Shaft Contractor that involved drilling in sand, gravel, large boulders and rock similar to those conditions expected at this project location. Provide the drilled shaft plans, logs of test holes, dates of work, type of work, description of work, and amount of work performed. Provide the name and telephone number of a contact person at the agency or company for which the work was completed.

2. Personnel Experience. Provide a list of the key personnel involved in the drilled shaft construction. Include the name of the superintendent and of the superintendent's assistants who will be performing and directing the actual drilling operations. Include a resume of each superintendent and assistant involved in drilled shaft construction indicating:

    a. A minimum of five years experience in directing drilled shaft construction of which two years being in responsible charge or operating equipment proposed for this project.

    b. The number of years of recent continuous relevant experience in performing similar drilling operations and operating the contractor proposed equipment for this job.

    c. Detailed recent relevant experience (3 project minimum) including project description, date of work, actual work performed by individual, and a reference for each project including telephone number.

    d. A list of relevant equipment operated including type of equipment and amount and nature of experience.

    Only those personnel approved by the Engineer may work on the drilled shaft construction. The Engineer may suspend the drilled shaft work if the Contractor substitutes unauthorized personnel for authorized personnel during construction. If work is suspended due to

unauthorized substitution of personnel, the Contractor shall be fully liable for all additional costs resulting from the suspension of work and no adjustment in contract time will be allowed.

3. Submit the following for review and approval no less than 45 days prior to the anticipated start of drilled shaft construction:

. Drilled Shaft Installation Plan. Provide the installation plan for the drilled shaft foundations. Include the following:

a. Personnel Experience information identified in item number 1.
b. List the type, number and size of all proposed equipment, including cranes, barges, drills, augers, bailing buckets, final cleaning equipment, desanding equipment, slurry pumps, tremies, concrete pumps, casings, grout pumps, etc. Include manufacturer's recommended capacities for each piece of equipment.
c. Details and methods required for construction including temporary work structures and access roads.
d. Details of sequence of construction operations and sequence of shaft construction including dates and anticipated duration of work.
e. Details of shaft excavation methods.
f. Procedure for maintaining correct horizontal and vertical alignment during shaft installation.
g. Casing diameter and thickness required but not less than that indicated on the plans.
h. Method to advance casing.
i. Methods and equipment proposed to prevent displacement of casing and/or shafts throughout shaft construction.
j. Details for obstruction removal.
k. The casing grouting plan and procedure if required.
l. Details of proposed methods to clean shaft after initial excavation.
m. Details of shaft reinforcement, including methods to ensure centering/required cover, reinforcement cage integrity during placement, placement procedures, cage support, tie downs, etc.
n. Details of concrete placement, including proposed operational procedures for concrete tremie or pump, concrete placement rates, initial concrete placement procedure, method for raising tremie during concrete placement, and overfilling of the shaft concrete. Also provide provisions to ensure proper final shaft cutoff elevation.
o. Action plan for correcting defects in the shaft. Defects include but are not limited to the following: tilted casing, partially or completely collapsed casing, partially or completely collapsed reinforcement cage, improper concrete placement, and equipment failure.
p. Required submittals, including shop drawing, mill certification and concrete mix designs.
q. Welding Quality Control plan conforming to the requirements of AWS D1.1:2002.
r. Details for Crosshole Sonic Logging (CSL) testing procedure including testing schedule, inspector's name, inspector's qualifications, required instrumentation and power sources.
s. Safety plan to be implemented to ensure employee safety. Provide worker safety procedures around the shaft excavation and in the shaft when personnel descend for inspection.
t. Details of environmental control procedures used to prevent loss of slurry, concrete or other shaft materials into waterways or other protected areas.
u. Wastewater and concrete disposal procedures.
v. Other information shown in the Plans, requested by the Engineer or deemed necessary by the Contractor.

The Engineer will evaluate the drilled shaft installation plan for conformance with the Contract Documents and will reject any portion of the plan that is unacceptable. Partial submittals will not be accepted for approval. Within 20 days after receipt of the complete plan, the Engineer will notify the Contractor of any additional information required and/or changes that may be necessary in the opinion of the Engineer to satisfy the Contract Documents. Submit agreed

upon changes for reevaluation. The Engineer will notify the Contractor within 10 days after receipt of proposed changes of their acceptance or rejection. All approvals given by the Engineer are subject to trial and satisfactory performance in the field. Do not begin any drilled shaft work without an approved Drilled Shaft Installation Plan. Do not begin any drilled shaft work without the written approval of the Engineer.

Identify all Critical Path Schedule Items in the drilled shaft installation plan. Provide adequate lead time to obtain concrete mix design approval and permanent metal casing delivery.

4. Submit the CSL results within 5 days of testing. Provide the following:

. CSL Report. A report that contains the following:

a. The CSL logs for all tested tube pairs. Identify the CSL log for each test tube pair indicating the orientation relative to the structure.
b. The traditional signal peak diagram (time versus depth).
c. The computer first pulse arrival time verses depth.
d. The computed pulse wave speed versus depth.
e. The computed relative pulse energy or amplitude versus depth.
f. Identification of defect zones, if any, on the CSL logs. Defect zones are defined by an increase in arrival time of more than 20% relative to arrival time in a nearby zone of good concrete.

515-1.06 CERTIFICATIONS. Provide certification that all available geotechnical information provided by the Department has been reviewed and considered in the bid preparation.

515-2.01 MATERIALS. Use materials that conform to the following:

DS Concrete	Section 501
DS Grout	Subsection 701-2.07
Reinforcing Steel	Section 503
Steel for Casing	ASTM A709, Grade 50 or higher
CSL Tubes	ASTM A53

CONSTRUCTION REQUIREMENTS

515-3.01 GENERAL METHODS AND EQUIPMENT. Perform the excavations required for the shafts through all materials encountered to the dimensions and elevations shown in the Contract Documents. Use methods and equipment suitable for the intended purpose and the materials encountered. Provide equipment capable of constructing shafts to a depth equal to the deepest shaft shown in the plans plus three times the shaft diameter.

Construct drilled shafts according to the Contract Documents except when permitted otherwise by the Engineer. An alternate method of shaft construction may be proposed. Acceptance of other proposed shaft installation methods will be based upon the suitability of the method to the site conditions and the effect of the method on the structural system. Submit alternate methods of shaft construction for approval.

Maintain a construction method and soil log during shaft excavation. Submit copies of the log daily. Resolve all differences in the production logs between the Engineer and the Contractor within 24 hours of submittal to the Engineer. Provide the log to the CSL Inspector within 3 days of placing shaft concrete. Provide at least the following items in the log:

1. Description and approximate top and bottom elevation of each soil or rock material encountered

2. Location of all obstructions and time spent removing the obstruction

3. Drilling rate, down thrust, and torque

4. Seepage or groundwater

5. Remarks and comments

Barges, temporary work structures and roads may be required to install the drilled shaft foundation, piers, and bridge superstructure.

515-3.02 CONSTRUCTION METHOD. Use the permanent casing method.

Permanent Casing Method: Excavate through the casing and advance the casing until reaching the desired penetration. Over reaming the outside diameter of the casing before placing the casing may be necessary.

Casing may be placed in oversized holes and grouted in place according to Subsection 515-3.09.

Vibratory and impact hammers may be used to install casing. Casing that is driven or vibrated into place need not be grouted.

Oscillating and rotary type casing installation devices may be used with the Engineer's approval. After the concrete has cured according to Section 501, cut the casing off at the prescribed elevation and leave the remainder of the casing in place.

515-3.03 POSITION AND ALIGNMENT. When drilling from a barge, provide a fixed template, adequate to maintain shaft position and alignment during all excavation and concreting operations. Do not use floating templates (attached to a barge). A fixed template for shafts drilled on land will not be required if the Contractor demonstrates satisfactorily to the Engineer that shaft position and alignment can be properly maintained. The Engineer will require a fixed template adequate to maintain shaft position and alignment during all excavation and concreting operations for shafts drilled on land when the Contractor fails to demonstrate to the Engineer's satisfaction that he can properly maintain shaft position and alignment without use of a template.

515-3.04 EXCAVATIONS AND EQUIPMENT. All shaft excavation from the mud line to the top of bedrock, including the rubble layer, is Unclassified Shaft Excavation. All shaft excavation from the top of bedrock to the bottom of the shaft is Special Shaft Excavation. Mud line, top of bedrock and bottom of shaft elevations are shown on the Plans. The Engineer may require Drilled Shaft Sidewall Overreaming.

1. Unclassified Shaft Excavation. All processes required to excavate a drilled shaft of the dimensions shown in the Contract Documents, completed and accepted. Include in the work all shaft excavation, whether the material encountered is soil, rock, boulders, weathered rock, stone, natural or man-made obstructions, or any other materials. Special Shaft Excavation begins either when top of bedrock elevation is reached or when drilling operations using conventional equipment reach practical refusal. Practical refusal is defined as the point where the rate of hole advancement using earth augers with soil or rock teeth, drill buckets, and/or under reaming tools with the drilling equipment operating at maximum power, torque and downthrust, is less than 1 foot after 15 minutes of continuous drilling.

2. Special Shaft Excavation. All processes required to excavate a drilled shaft of the dimensions shown in the Contract Documents, completed and accepted. Include in the work all shaft excavation, whether the material encountered is soil, rock, boulders, weathered rock, stone, natural or man-made obstructions, or any other materials. Payment for excavation below the point where Special Shaft Excavation has been authorized will be for Special Shaft Excavation only and will not include payment for Unclassified Shaft Excavation.

3. Drilled Shaft Sidewall Overreaming. The excavation required to enlarge the drilled shaft diameter to accommodate the installation of the permanent metal casing. Increase the shaft radius a maximum of 6 inches by overreaming.

If the Engineer determines that the material encountered while drilling the shaft excavation is unsuitable and/or is not the same as anticipated in the design of the drilled shaft, extend the drilled shaft excavations as required by the Engineer.

Provide areas for the disposal of unsuitable materials and excess materials that are removed from shaft excavations, and dispose of them subject to permit requirements and in a manner meeting all requirements pertaining to the approved storm water pollution prevention (SWPP) plan.

Use excavation and drilling equipment having adequate capacity, power, torque, and downthrust to perform the work. Use excavation and overreaming tools of adequate design, size, and strength to perform the work. If the material encountered cannot be drilled using conventional earth augers and/or underreaming tools, provide special drilling equipment, including but not limited to rock augers, core barrels, rock tools, air tools, blasting materials, and other equipment as necessary to continue the shaft excavation to the size and depth required.

515-3.05 CASINGS. Use casings that are of ample strength to withstand handling and driving stresses and the pressure of concrete and surrounding earth materials. Casing may be thickened or reinforced to withstand applied stresses. Internally brace casing during shipping.

Use casings that are smooth and water tight. Provide a casing that is continuous along the entire length of the shaft. Casing over 100 feet in length may be delivered to the site in segment lengths of not less than 50 feet. Use complete joint penetration (CJP) welds for casing splices. Verify weld quality by performing ultrasonic testing (UT) or all casing field weld splices at your expense. Provide UT test reports to the Engineer for approval prior to advancing the casing.

Ensure that the inside diameter of casing is not less than the specified size of shaft. Oversized casing may be used with the Engineer's approval. The Department will not provide extra compensation for excess concrete required to fill an oversize casing.

If the installed casing does not satisfy the requirements of Subsection 515-3.10, submit casing repair procedure for approval.

Special casing systems may be used with the Engineer's written approval. Design special casings so that no damage occurs to the drilled shaft foundation.

515-3.06 INSPECTION OF EXCAVATIONS. Do not enter the shaft unless the casing is installed and adequate safety equipment and procedures have been provided.

Inspect the excavations for the following:

1. Dimensions and Alignment. Provide equipment for checking the dimensions and alignment of each shaft excavation. Verify the dimensions and alignment of the shaft excavation under the observation and approval of the Engineer. Check the following:

    a. Shaft excavation dimensions and alignment.
    b. Casing dimensions and alignment periodically throughout the installation process.
    c. Casing dimension and alignment in final position.

2. Depth. Reference the depth of the shaft during drilling using marks on the Kelly bar or other suitable methods. Measure final shaft depths with a suitable weighted tape or other approved methods after final cleaning.

3. Shaft Cleanliness Requirements. Clean the shaft so that at least 50 percent of the base of each shaft has less than 3/4 inch of sediment at the time of concrete placement. Ensure that the maximum depth of sedimentary deposits or other debris does not exceed 1½ inches at any location on the bottom of the excavation. The Engineer will approve shaft cleanliness based on visual inspection for dry shafts. The Engineer will approve shaft cleanliness using divers, Shaft Inspection Device (SID) or other appropriate methods for wet shafts.

4. Casing. Visually inspect casings above water. Use a SID, diver, or other methods as directed by the Engineer to examine the casings below water for defects.

515-3.07 REINFORCING STEEL CONSTRUCTION AND PLACEMENT.

1. Reinforcement Cage Construction and Placement. Tie all intersections of drilled shaft reinforcing steel with cross ties or "figure 8" ties. Use double strand ties or ties with larger tie wire when necessary. The Engineer will give final approval of the cage construction subject to satisfactory performance in the field.

   Assemble and place as a single unit the cage of reinforcing steel consisting of; longitudinal bars, ties, spirals, cage stiffener bars, CSL tubes and all other components. Place the cage immediately after the Engineer inspects and accepts the shaft excavation and immediately prior to placing concrete. The Engineer will give final approval of the placement subject to satisfactory performance in the field.

2. Splicing Reinforcement Cage. If the bottom of the constructed shaft elevation is lower than the bottom of the shaft elevation in the plans, extend a minimum of one half of the longitudinal bars required in the lower portion of the shaft the additional length. Continue the tie bars throughout the extra depth and extend the stiffener bars to the final depth. Splice the longitudinal bar extensions as required.

3. Support, Alignment, and Tolerance. Tie and support the reinforcing steel in the shaft so that the reinforcing steel will remain within allowable tolerances as specified in Section 515-3.10.

   Use concrete wheels or other approved, non-corrosive spacing devices near the bottom and at intervals not exceeding 15 feet up the shaft to ensure concentric spacing for the entire length of the cage. Do not use block or wire type spacers. Use a minimum of one spacer for each 30 inches of cage circumference.

   Provide concrete or other Engineer-approved spacers at the bottom of the drilled shaft reinforcing cage. Maintain the specified distance between the bottom of the cage and the bottom of the shaft. Use one spacer per longitudinal bar unless approved by the Engineer. Use spacers sized to prevent vertical movement of the cage. Use spacers constructed of material equal in quality and durability to the shaft concrete. Submit spacer information for approval.

   Check the elevation of the top of the steel cage before and after placing the concrete. If the cage is not maintained within the specified tolerances, correct it as approved by the Engineer. Do not construct additional shafts until modifying the reinforcement cage support in a manner satisfactory to the Engineer.

515-3.08 FLUID IN EXCAVATION AT TIME OF CONCRETE PLACEMENT. Prior to placing concrete in any shaft excavation, ensure that contaminated suspensions, which could impair the free flow of concrete from the tremie pipe, have not accumulated in the bottom of the shaft. Take samples of the fluid in the shaft starting 1 foot from the base of the shaft and at intervals not exceeding 10 feet up the shaft, using an approved sampling tool. Ensure that the density of the fluid in the shaft excavation prior to concreting is less than 70 lb/ft3 for mineral slurries including bentonite and attapulgite and less than 64 lb/ft3 for polymer slurries according to ASTM D 4380. If desanding equipment is required, ensure that the sand content does not exceed 4 percent by

volume. Take whatever action is necessary to modify the fluid in the shaft excavation prior to placing the concrete to bring the fluid within the contract requirements.

515-3.09 CONCRETE PLACEMENT. Place concrete in accordance with Section 501 and the requirements herein.

At no expense to the Department, furnish the additional drilled shaft concrete (over the theoretical amount required to fill the shaft as shown in the Plans) required to complete filling shafts larger than required by the Plans or authorized by the Engineer.

If the pressure head is lost during concrete placement for any reason, the Engineer may direct the Contractor to perform integrity testing at no expense to the Department.

Cure the top surface of the shaft in accordance with Section 501.

Install grout in all voids between the casing and shaft excavation after placing shaft concrete. For drilled shaft foundation casings installed in oversized holes or where gaps exist between the shaft excavation and the casing, grout the zone between the casing and the soil with DS Grout. Grout the casing the full depth of the shaft. Use at least six grout placement tubes placed uniformly around the perimeter the full length of the casing. Grout the casing in one continuous operation. Withdraw the grout tubes vertically during grout placement operations. Provide at least two water relief/release pipes on opposite sides of the casing. Withdraw the water relief/release pipes vertically during the grout placement operations.

Submit the grout placement procedure for approval.

Pressure wash all concrete overflow from the outside surface of the shaft casing. Do not allow loose concrete and other debris generated during pressure washing the casing to flow into adjoining bodies of water.

515-3.10 CONSTRUCTION TOLERANCES. Conform to the following:

1. Ensure that the top of the drilled shaft is no more than 3 inches laterally from the position indicated in the plans.

2. Ensure that the vertical alignment of the shaft excavation does not vary by more than ¼ inch horizontally for each foot of depth.

3. After placing all the concrete, ensure that the top of the reinforcement cage is no more than 2 inches above and no more than 3 inches below plan position.

4. Ensure that the column and shaft reinforcement cages are concentric with the shaft within a tolerance of 1 inch. Ensure that concrete cover is within 1½ inches of the plan dimension.

5. Ensure that the top elevation of the drilled shaft concrete is within 6 inches of the top of shaft elevation shown in the plans.

6. Do not exceed a difference between the major and minor outside diameters at any point along the length of the permanent metal casing (out-of-roundness) of 1 percent of the nominal diameter. The circumference of the permanent metal casing shall not vary more than 3/16 inch from the nominal circumference.

7. Ensure that the cutting edges of excavation equipment are normal to the vertical axis of the equipment within a tolerance of ±3/8 inch per foot of shaft diameter.

8. The completed shaft excavation shall have a flat bottom as shown on the plans. The flat bottom of the shaft excavation shall be fully founded on rock and be level within ±3/8 inch per foot of shaft diameter.

9. Provide a solid concrete shaft without voids or sections of unsound concrete as determined by CSL.

515-3.11 INSTRUMENTATION AND DATA COLLECTION.

1. Shaft Inspection Device. The Engineer may use a SID comprised of a television camera sealed inside a watertight jacket to inspect the bottoms of the shafts. Cooperate with the Engineer in using this device. Place the device in position for inspection and removing it after the inspection. Furnish 110 V single-phase current (minimum 30 A service), 220 V single-phase current (minimum 15 A service), and a 150 psi compressor (230 in^3/s minimum) to operate the SID.

2. Crosshole Sonic Logging. Provide CSL inspection of all drilled shaft foundations along their entire lengths. Provide an independent CSL inspector with at least 3 years experience in CSL testing to inspect the drilled shaft and prepare the CSL report.

   Secure CSL tubes (steel pipes) to the inside of the reinforcing steel cage on regular intervals not exceeding 3 feet. Place CSL tubes as near parallel and plumb as possible and around the reinforcement cage perimeter as indicated on the plans. Extend the CSL tube from the bottom of the shaft to at least 3 feet above the top of the shaft or as approved by the Engineer.

   Do not damage CSL tubes. Prior to beginning CSL testing, assure that the test probes can pass through every tube to the bottom. If a tube is obstructed, at your expense core a hole that is near to the obstructed tube and extends to its full depth. The core hole should be large enough to accommodate the CSL probe.

   Prior to coring, submit for approval a coring plan including core hole locations and coring equipment and procedures. Provide for complete core recovery and minimize abrasion and erosion of the core. Place the core hole at a position in the shaft that will not produce damage to the reinforcing steel in the shaft. Log the core hole and submit the log. Indicate in the log voids and defects located in the core hole. Preserve the cores and make them available for inspection by the Engineer. Commence downhole testing with the core hole treated as an access tube.

   CSL tubes shall be schedule 40 pipes that provide an inside diameter of at least 2 inches. Provide CSL tubes with smooth, regular inside surface free of defects and obstructions (including pipe joints) to permit the free movement of a 1¼ inch diameter probe over the entire length of the tube.

   Use mechanical couplers to extend CSL tubes. Seal all CSL tube joints. Do not weld CSL tube joints.

   CSL tubes must be watertight. Provide a watertight cap at the bottom of the CSL tube. Provide a watertight, removable cap at the top of the CSL tube. Fill CSL tubes with potable water prior to or within 1 hour after placement of shaft concrete.

   The exterior surface of CSL tubes must be free from corrosion, oil, and coatings so that a good bond is provided between the concrete and the tube.

   Test the drilled shaft no sooner than 3 days and no later than 10 days after placement of drilled shaft concrete.

Perform CSL testing between all adjacent tube pairs and across at least two major diagonals. Perform additional diagonal testing if shaft defects are identified. At your expense, perform as many additional diagonal tests as needed to determine the extent of the shaft defect.

If the CSL results indicate a potential defect, the core the location of the defect as described above for blocked CSL tubes.

If the cores indicate the presence of a defect, submit a repair procedure for review and approval. Repair the shaft at your expense and at no extra cost to the Department. If a defect is not observed in the cores, the Department will pay for all coring costs.

After CSL testing has been completed and accepted by the Engineer, remove water from the CSL tube, cut the tube flush with the top of the shaft, and fill the tube with DS Grout.

515-3.12 DRILLED SHAFT EXCAVATIONS CONSTRUCTED OUT OF TOLERANCE. Do not construct drilled shaft foundations in such a manner that the concrete shaft cannot be completed within the required tolerances. If the contract tolerances are not met, the Contractor may request design changes in the pier to incorporate shafts installed out of tolerance. The Contractor shall bear the costs of redesign and all related costs resulting from approved design changes to incorporate shafts installed out of tolerance. Furnish additional materials and work necessary, including engineering analysis and redesign, to implement corrections of out of tolerance drilled shafts at no expense to the Department.

Provide a proposal on correcting out of tolerance shafts. Do not begin any redesign until the proposal has been reviewed for acceptability and approved by the Engineer in writing.

A Professional Engineer registered in the State of Alaska must perform all redesign to correct for out of tolerance shafts. The Registered Professional Engineer performing the redesign is subject to the approval of the Engineer.

515-4.01 METHOD OF MEASUREMENT.

1. Drilled Shaft. This item will not be measured for payment.

2. Unclassified Shaft Excavation. The quantity to be paid for will be the length, in feet, of unclassified shaft excavation of the diameter shown in the plans, completed and accepted. The length will be measured along the centerline of the shaft.

3. Special Shaft Excavation. The quantity to be paid for will be the length, in feet, of special shaft excavation of the diameter shown in the plans, completed and accepted. The length will be measured along the centerline of the shaft.
4. Casings. The sum of the lengths, in feet, of the casing in place in the completed structure. The length will be measured along the casing from the top to the bottom of the casing at each shaft location.

5. Instrumentation and Data Collection. This item will not be measured for payment.

515-5.01 BASIS OF PAYMENT.

1. Drilled Shaft. Payment will be full compensation for furnishing, erecting, operating, maintaining, dismantling and transporting all drilled shaft equipment necessary to drill foundation shafts and place the casing as indicated on the plans.

   Payment will be full compensation for all Quality Control Inspection.

Payment will be full compensation for the design, fabrication, installation, maintenance and removal of all temporary work structure(s) required to construct the bridge substructure and superstructure.

Payment of 85 percent of the amount bid for this bid item will be made when all equipment is at the site, assembled and ready to begin operation, and all temporary structures required for the installation of the drilled shafts are installed and ready to use.

Payment of 10 percent will be made when the all shafts have been drilled, all shaft concrete is in place to the top of the shaft, all Instrumentation and Data Collection is complete, and after all shafts have been accepted by the Engineer.

Payment of the remaining five percent will be made after the temporary work structure(s) has been removed in its (their) entirety.

2. Unclassified Shaft Excavation. Payment will be full compensation for the shaft excavation; sidewall overreaming; removal from the site and disposal of excavated materials; preparation of the site as required; cleaning and inspecting shaft excavations; using desanding equipment as necessary; using drilling equipment; and furnishing all other labor and materials necessary to complete the work.

3. Special Shaft Excavation: Payment will be full compensation for the shaft excavation; sidewall overreaming; removal from the site and disposal of excavated materials; preparation of the site as required; cleaning and inspecting shaft excavations; using desanding equipment as necessary; using drilling equipment; and furnishing all other labor and materials necessary to complete the work.

4. Shaft Casing: Payment will be full compensation for all costs necessary for furnishing and placing the casing in the shaft excavation.

5. Shaft Instrumentation and Data Collection: Payment will include all labor, equipment, materials, transportation, storage, and insurance required for the instrumentation, data collection and reporting of shaft testing.

Payment will be made under:

Pay Item	**Pay Unit**
515(1) Drilled Shaft	Lump Sum
515(2) Unclassified Shaft Excavation (Identification)	Linear Foot
515(3) Special Shaft Excavation (Identification)	Linear Foot
515(4) Shaft Casing (Identification)	Linear Foot
515(5) Shaft Instrumentation and Data Collection	Lump Sum

STATEWIDE SPECIAL PROVISION **01/01/16**
SSP-21

Insert new Section 516 Expansion Joints and Bearings:

SECTION 516
EXPANSION JOINTS AND BEARINGS

516-1.01 DESCRIPTION. Furnish and install expansion joints and bearings according to the Plans.

516-2.01 MATERIALS. Use materials that conform to the following:

Grout	Subsection 701-2.03
Bridge Seals	Subsection 705-2.03
Expanded Polyethylene	Subsection 705-2.06
Structural Steel	Section 716
Elastomeric Bearing Pads	Subsection 720-2.01
Epoxy Adhesive for Elastomeric Bearing Pads	Subsection 720-2.02
Polytetrafluoroethylene (PTFE) Bearings	Subsection 720-2.03
Water Stops	Section 723

CONSTRUCTION REQUIREMENTS

516-3.01 EXPANSION JOINTS. Locate and form expansion joints as shown on the Plans.

1. Shop Drawings. Provide shop drawings for expansion joints having a total movement of more than 1.75 inches. Submit drawings showing installation procedures and joint assembly details. Install joints only after shop drawings are approved.

2. Manufacture and Fabrication.

   a. Open Joints. Place open joints where shown on the Plans. Remove forms without chipping or breaking the corners of the concrete. Do not extend reinforcement across an open joint, unless shown on the Plans.

   b. Filled Joints. Construct expansion joints with expanded polyethylene joint filler as thick as the width of the joint.

      Cut the joint filler to the same shape and size as the adjoining surfaces. Fix the joint filler against the concrete surfaces in place to keep the joint filler from displacing when concrete is placed.

      Immediately after removing the forms, inspect the expansion joints. Remove concrete or mortar that has sealed across the joint.

   c. Compression Seals. Shape the joint as shown on the Plans. Install the seal according to the manufacturer's instructions.

      Install the seal in one piece for the full width of the roadway joint. Install the seal immediately after the curing period of the concrete.

   d. Strip Seals. Use expansion joint strip seals in one piece for the length of the joint. Shape the steel components to conform to the section of the concrete. Ensure that the surface in the finished plane is true and free of warping. When placing the joints, use methods to

keep them in correct position during concrete placement that do not affect or modify the structure or joint.

Install the expansion joints according to the manufacturer's recommendations. Adjust the joint opening for the dimensions indicated on the Plans.

e. Steel Joints. At the shop, shape the plates, angles, or other structural components to conform to the section of the concrete. Fabricate and paint structural shapes to meet the specifications covering those items. Ensure that the surface in the finished plane is true and free of warping. When placing the joints, use methods to keep them in correct position during concrete placement that do not affect or modify the structure or joint. Meet the joint opening dimension shown on the Plans.

f. Modular Seals. Shape the joint as shown on the Plans. Use expansion joint modular seals in one piece for the length of the joint. Ensure that the surface in the finished plane is true and free of warping. When placing the joints, use methods to keep them in correct position during concrete placement that do not affect or modify the structure or joint.

Install the expansion joints according to the manufacturer's recommendations. Adjust the joint opening for the dimensions indicated on the Plans.

g. Silicone Expansion Joint Seals. Prepare concrete surface by sandblasting each face until the surface is roughened and all contaminants are removed. Ensure all joint faces are sound, clean, dry, and free of frost immediately prior to sealant application. Install a bond breaking backing material that is configured per the sealant manufacturer's specifications. Install the sealant according to the manufacturer's recommendations.

3. Tolerances. Install expansion joints conforming to the following tolerances:

a. Top Surface Profile: 1/4 to 5/8 inch recessed from the finished roadway profile.

b. Surface Irregularities (deviation from a 10-foot straight edge): ±1/8 inch.

c. Gap Width: ±1/4 inch.

516-3.02 BEARINGS. Install bearing at locations shown on the Plans.

1. Shop Drawings. Provide shop drawings showing all details of the bearings and of the materials proposed for use. Fabricate bearings only after shop drawings are approved.

2. Packaging, Handling, and Storage. Prior to shipment from the point of manufacture, package the bearings in a manner to ensure that each bearing will be protected from damage during shipment, handling, and storage. Store the bearings in an area that provides protection from environmental and physical damage. Prior to installation, clean the bearings of all foreign substances.

3. Construction and Installation. Set the bearing plates, sole plates and elastomeric bearing pads as shown on the Plans in the exact position with full and even bearing on properly finished bearing seats. Do not use shims to set bearing plates, sole plates, or elastomeric bearing pads.

Finish bearing areas or grind them to elevation and parallel to the roadway grade and parallel to the roadway cross slope or crown, unless otherwise shown on the Plans.

When shown on the Plans, place grout under masonry plates. Mix and place grout according to the manufacturer's written recommendations. Clean concrete areas that will contact the

grout. Remove loose or foreign matter that would prevent the bond between the mortar and the concrete surfaces.

Tightly pack the grout under the masonry plates to provide full bearing. After placing, cover exposed surfaces of grout pads with a heavy thickness of burlap saturated with water for 3 days. Do not place a load on the grout until the grout has attained a compressive strength of 5000 psi as determined by field specimen.

Locate sole plates to correspond with the temperature during erection. Anchor bearing securely. Adjust the nuts on anchor bolts at the expansion ends of spans to permit the span to move freely. Burr threads sufficiently to prevent removal of nuts.

Apply epoxy adhesive to the bottom surface of the elastomeric bearing pads before placing them. Do not move the pad until the epoxy has cured and full adhesion is achieved. Do not apply epoxy adhesive to elastomeric bearings used in PTFE bearing assemblies.

4. Tolerances. Install bearings conforming to the following tolerances:

    a. Horizontal Position: ±1/8 inch
    b. Elevation: ±1/8 inch
    c. Grade and cross slope: ±1/16 inch per foot.

516-3.03 WATER STOPS. Furnish water stops in continuous, full-length segments without field splices. Do not field splice water stops. Ensure all spliced performed by the Manufacturer are fully vulcanized.

Use spacers, supporting wires, or other approved devices to secure the water stop in the position shown on the plans.

Remove and replace water stops that are out of position or shape at no expense to the Department.

516-4.01 METHOD OF MEASUREMENT. Section 109 and the following:

Expansion Joint. The sum of the lengths of joints complete in place, measured along the centerline of the joint.

Bearings. Measured per unit, complete in place.

Water Stops. The sum of the lengths of water stops complete in place, measured along the centerline of the water stop.

516-5.01 BASIS OF PAYMENT.

Expansion Joint. Payment for Expansion Joint includes all materials and work necessary for furnishing and installing expansion joints. If no pay item is included in the Bid Schedule for expansion joints, payment for expansion joint is subsidiary.

Bearings. Payment for Bearings includes all materials, testing, and work necessary for furnishing and installing bearings. If no pay item is included in the Bid Schedule for bearings, payment for bearings is subsidiary.

Water Stops. Payment for Water Stops includes all materials, and work necessary for furnishing and installing water stops. If no pay item is included in the Bid Schedule for water stops, payment for water stops is subsidiary.

Payment will be made under:

Pay Item	Pay Unit
516(1) Expansion Joint (identification)	Linear Foot
516(2) Bearings (identification)	Each
516(3) Water Stops	Linear Foot

STATEWIDE SPECIAL PROVISION **01/01/16**
SSP-22

Delete Section 520 Temporary Crossings and replace with the following:

SECTION 520
TEMPORARY CROSSINGS

520-1.01 DESCRIPTION. For each site where public traffic uses a temporary crossing or a Contractor uses a temporary crossing that is elevated over a public route, construct and maintain the temporary crossing. Remove temporary crossings after use and cleanup the site.

Design temporary bridges, change the preliminary design of approach roads to accommodate temporary bridges, and have an independent design check performed. Inspect and perform quality acceptance on temporary bridges.

520-1.02 DEFINITIONS.

Designer of Record (DOR). A civil engineer registered as a Professional Engineer in the State of Alaska, and in responsible charge of the work described. The DOR must have adequate and relevant prior bridge design and inspection experience. The DOR may delegate portions of design, quality acceptance, and inspection work, to qualified technicians. The DOR and qualified technicians must not be supervised by, or under the direction of the Contractor's temporary crossing superintendent and work crew.

Independent Engineer (IE). An engineer registered as a Professional Engineer in the State of Alaska, and in responsible charge of the independent design check. The engineer responsible for the check must have adequate and relevant prior bridge design experience. The engineer responsible for the check shall not be employed by the Contractor or the same firm as the Designer of Record; or employed by a firm managed or owned by the Contractor or the Designer of Record; nor shall the engineer performing the work manage or own the Contractor or the firm employing the Designer of Record.

Independent Design Check (IDC). An independent design check of the temporary bridge package including but not limited to: design, location and dimensions of the foundation, structural members, connections, erection plan and temporary bracing (when required), safety barrier, and independent calculations of design loads, member stress, material properties, hydraulic capacity and scour protection.

Temporary Bridge. A temporary bridge used by the public or over a public route, including abutments, piers, safety barrier and railing, foundation scour protection, and other incidentals.

Temporary Bridge Package (TBP). Design calculations, working drawings, specifications, load ratings and all items identified on Form 25D-8, for a temporary bridge.

Temporary Crossings. A detour route that includes temporary bridges, approach roads and other incidentals.

MATERIALS AND DESIGN

520-2.01 MATERIALS. New or used materials must meet the requirements of the design and the Contract. The DOR must verify the quality of temporary bridge materials before incorporation into the project.

520-2.02 GEOTECHNICAL DATA AND HYDROLOGY REPORT. The Department may provide records of geotechnical investigations. The Contractor is responsible for obtaining all additional geotechnical data necessary for design and construction of the temporary crossings.

The Department may provide a preliminary hydrology and hydraulics report. The Contractor is responsible for obtaining all additional hydrology and hydraulics data necessary for design and construction of the temporary crossings.

520-2.03 TRAFFIC CONTROL PLAN. Submit a traffic control plan for temporary crossing according to the Plans and Section 643.

520-2.04 DESIGN REQUIREMENTS. Retain the services of a DOR to design temporary bridges, and to provide a TBP. When the temporary bridges are used as a construction platform for the Contractor's equipment or workers, then design and construct temporary bridges that are wide enough for traffic lanes and construction areas, and strong enough to support design traffic and construction loads.

The Department will provide preliminary designs for approach roads. The DOR may change the design of approach roads to accommodate temporary bridges.

1. Design temporary crossings according to the following documents:

    a. *DOT&PF Standard Specifications for Highway Construction* for recommended construction methods, material properties, and sampling and methods.

    b. *AASHTO LRFD Bridge Design Specifications* for temporary bridge design criteria, as modified by Subsection 520-2.04; and

    c. *DOT&PF Preconstruction Manual* for design criteria for changes to approach roads.

2. Provide working drawings for temporary bridges including:

    a. All information and details necessary to construct temporary bridges including all items listed in the Contractor's Questionnaire on Form 25D-8 that can be found at this web address: http://www.dot.state.ak.us/stwddes/dcsconst/pop_constforms.shtml;

    b. All dimensions controlling the temporary bridge design and erection, including beam length and spacing, post location and spacing, vertical distance between connections in diagonal bracing, height of bents, and similar design controlling dimensions;

    c. All design loads and material properties;

    d. The soil bearing values;

    e. The openings required to allow the passage of traffic, including horizontal and vertical clearances, and the location of railing or barrier;

    f. Water design flow, opening size and elevations under superstructure, the high water elevation, and the maximum water flow elevation, and vertical clearances; and

    g. When a bridge is built over a traveled way show where temporary bracing is used during erection or removal of the bridge, show the sequence of erection and removal, and show details of the temporary bracing used.

3. Design temporary bridges to conform to the following requirements:

    a. To support 100% of HL-93 live loads or the Contractor's maximum construction load whichever is greater, without overstress. Follow the most recent version, including interim version, of *AASHTO LRFD Bridge Design Specifications*. Indicate governing live load on working drawings;

    b. Design for half the seismic acceleration value of the permanent bridge shown on the Plans;

c. Include the capacities and demands of load-supporting members in the design calculations;

d. Provide a clear roadway and clear pathway widths equal to or greater than the widths indicated on the plans. Construct the temporary bridge and approach embankments wide enough to provide the widths indicated on the plans, and to safely pass contractor's equipment during all phases of constructing the new bridge;

e. Design vertical clearance for the life of the temporary structure. A minimum vertical clearance of 16.5 feet is required above a state highway, local road, or street open to the public. A minimum vertical clearance of 23 feet is required above the Alaska Railroad. For navigable waters a minimum vertical clearance of 17 feet is required between the low elevation of the superstructure and (1) the ordinary high fresh water elevation or (2) mean high salt water elevation;

f. Minimum vertical clearance of one foot between the low elevation of the superstructure and the maximum water flow elevation within your proposed construction opening. Calculate the design water discharge for each temporary bridge;

g. To support equipment used to install and remove the temporary bridge, and construct or renovate the existing bridge. List equipment type, size, capacity, lifting locations, and traffic patterns during lift on the working drawings. Indicate maximum construction loads and locations of applied construction loads;

h. Provide a concrete f shape barrier system on the bridge and bridge approaches. Anchor barrier system to prevent deflection when impacted. Locate barrier so outside edge is setback a minimum of 12 horizontal inches from outside edge of bridge deck;

i. Construct roadway surface of concrete or asphalt. Construct skid-resistant bridge deck surface of concrete, asphalt, timber or steel;

j. Design to comply with the requirements of all permits and environmental commitments, including time windows during which work may occur. Apply for and obtain additional permits or modifications to existing permits as needed;

k. Do not use existing bridge components on the project site for temporary bridge construction;

l. To support loads from utilities identified in the Contract;

4. Provide load ratings of the temporary bridge according to the most recent version, including interim version, of the AASHTO *Manual for Bridge Evaluation* (*MBE*). Load rate steel and concrete bridges using the Load Factor Rating (LFR) and Load and Resistance Factor Rating (LRFR) methods. Load rate timber bridges using the Allowable Stress Rating (ASR) method and Load and Resistance Factor Rating (LRFR) methods.

   Include values for moment, shear and, where applicable, axial stresses. Specify live load type, placement for maximum stress, distribution, and impact. Include the following cases for LFR load ratings:

   a. inventory with multiple lanes and impact included
   b. operating with multiple lanes and impact included
   c. operating with one lane centered on the bridge and impact not included.

5. Design changes to approach roads must conform to permit requirements, and Department design standards applicable to the design criteria listed on the plans.

520-2.05 DESIGN SUBMITTAL AND REVIEW. Comply with the following:

1. Retain a DOR to design temporary bridges and design changes to the approach roads, and to provide load ratings for temporary bridges. The design drawings and load ratings in the TBP must be stamped with the seal of, dated by, and signed by the DOR;

2. Retain an IE to perform an IDC; and to stamp with their seal, date, and sign an IDC letter certifying: "The TBP meets the AASHTO LRFD Bridge Design Specifications and the Contract requirements"; and
3. Submit the IDC letter with the TBP (except calculations may be one set), and with three sets of design changes to the approach roads, to the Engineer for review and approval at least 30 days prior to beginning construction of the temporary bridge.

520-2.06 VALUE ENGINEERING CHANGE PROPOSALS. Base your bid on supplying temporary bridge structures according to the Contract documents. After Award you may submit construction value engineering change proposals to the Engineer. Proposals must include permitting requirements and timelines for construction. The Department will consider value engineering change proposals in accordance with Subsection 104-1.06.

CONSTRUCTION

520-3.01 TRAFFIC MAINTENANCE. Protect and control traffic according to Section 643 and the approved traffic control plan.

520-3.02 CONSTRUCTION AND MAINTENANCE REQUIREMENTS. Construct temporary crossings entirely within the right-of-way and within permitted areas. Construct the temporary bridge according to the approved TBP. Construct the approach roads according to the Plans and Specifications, as modified by the DOR and approved by the Engineer. Construct according to the Standard Specifications for Highway Construction with exceptions noted by the DOR and this Section 520.

Bolted steel connections must use load indicating washers. Weld according to Subsection 504-3.01.7 Welding.

Maintain structure, safety appurtenances, and wearing surface of temporary crossings until substantial completion. Maintain temporary crossings in a safe and functional condition. Keep bracing and connections tight, and immediately replace any damaged members or damaged connections. Promptly remove debris caught against, under or inside, temporary bridges.

Limit surface deviations to 3/8 inch, as measured from the testing edge of a 10-foot straightedge, between two contacts on the driving surface of the temporary crossings.

520-3.03 WINTER MAINTENANCE. The Department may accept the maintenance responsibility for winter snow and ice removal only. The Contractor retains responsibility for all repairs and maintenance, in accordance with Subsections 105-1.13 and 107-1.15.

520-3.04 INSPECTION. The Contractor is responsible for Quality Control, and for the construction of temporary crossings, including temporary bridges and approach roads, to conform to the working drawings, specifications and the Contract requirements.

The DOR is in responsible charge of Quality Acceptance and inspection, of temporary bridge materials and construction work. The DOR must verify in writing that the quality of bridge materials and construction work meet the design and Contract requirements. The DOR or qualified technician is required to be on-site and to inspect critical work including but not limited to abutments, piers, pile driving, welding, structural elements, fastening of structural elements, reinforcing steel placement, concrete pours, and foundation scour protection.

The Engineer may sample and test materials, and may reject materials that do not meet the requirements of the design. The Engineer may inspect the construction of temporary crossings at any phase of construction and reject unacceptable work. The Engineer will inspect the finished construction of temporary crossings before public use; however, inspection by the Engineer will not relieve the Contractor from any responsibility for defective work.

520-3.05 APPROVALS. Obtain the following written approvals from the Engineer:

1. TBP prior to beginning temporary bridge construction;

2. Design changes to temporary approach roads prior to construction of approach roads;

3. Temporary bridge construction prior to opening the bridge to traffic; and

4. Approach road construction prior to opening the road to traffic.

Such approvals will not relieve the Contractor of the responsibility for defective work. The Contractor shall remain responsible for all aspects of the design, location and dimensions of the temporary crossing, including but not limited to materials, foundation, structural members, connections, safety barrier, and for satisfactory and safe construction of all work.

The Engineer's review and approval of the TBP shall not be construed as a complete review, but will indicate only that the general method of construction and working drawings are acceptable to the Department, that the TBP appears complete, and that a certification of an IDC was provided.

The request to open the temporary bridge to traffic must be supported by a final inspection report that is stamped with the seal of, dated by, and signed by the DOR; and that certifies: "The temporary bridge has reached Substantial Completion as defined in Subsection 101-1.03, conforms to the requirements of the TBP and the Contract, and can support design traffic loads and construction loads, and is suitable for public use."

520-3.06 CLEANUP. Remove temporary crossings, cleanup site, and stabilize site from erosive forces before final completion. Return the site substantially to its original condition. Additional cleanup conditions may be listed in the permits. Remove piling to one foot below ground level.

520-4.01 METHOD OF MEASUREMENT. Section 109.

520-5.01 BASIS OF PAYMENT.

Temporary Crossings. The lump sum payment is full compensation for all design, engineering, inspection, labor, equipment and materials necessary to furnish, install, repair, maintain and remove temporary crossings in their entirety. The lump sum payment also includes all traffic control and traffic maintenance within the limits of the temporary crossings.

Pay Item	Pay Unit
520(1) Temporary Crossings	Lump Sum

STATEWIDE SPECIAL PROVISION **01/01/16**
SSP-23

Delete Section 701 Hydraulic Cement and Supplementary Cementitious Materials and replace with the following:

SECTION 701
HYDRAULIC CEMENT AND SUPPLEMENTARY CEMENTITIOUS MATERIALS

701-1.01 GENERAL. Meet the following general requirements for all cementitious materials furnished:

Before using, retest Portland cement stored longer than 3 months in bags or 6 months in bulk for compressive strength, time of setting, and loss on ignition according to AASHTO M 85. Store separately different types or brands of cementitious materials, or cementitious materials from different mills.

Protect cementitious materials from dampness during shipment and storage. Do not use partially set cement or cement which contains caked lumps. Do not use cement salvaged from discarded or used bags.

701-2.01 PORTLAND CEMENT. Meet AASHTO M 85, Type I, II, or III including the low-alkali cement requirement shown in Table 2—Optional Chemical Requirements.

701-2.02 BLENDED HYDRAULIC CEMENT. Meet AASHTO M 240, Type IP, or Type IS. Report the weight of pozzolan and ground granulated blast furnace slag as percent of weight of the total cementitious material. Do not vary the pozzolan and ground granulated blast furnace slag constituent content from the certified value more than ±5 percent by weight of the total cementitious material. Limit pozzolan in Type IP to fly ash. Meet the replacement limits in Table 701-1

TABLE 701-1
BLENDED HYDRAULIC CEMENT LIMITS

Cement Type	Constituent	Percent of Total Cementitious Material by Weight
		Maximum
Type IP	**Fly Ash**	35%
Type IS	**Slag cement**	40%

701-2.03 GROUT. Non-shrink, non-corrosive, non-metallic, cement-based grout meeting ASTM C1107, except develop a 28-day compressive strength of at least 9,000 psi when tested according to AASHTO T 106 or ASTM C109.

701-2.04 FLY ASH. Meet AASHTO M 295, Class C or Class F, including optional chemical requirements as set forth in Table 2—Supplementary Optional Chemical Requirement.

701-2.05 GROUND GRANULATED BLAST-FURNACE SLAG. Meet AASHTO M 302, Grade 100 or Grade 120.

701-2.06 SILICA FUME. Meet AASHTO M 307.

701-2.07 DS GROUT. Use drilled shaft (DS) grout conforming to the following requirements:

1. Portland Cement Type I or Type II cement meeting the requirements of Subsection 701-2.01.

2. Fine Aggregate: Use fine aggregate meeting Subsection 703-2.01, except 100 percent passing the No. 4 sieve.

3. Potable Water: Use water meeting the requirements of Subsection 712-2.01.

4. Proportioning: Mix grout in proportions using at least 564 lbs/yd^3 of Portland cement, fine aggregate, and with enough water to produce a flowable mixture. Do not exceed 67 gal/yd^3 of water.

Thoroughly mix DS grout to a uniform consistency before injecting into soil surrounding drilled shaft casing and filling CSL tubes.

701-2.08 RESERVED

701-2.09 CERTIFICATION. Furnish a Certified Test Report from the manufacturer or an independent testing laboratory containing a list of dimensional, chemical, metallurgical, electrical, physical, and other required test results of the specified material certifying that the product or assembly has passed all specified tests. Include the following:

1. the project name and number;
2. the manufacturer's name;
3. the name of the product or assembly;
4. a complete description of the material;
5. country of origin;
6. the lot, heat, or batch number that identifies the material;
7. all required test results for the specified material from the same lot, heat, or batch defined in Subsection 701-2.09.6;
8. a statement, signed by a person having legal authority to act for the manufacturer or the independent testing laboratory, that the test results show that the product or assembly to be incorporated into the project has been sampled and tested and the samples have passed all specified tests.

Tag, stencil, stamp, or otherwise mark all materials or assemblies furnished under certification to the project with the lot number, heat number, batch number, or other appropriate identification, which can be readily recognized and legible, and is identical to the accompanying Certified Test Report.

STATEWIDE SPECIAL PROVISION **01/01/16**
SSP-24

Delete Subsection 703-2.13 Structural Fill and Subsection 703-2.14 Aggregate for Abrasive Finish of Section 703 Aggregates and replace with the following:

SECTION 703
AGGREGATES

703-2.13 STRUCTURAL FILL. *Add the following Subsection*: Aggregate containing no muck, frozen material, roots, sod or other deleterious matter and with a plasticity index not greater than 6 as determined by ATM 204 and ATM 205. Meet the grading requirements of Table 703-9 as determined by ATM 304.

TABLE 703-9
AGGREGATE GRADATION FOR STRUCTURAL FILL

SIEVE	PERCENT PASSING BY WEIGHT
3 in.	100
3/4 in.	75-100
No. 4	15-60
No. 16	10-30
No. 200	0-6

703-2.14 AGGREGATE FOR ABRASIVE FINISH. *Add the following Subsection*: Crushed silica sand, oven dried, and stored in moisture-proof bags. Free from clay balls, vegetative matter, or other deleterious matter (AASHTO T 112). Not coated with dirt or other finely divided mineral matter. Meet the grading requirements of Table 703-10 as determined by ATM 304.

TABLE 703-10
GRADATION FOR SAND FOR ABRASIVE FINISH

SIEVE	PERCENT PASSING BY WEIGHT
No. 12	100
No. 40	0-5

STATEWIDE SPECIAL PROVISION **01/01/16**
SSP-25

Delete Subsections 705-2.02 Joint Sealer, 705-2.03 Bridge Seals and 705-2.06 High Molecular Weight Methacrylate (HMWM) Resin of Section 705 Joint Materials and replace with the following:

SECTION 705
JOINT MATERIALS

705-2.02 JOINT SEALER.

Silicone Joint Sealer	ASTM D 5893
Hot Pour Joint Sealer (Asphalt, Concrete)	ASTM D6690, Type IV

705-2.03 BRIDGE SEALS.

1. Preformed Strip Seals and Compression Seals. Use preformed seals constructed with only virgin natural polyisoprene (natural rubber) as the raw polymer in the elastomeric compound. Do not use polychloroprene (neoprene). Use steel extrusions meeting ASTM A709 Grade 36. Galvanize steel extrusions in accordance with Subsection 716-2.07. Use preformed material meeting the following requirements of ASTM D2000:

   $$M4AA\ 514\ A_{13}B_{13}C_{12}F_{17}$$

   Use a lubricant-adhesive for installing preformed strip seals and compression seals meeting ASTM D4070.

   a. Certification. Furnish a Certified Test Report from the manufacturer or an independent testing laboratory containing a list of dimensional, chemical, metallurgical, electrical, physical, and other required test results of the specified material certifying that the product or assembly has passed all specified tests. Include the following:

      (1) the project name and number;
      (2) the manufacturer's name;
      (3) the name of the product or assembly;
      (4) a complete description of the material;
      (5) country of origin;
      (6) the lot, heat, or batch number that identifies the material;
      (7) all required test results for the specified material from the same lot, heat, or batch defined in Subsection 705-2.03.1.a.(6);
      (8) a statement, signed by a person having legal authority to act for the manufacturer or the independent testing laboratory, that the test results show that the product or assembly to be incorporated into the project has been sampled and tested and the samples have passed all specified tests.

      Tag, stencil, stamp, or otherwise mark all materials or assemblies furnished under certification to the project with the lot number, heat number, batch number, or other appropriate identification, which can be readily recognized and legible, and is identical to the accompanying Certified Test Report.

2. Silicone Expansion Joint Seals. Use materials that conform to the following:

   a. Silicone Joint Sealants.

(1) Horizontal Joints. Use formed-in-place sealant composed of 100 percent silicone that is self-leveling, cold applied, and two-part formulation meeting the requirements in Table 705-1.

(2) Vertical Joints. Use formed-in-place sealant composed of 100 percent silicone meeting the requirements of ASTM D5893, Type NS (Non-Sag). Do not use acid cure sealants. Ensure the silicone sealant is compatible with the surface to which it is applied.

b. Bond Breaking Backing Material. Use closed-cell expanded polyethylene foam backer rod meeting the requirements of ASTM D5249.

TABLE 705-1
SELF-LEVELING SEALANT REQUIREMENTS

Property	**Requirements**	**Test Method**
Extrusion Rate	Min, 50 mL/minute	ASTM C1183
Specific Gravity	Min. 1.25 Max. 1.35	ASTM D792
Joint Elongation	Min. 600%	ASTM D5329 (modified)*
Joint Modulus (at 100% elongation)	Min. 3 psi Max. 12 psi	ASTM D5329 (modified)*

* Modify the ASTM D5329 test by using a pull rate of 2 inches per minute and a joint size of 1/2 inch x 1/2 inch x 2 inch.

705-2.06 EXPANDED POLYETHYLENE. Use closed-cell expanded polyethylene with a density of at least 2.1 lb/ft^3 as determined by ASTM D3575 and with a minimum compressive stress of 9 psi at 25% deflection as determined by ASTM D3575.

STATEWIDE SPECIAL PROVISION **01/01/16**
SSP-26

Delete Section 709 Reinforcing Steel and Wire Rope and replace with the following:

SECTION 709
REINFORCING STEEL AND WIRE ROPE

709-2.01 REINFORCING STEEL.

1. Reinforcing Steel Bars. Furnish deformed reinforcing steel bars of the type, grade, and size as specified. For steel reinforcing bars used in bridge structures, use bars meeting ASTM A706, Grade 60. For all other structures, use bars meeting AASHTO M 31, Grade 60.

2. Headed Reinforcing Steel Bars. Furnish headed reinforcing steel bars meeting the requirements of ASTM A970, Class HA. Use reinforcing steel meeting Section 709-2.01.1 unless otherwise noted.

3. Epoxy-Coated Reinforcing Steel Bars. Furnish epoxy-coated steel bars meeting the requirements of ASTM A775. Coat epoxy-coated reinforcing steel in an epoxy coating applicator plant certified in accordance with the Concrete Reinforcing Steel Institute (CRSI) Voluntary Certification Program. Use reinforcing steel meeting Section 709-2.01.1 unless otherwise noted.

4. Steel Wire. Furnish plain steel wire of the size specified that meets the requirements of AASHTO M 32.

5. Steel Bar Mats. Furnish deformed steel bar mats of the type, grade, size, and spacing as specified. Unless otherwise noted, furnish steel bar mats meeting the requirements of AASHTO M 54, Grade 60.

6. Steel Welded Wire Fabric. Furnish plain steel welded wire fabric of the size and spacing specified that meets the requirements of AASHTO M 55.

7. Epoxy-Coating Patch Material. Furnish epoxy-coating patch material meeting the requirements of ASTM D3963.

8. Certification. Furnish a Certified Test Report from the manufacturer or an independent testing laboratory containing a list of dimensional, chemical, metallurgical, electrical, physical, and other required test results of the specified material certifying that the product or assembly has passed all specified tests. Include the following:

    a. the project name and number;
    b. the manufacturer's name;
    c. the name of the product or assembly;
    d. a complete description of the material;
    e. country of origin;
    f. the lot, heat, or batch number that identifies the material;
    g. all required test results for the specified material from the same lot, heat, or batch defined in Subsection 709-2.01.8.f; and,
    h. a statement, signed by a person having legal authority to act for the manufacturer or the independent testing laboratory, that the test results show that the product or assembly to be incorporated into the project has been sampled and tested and the samples have passed all specified tests.

Tag, stencil, stamp, or otherwise mark all materials or assemblies furnished under certification to the project with the lot number, heat number, batch number, or other appropriate identification, which can be readily recognized and legible, and is identical to the accompanying Certified Test Report.

709-2.02 WIRE ROPE OR WIRE CABLE. Meeting AASHTO M 30, 3/4 inch Type 1, Class A.

709-2.03 BAR SUPPORTS.

1. Precast Mortar Blocks. Provide mortar blocks meeting the following:

    a. Ensure the mortar blocks have compressive strength at least equal to the strength of the concrete in which the mortar blocks are embedded. Sample and test the mortar for compressive strength according to AASHTO T 106. Each test will be considered to represent no more than 2,500 mortar blocks made of the same mortar and cured under the same conditions.
    b. Ensure the bearing area of the mortar block is less than 2 inches in each dimension.
    c. Secure to the reinforcing steel with either a grooved top that will hold the bar in place or a protruding embedded wire that is tied to the reinforcing steel.

2. Metal Supports. Provide metal supports meeting at least one of the following:

    a. Galvanized after fabrication according to AASHTO M 232 Class D,
    b. Stainless steel meeting the requirements of ASTM A493, Type 302, or
    c. Plastic coated using coatings that do not react chemically with the concrete, have a minimum thickness of 3/32 inch where the support touches the form, do not crack at or above -5°F, and do not deform enough to expose the metal at or below 200°F.

3. Plastic Supports. Provide plastic supports meeting the following:

    a. Non-porous.
    b. Chemically inert in concrete.
    c. Have rounded seats.
    d. Do not deform under load during normal temperatures.
    e. Do not shatter or crack under impact loading in cold weather.
    f. Have at least 25 percent of their gross area perforated.

    Do not use plastic supports that prevent complete concrete consolidation in and around the support or require supports less than 1 foot apart along the length of the bar.

STATEWIDE SPECIAL PROVISION **01/01/16**
SSP-27

Delete subsection 711-2.01 Curing Materials and 711-2.02 Chemical Admixtures of Section 711 Concrete Curing Materials and Admixtures and replace with the following:

SECTION 711
CONCRETE CURING MATERIALS AND ADMIXTURES

711-2.01 CURING MATERIALS.

Burlap Cloth made from Jute or Kenaf	AASHTO M 182, Class 4
Sheet Materials for Curing Concrete	ASTM C171
Liquid Membrane-Forming Compounds for Curing Concrete	ASTM C309, Type 1-D Class B, except do not use compounds containing linseed oil.

711-2.02 CHEMICAL ADMIXTURES.

Air-Entraining Admixtures	AASHTO M 154
Water-Reducing Admixtures	AASHTO M 194, Type A
Set-Retarding Admixtures	AASHTO M 194, Type B
Set-Accelerating Admixtures	AASHTO M 194, Type C
Water-Reducing and Set-Retarding Admixtures	AASHTO M 194, Type D
Water-Reducing and Set-Accelerating Admixtures	AASHTO M 194, Type E
Water-Reducing Admixtures	AASHTO M 194, Type F
High Range Water-Reducing and Set-Retarding Admixtures	AASHTO M 194, Type G
Specific Performance Admixtures	ASTM C494, Type S

STATEWIDE SPECIAL PROVISION **01/01/16**
SSP-28

Add the following subsections 712-2.19 Low-Viscosity Resin, 712-2.20 Concrete Anchors, 712-2.21 Epoxy for Bonding Dowels and 712-2.22 Controlled Low-Strength Material to Section 712 Miscellaneous:

SECTION 712
MISCELLANEOUS

712-2.19 LOW-VISCOSITY RESIN. Meet AASHTO M 235, Type IV, Grade 1, with the following revisions:

Amend Table 1 as follows:
Replace "2.0[20]" with "0.105[1.05]" in the row labeled "Grade 1, max".

712-2.20 CONCRETE ANCHORS.

1. Anchor Bolts. Use hot-dip galvanized anchor bolts meeting ASTM F1554, Grade 36, unless noted otherwise.

2. Coil Anchor Inserts. Use 1-inch diameter galvanized inserts with a minimum safe working load of 7,500 pounds. Hot-dip galvanize anchors according to AASHTO M 111 or AASHTO M 232.

3. Threaded Anchor Inserts. Use 1-inch diameter galvanized ferrule inserts with a minimum safe working load of 6,500 pounds. Hot-dip galvanize anchors according to AASHTO M 111 or AASHTO M 232.

712-2.21 EPOXY FOR BONDING DOWELS. Use an epoxy cartridge system appropriate for the service temperature and ambient concrete temperature at the time of installation.

Use epoxy cartridge systems that meet the requirements of the “Acceptance Criteria for Adhesive Anchors in Masonry Elements,” AC58, by the International Code Council Evaluation Service (ICC-ES) including the suitability requirements for creep, in-service temperature, dampness, freezing and thawing, and seismic tests.

712-2.22 CONTROLLED LOW-STRENGTH MATERIAL. Provide controlled low-strength material (CLSM) that is a self-compacting, cementitious, flowable material requiring no subsequent vibration or tamping to achieve consolidation and meeting the following:

1. Cementitious Materials. Meet Section 701.

2. Water. Meet Subsection 712-2.01

3. Chemical Admixtures. Meet Subsection 711-2.02

4. Aggregate. Crushed stone or naturally occurring gravel, containing no deleterious matter, and with 100 percent of the aggregate passing a 3-inch sieve.

5. Strength. 100 psi minimum to 300 psi maximum 28-day compressive strength as determined by ASTM D4832.

STATEWIDE SPECIAL PROVISION **01/01/16**
SSP-29

Delete Section 715 Steel for Piles and replace with the following:

SECTION 715
STEEL FOR PILES

715-2.01 SCOPE. Steel used for Structural Steel Piling and Sheet Piling.

715-2.02 GENERAL REQUIREMENTS. Furnish steel piles of the dimensions, weights, cross-sections, and grades specified. Satisfy the impact test requirements of Subsection 716-2.02. Meet the following:

1. Structural Steel HP Piling. Furnish HP shape piles meeting ASTM A709, Grade 50T3.

2. Structural Steel Pipe Piling. Furnish pipe piles meeting one of the following:

    a. American Petroleum Institute (API) 5L X52 PSL2.
    b. ASTM A709, Grade 50T3 fabricated
    c. ASTM A709, Grade 50T3 fabricated according to the following:

        (1) General. Fabricate pipe piling using coiled steel with one helical seam weld. Use skelp material that does not contain repair welds. Use skelp having a width not less than 0.8 times the outside diameter of the pipe and not greater than 3.0 times the outside diameter of the pipe. Form pipe when the steel temperature is below 400°F. Locate junctions of skelp end welds and the helical seam welds at distances greater than 1.0 times the outside diameter of the pipe from the pipe ends and at distances greater than 5.0 times the outside diameter of the pipe from other junctions of skelp end welds and helical seam welds.

        (2) Welding. Use complete joint penetration welds produced by the automatic submerged–arc welding process, the automatic gas metal-arc welding process, or a combination of both processes. Perform welding according to Section 504.

        (3) Welding Inspection. Perform welding inspection according to AWS D1.1. Provide visual inspection of welds on the inside and outside surfaces of the pipe.

        (4) Non-Destructive Examination. Randomly examine 10% of the total length of helical seam welds and skelp end welds. Examine welds by performing one of the following tests:

            (a) Radiographic testing according to the requirements of AWS D1.1 Section 6, Part E with Subsection 6.12.3 of AWS D1.1.

            (b) Ultrasonic testing according to the requirements of AWS D1.1 Section 6, Part F with Subsection 6.13.3.1 of AWS D1.1.

        If more than 10% of the weld lengths examined are defective, examine a second random sample of 25% of the total length of welds. If more than 10% of the weld length examined in the second sample are defective, examine 100% of the total length of welds.

        Repair all weld defects in accordance with AWS D1.1.

(5) Destructive Examination. Perform destructive examination on specimens from finished pipe of each specified outside diameter, wall thickness, steel type, and grade. Examine specimens at a frequency of at least one set of tests for each lot representing 2000 linear feet of finished pipe or once per week during each production run, whichever occurs first. Do not use specimens containing repaired welds.

(a) Tensile Tests. Meet the specified tensile requirements for yield strength, tensile strength, and elongation. Perform tension tests according to ASTM A307 using one base metal specimen and two weld specimens taken at 90° to the length of the weld with the weld across the center of the sample. For base metal specimen, determine and report yield point, yield strength, tensile strength, and elongation. For weld test specimens, determine and report tensile strength.

Each lot of pipe will be considered to meet the tensile requirements if the base metal test results meet the specified yield strength, tensile strength, and elongation and the weld test results meet the specified tensile strength result.

(b) Bend Tests. Perform transverse side bend tests according to ASTM E190. Each lot of pipe will be considered to meet the bend test requirements if the no cracks occur in the specimen.

(6) Tolerances. Meet the following tolerances:

(a) Roundness. Limit the difference between the major and minor outside diameter to 1% of the specified outside diameter of the pipe or 1/4 inch, whichever is less.

(b) Circumference. Limit the outside circumference to 1% of the nominal outside circumference of the pipe or 1/2 inch, whichever is less.

(c) Straightness. Do not deviation from a straight line parallel to centerline of the pile more than ±1/8 inch per 10 feet of length, but not to exceed 3/8 inch.

(d) Length. ±1-1/2 inch per 10 feet of length.

(7) Defects. The Engineer may reject piles containing surface defects. The depth of the surface defect will be measured as the gap between the lowest point of the defect and a prolongation of the original contour of the pipe. Use of piles containing surface defects may be authorized according to the following requirements based on the depth of the surface defect:

(a) If the surface defect is not greater than 5% of the wall thickness in depth, the defect need not be repaired.

(b) If the surface defect is deeper than 5%, but not greater than 7%, of the specified wall thickness, grind smooth the surface defect. Remove abrupt changes in contour, but do not reduce the thickness in the ground area more than 7% of the specified wall thickness.

(c) If the surface defect is deeper than 7%, but not greater than 20%, of the specified wall thickness, repair the defect by welding according to Section 504.

(d) If the surface defect is deeper than 20% of the specified wall thickness, repairs will not be permitted and the pile will be rejected.

3. Pile Tip Reinforcing. Use pile tip reinforcement conforming to the requirements of ASTM A27 Grade 65-35 or ASTM A148 Grade 90-60. Make each pile tip in one piece of cast steel. Weld tip reinforcing to the piles in conformance with the manufacturer's written directions.

4. Structural Steel Sheet Piling. Furnish sheet piles meeting AASHTO M 202.

715-2.03 CERTIFICATION. Furnish a certified test report from the manufacturer or an independent testing laboratory containing a list of dimensional, chemical, metallurgical, electrical, physical, and other required test results of the specified material certifying that the product or assembly has passed all specified tests. Include the following:

1. the project name and number;
2. the manufacturer's name;
3. the name of the product or assembly;
4. a complete description of the material;
5. country of origin;
6. the lot, heat, or batch number that identifies the material;
7. all required test results for the specified material from the same lot, heat, or batch defined in Subsection 715-2.03.6; and,
8. a statement, signed by a person having legal authority to act for the manufacturer or the independent testing laboratory, that the test results show that the product or assembly to be incorporated into the project has been sampled and tested and the samples have passed all specified tests.

For pipe manufactured to API 5L, submit an inspection certificate with test results according to API 5L 10.1.3.

715-2.04 MARKING. Tag, stencil, stamp, or otherwise mark all materials or assemblies furnished under certification to the project with the lot number, heat number, batch number, or other appropriate identification, which can be readily recognized and legible, and is identical to the accompanying certified test report.

For helical welded pipe piles, mark each pipe on the inside surface and outside surface of both ends indicating: the fabricators name, type of steel, grade of steel, steel heat number, welding process, total pipe weight or weight per lineal foot of pipe, length, nominal outside diameter, and nominal wall thickness.

STATEWIDE SPECIAL PROVISION **01/01/16**
SSP-30

Delete Section 720 Elastomeric Pads and replace with Section 720 Bearings:

SECTION 720
BEARINGS

720-2.01 ELASTOMERIC BEARING PADS. Elastomeric bearing pads include plain pads, consisting of elastomer only, and laminated pads with steel laminates.

1. General. Meet AASHTO M 251, with the following revisions:

4.1 Properties of the Elastomer
Delete the first sentence and replace with the following: Use elastomeric compound in the construction of the bearings containing only virgin natural polyisoprene (natural rubber) as the raw polymer. Do not use neoprene. Properties and requirements elsewhere in AASHTO M 251 pertaining solely to polychloroprene (neoprene) do not apply.

Add the following:
Use elastomer compound classified as low temperature Grade 5 and meeting the requirements of paragraph 8.9.1.

5. FABRICATION
Add the following paragraph:
5.5. Fabricate pads over 3/4 inch thick with alternating laminations of elastomer and metal or fabric reinforcements. The outside laminations must be metal or fabric with a minimum elastomer cover as shown on the Plans.

Table 2 – Tolerances.
Delete Item 6 and replace with the following:
6. Top, bottom, and edge cover of embedded laminates or connection members -0, +1/8 inch.

2. Certification. Furnish a Certified Test Report from the manufacturer or an independent testing laboratory containing a list of dimensional, chemical, metallurgical, electrical, physical, and other required test results of the specified material certifying that the product or assembly has passed all specified tests. Include the following:

a. the project name and number;
b. the manufacturer's name;
c. the name of the product or assembly;
d. a complete description of the material;
e. country of origin;
f. the lot, heat, or batch number that identifies the material;
g. all required test results for the specified material from the same lot, heat, or batch defined in Subsection 720-2.01.2.f; and
h. a statement, signed by a person having legal authority to act for the manufacturer or the independent testing laboratory, that the test results show that the product or assembly to be incorporated into the project has been sampled and tested and the samples have passed all specified tests.

Tag, stencil, stamp, or otherwise mark all materials or assemblies furnished under certification to the project with the lot number, heat number, batch number, or other appropriate identification, which can be readily recognized and legible, and is identical to the accompanying Certified Test Report.

720-2.02 EPOXY ADHESIVE FOR ELASTOMERIC BEARING PADS. Meet AASHTO M 235, Type IV, Grade 3.

720-2.03 POLYTETRAFLUOROETHYLENE (PTFE) BEARINGS. PTFE bearing assemblies consist of elastomeric bearing pads, polytetrafluoroethylene (PTFE) surfacing, and stainless steel and steel plates.

1. Materials.

Elastomeric Bearing Pads	Subsection 720-2.01
Stainless Steel Plates	ASTM A 240, Type 304
Steel Plates	ASTM A 709, Grade 36

Use PTFE from virgin material (not reprocessed) meeting the requirements of ASTM D 4894 or D 4895, and Table 720-1.

2. Fabrication. Fabricate the PTFE sliding surface with lubricant dimples having a maximum diameter of 0.32 inch, a minimum depth of 0.08 inch and a maximum depth of one half of the PTFE sheet thickness. Distribute the dimples uniformly within the area ¼ inch from the edges of the PTFE sheet and occupying between 20 percent and 30 percent of the PTFE sheet area.

For welding of structural steel, conform to the requirements of Section 504.

TABLE 720-1
POLYTETRAFLUOROETHYLENE (PTFE)

Test	Requirements
Specific Gravity	2.13 - 2.19
Peak Melting Temperature	623^{o}F ($\pm 2^{o}$F)
Tensile strength (Minimum)	2800 psi
Elongation (Minimum)	200%

Bond the PTFE to steel substrate under controlled conditions according to the written instructions of the manufacturer of the adhesive system. Use adhesive material meeting the requirements of the PTFE manufacturer.

Uniformly roughen the contact surfaces of PTFE sheet and steel plate to be bonded to a minimum roughness height value of 250 microinches.

Factory treat the side of the PTFE sheet to be bonded by the sodium naphthalene or sodium ammonia process, after the contact surface is roughened.

Fully bond the PTFE sheet in the recess. Ensure the PTFE surface is smooth and free from bubbles after completion of the bonding operation. PTFE sheets that are delaminated will be rejected.

Perimeter seal weld the stainless steel plate to the steel sole plate. Use stainless steel electrodes in accordance with the requirements of the electrode manufacturer. After the completion of the weld operation, ensure the stainless steel plate is smooth and free from waves.

Control the flatness of the bearing elements such that upon completion of the bearing assembly the PTFE/stainless steel sliding interface is in full bearing.

Provide a mating surface of the stainless steel plate with the PTFE surfacing with a surface finish of less than 8 microinches root-mean-square (rms), determined according to ASME Standard B46.1. Do not exceed a first movement static coefficient of friction of 0.05 for the sliding element of the production bearings, when tested without the coating of silicone grease.

Fully vulcanize elastomeric bearing pads to the steel plates under factory controlled conditions. Provide a bond with a peel-strength of at least 30 pounds per inch as determined by AASHTO M 251, appendix X2.

Prepare and paint metal surfaces, except stainless steel surfaces, of bearings exposed to the atmosphere in the completed work. Prepare and paint the surfaces according to Section 504.

After installation of the bottom portion of the bearing assembly, apply a 1/16 inch thick coating of silicone grease to the entire PTFE surface and reassemble the bearing without damage to the mating sliding surfaces. Use silicone grease conforming to SAE AS8660.

At your expense and without contract extension time return damaged bearings and bearings with scratched mating surfaces to the factory for replacement or resurfacing.

Prior to proof testing, permanent die stamp all individual components on 2 of 4 sides with markings consisting of bearing number and contract number. Provide each bearing with a unique bearing number and match marks on plate edges to insure correct assembly at the job site.

3. Testing. Proof test and evaluate full sized PTFE bearings for compression and coefficient of friction in the presence of the Engineer, unless otherwise directed. Perform proof tests on samples randomly selected by the Engineer from the production bearings to be used in the work. Perform proof tests at an approved independent laboratory. If proof tests are not performed at the specified load, perform additional physical tests in the presence of the Engineer, unless otherwise directed, to demonstrate that the requirements for proof testing at the specified load are satisfied. Give the Engineer at least 7 working days notice before beginning proof testing.

   Proof test one bearing per lot of production PTFE bearings. A lot is defined as 25 PTFE bearings or fraction thereof of the number of PTFE bearings shown on the Project Plans.

   Clean the bearing surfaces prior to testing.

   Proof test bearings after conditioning specimen for 12 hours at $75^{o} \pm 5^{o}$F.

   Perform the tests with the dead load as specified in the Contract for the bearing with the test load applied for 12 hours prior to friction measurement and the following:

   Arrange the tests to allow measurement of the static coefficient of friction on the first movement of the bearing.

   Measure the first movement static and dynamic coefficients of friction at a sliding speed not exceeding one inch per minute and do not exceed the specified coefficient of initial static friction.

Subject the test bearings to a minimum of 100 movements of at least one inch of relative movement at a sliding speed not exceeding 12 inches per minute. After cycling, measure again the first movement static and dynamic coefficients of friction at a sliding speed not exceeding one inch per minute and do not exceed the specified coefficient of initial static friction.

The proof tested bearings are to show no visible sign of: (1) bond failure of bearing surfaces, (2) separation or lift-off of plates from each other or from PTFE surfaces, (3) other defects. When a proof tested bearing fails to comply with the Contract Documents, test each bearing in that lot for acceptance.

Proof test results are to be certified correct and signed by the testing laboratory personnel who conducted the test and interpreted the test results. Include the bearing numbers of the bearings tested on the proof test results.

Test a minimum of one pad per lot for bond strength per AASHTO Test M 251. Test specimens are to show no indication of deterioration of elastomer or loss of bond between the elastomer and steel laminates.

Protect all PTFE and stainless steel surfaces from contamination and weather damage.

4. Certification. Furnish a Certified Test Report from the manufacturer or an independent testing laboratory containing a list of dimensional, chemical, metallurgical, electrical, physical, and other required test results of the specified material certifying that the product or assembly has passed all specified tests. Include the following:

    a. the project name and number;
    b. the manufacturer's name;
    c. the name of the product or assembly;
    d. a complete description of the material;
    e. country of origin;
    f. the lot, heat, or batch number that identifies the material;
    g. all required test results for the specified material from the same lot, heat, or batch defined in Subsection 720-2.03.4.f; and,
    h. a statement, signed by a person having legal authority to act for the manufacturer or the independent testing laboratory, that the test results show that the product or assembly to be incorporated into the project has been sampled and tested and the samples have passed all specified tests.

    Tag, stencil, stamp, or otherwise mark all materials or assemblies furnished under certification to the project with the lot number, heat number, batch number, or other appropriate identification, which can be readily recognized and legible, and is identical to the accompanying Certified Test Report.

STATEWIDE SPECIAL PROVISION **01/01/16**
SSP-31

Delete Section 721 Prestressing Steel and Fittings and replace with the following:

SECTION 721
PRESTRESSING STEEL AND FITTINGS

721-2.01 SCOPE. Prestressing steel and fittings used in pre-tensioned and post-tensioned concrete construction.

721-2.02 PRESTRESSING STEEL. Meet the following:

Steel Strand	AASHTO M 203
Uncoated Stress-Relieved Steel Wire	AASHTO M 204. Do not use oil-tempered wires.
High Strength Steel Bars	AASHTO M 275

721-2.03 POST-TENSIONING SYSTEM. Use only post-tensioning systems that utilize tendons fully encapsulated in anchorages and ducts. Systems that transfer prestress force by bonding the prestress steel directly to concrete are not allowed. Use only post-tensioning systems that are approved by the Engineer and meet the following requirements:

1. Anchorage and Distribution. Secure prestressing steel at the ends by means of approved permanent type anchoring assemblies.

   Use anchorage devices for post-tensioning that hold the prestressing steel at a load producing a stress of not less than 95 percent of the guaranteed ultimate tensile strength (GUTS) of the prestressing steel, when tested in an unbonded state, without exceeding the anticipated set.

   Distribute the load from the anchoring assemblies to the concrete by means of approved devices or bearing plates that will effectively distribute the load to the concrete. Construct the bearing plate and wedge plate from ferrous metal. For bending stresses in the bearing plates or assemblies induced by the pull of the prestressing steel, do not exceed the yield point of the material or cause visible distortion in the bearing plate when 95 percent of the GUTS of the tendons is applied as determined by the Engineer. Do not exceed 3500 psi directly underneath the bearing plate or assembly for the final unit compressive stress on the concrete.

   Galvanize the body of the anchorage assembly in accordance with AASHTO M 111. Other components of the anchorage assembly including wedges, wedge plate and local zone reinforcement need not be galvanized.

   Construct anchorage assemblies with grout vents suitable for post-grouting inspection access as approved by the Engineer. Equip all anchorages with a grout cap that is vented and bolted to the anchorage.

   Recess the anchoring assemblies so that the ends of the prestressing steel and all parts of the anchoring assemblies will be at least 3 inches inside of the end surface of the members, unless shown otherwise on the plans. After post-tensioning all tendons, fill the recesses with concrete conforming to the provisions for the structure and then finished flush with the abutment end diaphragm.

2. Strand Couplers. Do not use strand couplers.

3. Enclosures for Post-tensioning. Use rigid ferrous metal duct enclosures for prestressing steel that are galvanized, mortar tight, and capable of withstanding concrete pressures without deforming. Use rigid ducts with smooth inner walls that can be curved to the proper configuration without crimping or flattening and have sufficient strength to maintain their correct alignment during placing of concrete. Do not use semi-rigid ducts. Fabricate ducts with either welded or interlocked seams.

   Connect sections of rigid ducts using galvanized ferrous metal couplings that are mortar tight and do not result in angle changes at the joints. Do not use split metal couplings. Use waterproof tape to seal all connections to the duct. Connect ducts to anchoring assemblies using transition couplings that are galvanized ferrous metal or polyethylene, mortar tight, and of sufficient strength to prevent displacement of the ducts during concrete placement.

   Use ducts for multi-strand tendons with a minimum diameter that provides an inside area at least 2.5 times the net area of the prestressing steel in the tendon.

   Do not use ducts with diameters that exceed 0.4 times the least gross concrete thickness at the duct location.

   Use duct enclosures with vents for the injection of grout after post-tensioning.

4. Grout Vents. Use vents with positive means for allowing the escapement of air, water, grout, and bleed water out of the vents, injecting grout through the vents, and sealing to prevent grout leakage from the vents. Use 3/4 inch minimum diameter standard pipe or suitable plastic pipe vents with positive shut-off designed to withstand the grouting pressure. Do not crimp or bend the vent pipe. Use metallic or plastic structural fasteners to connect the vent with the duct. Do not use plastic components that react with the concrete or enhance corrosion of the prestressing steel, or contain water-soluble chlorides. Make all vents mortar tight, taped as necessary. Make vents with sufficient length out of the concrete member to allow proper closing of the vents. Remove ends of vents at least 1 inch below the roadway surface after grouting has been completed.

   Place vents at the following locations:

   a. At anchorages.
   b. At the high points of the duct, when the vertical distance between the highest and lowest point is more than 20 inches.
   c. At a location down flow from all high point vents where the duct is approximately one-half duct diameter lower than the crest, but not to exceed 3 feet downstream.
   d. At the lowest point of the duct.
   e. At major changes in the cross-section of the duct.
   f. At other locations designated by the Engineer.

5. Grout Caps. Use grout caps that completely cover and seal all exposed ends of prestressing steel at the anchorage. Seal the cap with neoprene “O” ring seals and place a grout vent on the top of the cap. Use caps rated for a minimum pressure of 150 psi.

721-2.04 CERTIFICATION.

1. Prestressing Steel. Furnish a Certified Test Report from the manufacturer or an independent testing laboratory containing a list of dimensional, chemical, metallurgical, electrical, physical, and other required test results of the specified material certifying that the product or assembly has passed all specified tests. Include the following:

   a. the project name and number;
   b. the manufacturer's name;

c. the name of the product or assembly;
d. a complete description of the material;
e. country of origin;
f. the lot, heat, or batch number that identifies the material;
g. all required test results for the specified material from the same lot, heat, or batch defined in Subsection 721-2.04.1.f; and,
h. a statement, signed by a person having legal authority to act for the manufacturer or the independent testing laboratory, that the test results show that the product or assembly to be incorporated into the project has been sampled and tested and the samples have passed all specified tests.

Tag, stencil, stamp, or otherwise mark all materials or assemblies furnished under certification to the project with the lot number, heat number, batch number, or other appropriate identification, which can be readily recognized and legible, and is identical to the accompanying Certified Test Report.

2. Post-Tensioning Systems. Submit certified test reports to the Engineer that shows the post-tensioning system meets all the requirements specified herein. Submit the certified test reports with the shop drawing submittal. If any component of the post-tensioning system is modified or replaced, the entire system must be retested and resubmitted to the Engineer for approval.

   Ensure that all components of a system are stamped with the supplier's name, trademark model number and size corresponding to catalog designation.

   Submit certification stating the manufacturer's minimum guaranteed ultimate tensile strength of all prestressing steel used for this project.

   Assign an individual lot number for each manufactured reel of prestressing steel to be shipped to the site. Tag each reel in such a manner that each lot can be accurately identified at the site. All unidentified prestressing steel received at the site will be rejected.

   Assign and tag each lot of anchorage assemblies to be installed at the site. Tag each anchorage assembly in such a manner it can be accurately identified at the site. All unidentified anchorage assemblies received at the site will be rejected.

STATEWIDE SPECIAL PROVISION **01/01/16**
SSP-32

Delete Section 722 Bridge Railing and replace with the following:

SECTION 722
BRIDGE RAILING

722-2.01 BRIDGE RAILING.

Steel tube rail elements	ASTM A500, Grade B
Steel Thrie Beam elements	AASHTO M 180, Class B, Type II
Posts	ASTM A709, Grade 36
Machine bolts, cap screws, nuts and washers	ASTM A307
High strength bolts, nuts and washers	Subsection 716-2.03
Anchor bolts	AASHTO M 314, Grade 105; ASTM F1554, Grade 105; or ASTM A449, Type 1
Anchor studs	AASHTO M 169, Grade 1015 or 1020
Shims, plates, angles and sleeves	ASTM A709, Grade 36
Galvanize steel portions of railing after fabrication.	AASHTO M 111 or M 232 and Subsection 716-2.07

722-2.02 CERTIFICATION. Furnish a certified test report from the manufacturer or an independent testing laboratory containing a list of dimensional, chemical, metallurgical, electrical, physical, and other required test results of the specified material certifying that the product or assembly has passed all specified tests. Include the following:

1. the project name and number
2. the manufacturer's name
3. the name of the product or assembly
4. a complete description of the material
5. country of origin
6. the lot, heat, or batch number that identifies the material
7. all required test results for the specified material from the same lot, heat, or batch defined in Subsection 722-2.02.6
8. a statement, signed by a person having legal authority to act for the manufacturer or the independent testing laboratory, that the test results show that the product or assembly to be incorporated into the project has been sampled and tested and the samples have passed all specified tests.

Tag, stencil, stamp, or otherwise mark all materials or assemblies furnished under certification to the project with the lot number, heat number, batch number, or other appropriate identification, which can be readily recognized and legible, and is identical to the accompanying certified test report.

STATEWIDE SPECIAL PROVISION **01/01/16**
SSP-33

Delete Subsection 730-2.03 Retroreflective Sheeting and replace with the following:

SECTION 730
SIGN MATERIALS

730-2.03 RETROREFLECTIVE SHEETING. Meet ASTM 4956 for the type specified.

STATEWIDE SPECIAL PROVISION **01/01/16**
SSP-34

Delete subsection 202-2.01 Materials and replace with the following:

SECTION 202
REMOVAL OF STRUCTURES AND OBSTRUCTIONS

202-2.01 MATERIALS. Use materials that conform to the following:

Timber	AASHTO M 168 (Hemlock, Douglas fir, Western Pine, or Sitka Spruce). Pressure treated per AASHTO M 133.
Steel Pipe	Standard Weight Steel Pipe, 2-inch (max.) diameter. Galvanized per AASHTO M 111.
Steel Fasteners	ASTM A307, Grade A. Galvanized per AASHTO M 232.
Reflectors	Yellow acrylic prismatic type meeting AASHTO M 290 or retroreflective sheeting meeting ASTM D4956, Type III, IV, or V.

STATEWIDE SPECIAL PROVISION **01/01/16**
SSP-35

Delete Section 643 Traffic Maintenance and replace with the following:

`SECTION 643
TRAFFIC MAINTENANCE

643-1.01 DESCRIPTION. Protect and control traffic during the contract. Furnish, erect, maintain, replace, clean, move and remove the traffic control devices required to ensure the traveling public's safety. Perform all administrative responsibilities necessary to implement this work.

Maintain all roadways and pedestrian and bicycle facilities affected by the work in a smooth and traversable condition. Construct and maintain approaches, crossings, intersections, and other necessary features throughout the project for the life of the contract.

Illuminate construction activities listed in Table 643-4 during hours of night work on roads open to the public within project limits.

643-1.02 DEFINITIONS.

ATM. When used in this Section, ATM stands for the *Alaska Traffic Manual*, which is the MUTCD with Alaska Supplement.

BALLOON LIGHT. Light surrounding by a balloon-like enclosure kept inflated by pressurized air or helium, and producing uniform light through 360 horizontal degrees.

CONSTRUCTION PHASING PLAN. A plan for each phase of the project showing how to accommodate traffic. Show the sequence of work by segment or phase, if required.

FIXED OBJECTS. Private vehicles, parked flagger vehicles, idle construction equipment, construction material stockpiles, culvert ends, individual trees, power poles, utility poles and appurtenances, and other items deemed by the Engineer to present a hazard to motorists, pedestrians, or bicyclists traveling through the work zone.

NIGHT WORK. Work occurring between sunset and sunrise on all days except the "No Lighting Required" period shown in the table 643-1 below:

TABLE 643-1
PROJECT LOCATIONS – NIGHT TIME ILLUMINATION EXCLUSION

Latitude	**No Lighting Required**		**Nearby**
(degrees)	**Start**	**End**	**Cities**
South of 61	Lighting Required All Year		Everything South of Hope
61	June 11	July 1	Anchorage, Valdez, Girdwood
62	June 2	July 13	Wasilla, Palmer, Glennallen, Talkeetna
63	May 27	July 17	Cantwell, Paxson, McGrath
64	May 22	July 21	Tok, Delta, Nome
65	May 18	July 25	Fairbanks
66	May 14	July 29	Circle City
67	May 10	August 2	Coldfoot, Kotzebue
68	May 7	August 6	Galbraith Lake
69	May 3	August 9	Happy Valley

70	April 30	August 12	Deadhorse
71	April 27	August 15	Barrow
72	April 24	August 19	

TRAFFIC. The movement of vehicles, pedestrians, and bicyclists through road construction, maintenance operations, utility work, or similar operations.

TRAFFIC CONTROL PLAN (TCP). A drawing or drawings indicating the method or scheme for safely guiding and protecting motorists, pedestrians, bicyclists, and workers in a traffic control zone. The TCP depicts the traffic control devices and their placement and times of use.

TRAFFIC CONTROL ZONE. A portion of a road construction project, maintenance operation, utility work or similar operation that affects traffic and requires traffic control to safely guide and protect motorists, pedestrians, bicyclists, or workers.

643-1.03 TRAFFIC CONTROL PLAN. Implement an approved TCP before beginning work within the project limits.

The TCP includes, but is not limited to, signs, barricades, traffic cones, plastic safety fence, sequential arrow panels, portable changeable message board signs, special signs, warning lights, portable concrete barriers, crash cushions, flaggers, pilot cars, interim pavement markings, temporary lighting, temporary roadways and all other items required to direct traffic through or around the traffic control zone according to these Specifications and the ATM. Address in the TCPs placement of traffic control devices, including location, spacing, size, mounting height and type. Include code designation, size, and legend per the ATM and the Alaska Sign Design Specification (ASDS). Include longitudinal buffer space for the posted speed limit, according to Table 6C-2 of the ATM unless project conditions or geometric features prohibit including all or a portion of the buffer length.

When a TCP is included in the Plans, use it, modify it, or design an alternative TCP. When a TCP is omitted from the Plans, provide one according to this Section and the ATM.

Submit new or modified TCPs to the Engineer for approval. All TCPs must include the following information:

1. Project name and number.
2. A designated TCP number and name on each page.
3. For TCPs more than one page, each page must be numbered.
4. The posted speed limit for each roadway.
5. Existing striping width, lane width, and road surfacing.
6. Construction lane widths, striping layout, and temporary pavement marker layout.
7. Provisions for Pedestrian, Bicycle, and ADA travel through the work zone.
8. Dates and times the TCP will be in effect and why it is being used.
9. The Worksite Traffic Supervisor's signature certifying that all TCPs conform with the ATM and the Contract.
10. The Project Superintendent's signature confirming the TCP is compatible with the work plan.
11. The name(s) of the Worksite Traffic Supervisor, his/her alternate and their 24 hour telephone number(s).
12. Signs to be used and the ASDS designation number and size.
13. Location and spacing of all devices and signs.
14. A plan to address any possible slopes, drop offs, paving joints, or similar temporary features that may occur during use of the TCP.
15. For TCPs proposed to be used at night, note how the requirements will be met for the required lighting and retroreflective material.

TCPs submitted for approval without all the required information will be rejected. Allow 7 days for review of each TCP submittal. All required modifications to a TCP require a new submission and an additional 7 days for review.

A minor revision to a previously approved TCP during construction requires 48 hours for review and approval by the Engineer.

The TCPs, Plans, and Standard Drawings show the minimum required number of traffic control devices. If unsafe conditions occur, the Engineer may require additional traffic control devices.

Use of oversize and overweight equipment within the project must conform to an approved TCP, including all traffic control devices these operations require.

643-1.04 WORKSITE TRAFFIC SUPERVISOR. Provide a Worksite Traffic Supervisor responsible for maintaining 24-hour traffic operations.

1. Qualifications. The Worksite Traffic Supervisor shall be knowledgeable and experienced regarding the requirements of the ATM and the implementation of those requirements. The Worksite Traffic Supervisor shall be familiar with the Plans, the Specifications, proposed operations, and certified as one of the following:

    a. Traffic Control Supervisor, American Traffic Safety Services Association (ATSSA)

    b. Work Zone Temporary Traffic Control Technician, or Work Zone Safety Specialist, International Municipal Signal Association (IMSA)

    Certify according to Form 25D-124 that the Worksite Traffic Supervisor has a minimum 4000 hours of temporary traffic control work experience, is competent and capable, and has the authority to perform the duties and responsibilities in accordance with this section.

    - Temporary traffic control work experience shall demonstrate an understanding of concepts, techniques, and practices in the installation and maintenance of traffic control devices, and skill in reading, interpreting, implementing, and modifying TCPs.
    - Temporary traffic control work experience includes: flagging; installing traffic control devices in accordance with TCPs; monitoring traffic control devices and TCP performance; and recognizing and reporting deficiencies in traffic control devices and TCPs for correction.
    - Temporary traffic control work experience is gained while serving as a Worksite Traffic Supervisor-in-training, temporary traffic control support personnel, and Flagger.
    - Four thousand (4,000) hours of experience serving solely as a Flagger does not satisfy these requirements.

    Worksite Traffic Supervisors shall maintain current certification and be able to show their certification anytime they are on the project.

2. Duties.

    a. Prepare the TCPs and public notices and coordinate traffic control operations between the Project Superintendent and the Engineer.

    b. Physically inspect the condition and position of all traffic control devices used on the project at least twice each day and at approximately 12 hour intervals. Ensure that traffic control devices work properly, are clean and visible, and conform to the approved TCP. Complete and sign a detailed written report of each inspection within 24 hours. Use Traffic Control Daily Review Form 25D-104.

    c. Supervise the repair or replacement of damaged or missing traffic control devices.

d. Review and anticipate traffic control needs. Make available proper traffic control devices necessary for safe and efficient traffic movement.

e. Review work areas, equipment storage, and traffic-safety material handling and storage.

f. Hold traffic safety meetings with superintendents, foremen, subcontractors, and others as appropriate before beginning construction, prior to implementing a new TCP, and as directed. Invite the Engineer to these meetings.

g. Supervise all traffic control workers, flaggers, and pilot car drivers.

h. Certify that all flaggers are certified as required by Subsection 643-3.04.4. Submit a copy of all flagger certifications to the Engineer.

i Supervise lighting for night work.

3. Authority. The Worksite Traffic Supervisor shall have the Contractor's authority to stop work and implement immediate corrective action to unsafe traffic control, in locations where unsafe traffic control is present.

643-1.05 CONSTRUCTION PHASING PLAN. Submit a Construction Phasing Plan for approval no less than 5 working days prior to the preconstruction conference. Include the following:

1. Form 25D-124 designating the Worksite Traffic Supervisor, providing the 24-hour telephone number, and certifying minimum 4,000 hours of work experience as described in 643-1.04 Worksite Traffic Supervisor.

2. A construction phasing plan for each phase or segment of the project.

3. TCPs for the first phase of the project. Show permanent and temporary traffic control measures, including the times each TCP will be used.

Submit any changes to the Engineer for approval 7 days before proposed implementation.

643-1.06 TRAFFIC MAINTENANCE SETUP. When shown on the bid schedule, Traffic Maintenance Setup items are site specific and are detailed as individual TCPs on the plan sheets. They depict the method or scheme required to route traffic safely and efficiently when any of the following restrictions occur:

1. Lane Closure. The closure of one or more lanes on a roadway.

2. Detour. The redirection of traffic through or around a traffic control zone.

3. Road Closure. The closure of a roadway with or without a specified detour route.

4. One Lane Road. A two-way roadway reduced to a single-lane roadway with flaggers, pilot cars, traffic signals, stop signs, or yield signs.

643-2.01 MATERIALS. Provide traffic control devices meeting the following requirements:

1. Signs. Use signs, including sign supports, that conform to Section 615, the ATM, and ASDS.

   a. Construction Signs: Regulatory, guide, or construction warning signs designated in the ASDS.

   b. Permanent Construction Signs: As designated on the Plans or an approved TCP.

   c. Special Construction Signs: All other signs are Special Construction Signs. Neatly mark the size of each sign on its back in 3-inch black numerals.

2. Portable Sign Supports. Use wind-resistant sign supports with no external ballasting. Use sign supports that can vertically support a 48 X 48 inch traffic control sign at the height above the adjacent roadway surface required by the ATM.

3. Barricades and Vertical Panels. Use barricades and vertical panel supports that conform to the ATM. Use Type III Barricades at least 8 feet long. Use retroreflective sheeting that meets ASTM D4956 Type II or III.

4. Portable Concrete Barriers. Use portable concrete barriers that conform to the Contract. For each direction of traffic, equip each 12.5-foot section of barrier with at least two side-mounted retroreflective tabs placed approximately 6 to 8 feet apart, or a continuous 4-inch wide horizontal retroreflective stripe mounted 6 inches below the top of the barrier. Use yellow tabs or stripe when barriers are placed at centerline. Use white tabs or stripe when barriers are placed on the roadway shoulder. Use retroreflective sheeting that meets ASTM D4956 Type III, IV or V.

5. Warning Lights. Use Type A (low intensity flashing), Type B (high intensity flashing) or Type C (steady burn) warning lights that conform to the ATM.

6. Drums. Use plastic drums that conform to the requirements of the ATM. Use retroreflective sheeting that meets ASTM D4956 Type II or III.

7. Traffic Cones and Tubular Markers. Use reflectorized traffic cones and tubular markers that conform to the requirements of the ATM. Use traffic cones and tubular markers at least 28 inches high. Use retroreflective sheeting that meets ASTM D4956 Type II or III.

8. Interim Pavement Markings. Apply markings according to Section 670 and the manufacturer's recommendations. Use either:

    a. Paint meeting Subsection 708-2.03 with glass beads meeting Subsection 712-2.08,

    b. Preformed Marking Tape (removable or non-removable) meeting Subsection 712-2.14, or

    c. Temporary Raised Pavement Markers meeting Subsection 712-2.15 or 712-2.16, as appropriate.

9. High-Level Warning Devices. Use high-level warning devices that conform to the ATM.

10. Temporary Crash Cushions. Use retroreflective sheeting that meets ASTM D4956 Type III, IV or V. Application of crash cushion must be appropriate for the intended use and be installed per manufacturer’s recommendation. Temporary crash cushions that are barrels or barricade filled with sand or water may only be used when the forecasted temperature during their use is above 32 degrees Fahrenheit.

11. Sequential Arrow Panels. Use Type A (24 X 48 inch), Type B (30 X 60 inch) or Type C (48 X 96 inch) panels that conform to the ATM.

12. Portable Changeable Message Board Signs. Use truck or trailer mounted portable changeable message board signs with a self contained power supply for the sign and with the following features:

    a. Message sign panel large enough to display 3 lines of 9 inch high characters

    b. Eight character display per message line

    c. Fully programmable message module

    d. The capacity to create, preview, and display new messages and message sequences

    e. A waterproof, lockable cover for the controller keyboard

f. An operator's manual, a service manual, and a wiring diagram

g. Quick release attachments on the display panel cover

h. Variable flash and sequence rates

i. Manual and automatic dimming capabilities on lamp bulb matrix models

j. Locate the bottom of the sign panel at least 7 feet above the pavement

k. Operate with a battery pack a minimum of 2 hours under full load

13. Plastic Safety Fence. Use 4 foot high construction orange fence manufactured by one of the following companies, or an approved equal:

    a. "Safety Fence" by Services and Materials Company, Inc., 2200 South "J" Street, Elwood, Indiana, 46036. Phone (800) 428-8185.

    b. "Flexible Safety Fencing" by Carsonite, 1301 Hot Springs Road, Carson City, Nevada, 89706. Phone (800) 648-7974.

    c. "Warning Barrier Fence" by Plastic Safety Systems, Inc. P.O. Box 20140, Cleveland, Ohio, 44120. Phone (800) 662-6338.

14. Temporary Sidewalk Surfacing. Provide temporary sidewalk surfacing as required by an approved TCP and the following:

    a. Use plywood at least 1/2 inch thick for areas continuously supported by subgrade. Use plywood at least 1 inch thick for areas that are not continuously supported.

    b. Do not use unsupported 1-inch plywood longer than 30 inches.

    c. Use plywood with regular surfaces. Do not overlap plywood joints higher than 0.5 inch and beveled with a slope not steeper than 50%.

    d. Use a method that will withstand 25 mph wind velocities to hold temporary surfacing in place.

15. Temporary Guardrail. Use temporary guardrail that meets Section 606, except that posts may require placement under special conditions, such as in frozen ground.

16. Flagger Paddles. Use flagger paddles with 24 inches wide by 24 inches high sign panels, 8 inch Series C lettering (see ASDS for definition of Series C), and otherwise conform to the ATM. Use retroreflective sheeting that meets ASTM D4956 Type VIII or IX. Use background colors of fluorescent orange on one side and red on the other side.

17. Truck Mounted Attenuator, TMA. The TMA shall be mounted on a vehicle with a minimum weight of 15,000 pounds and a maximum weight per the manufacturer's recommendations.

18. Portable Steel Barriers. Use portable steel barriers that conform to the contract. For each direction of traffic, equip each section of barrier with side-mounted retroreflective tabs placed approximately 6 to 8 feet apart, or a continuous 4-inch wide horizontal retroreflective stripe mounted 6 inches below the top of the barrier. Use yellow tabs or stripe when barriers are placed at centerline. Use white tabs or stripe when barriers are placed on the roadway shoulder. Use retroreflective sheeting that meets ASTM D4956 Type III, IV or V.

643-2.02 CRASHWORTHINESS. Submit documentation, by the method indicated on table 643-2, that the following devices comply with Test Level 3 requirements of National Cooperative Highway Research

Program (NCHRP) Report 350 or the Manual for Assessing Safety Hardware (MASH). Submit documentation of compliance to the Engineer before installing devices on the project.

TABLE 643-2
WORK ZONE TRAFFIC CONTROL DEVICE AND
BARRIER CRASH TESTING COMPLIANCE

Category	Devices	Method of Documentation
1	Cones, candles, drums w/o attachments, delineators	Manufacturer's Certification for devices exceeding height and weight limits
2	Barricades, portable sign supports, drums w/lights, other devices weighing less than 100 pounds but not included in category 1	FHWA acceptance letter indicating acceptance at Test Level 3 (when no test level is specified in the letter; it is implied that the tests were run for Test Level 3),
3	Truck mounted attenuators, redirective and nondirective temporary crash cushions, bridge railing, bridge and guardrail transitions, and guardrail and barrier end treatments.	FHWA acceptance letter indicating acceptance at Test Level 3 (when no test level is specified in the letter; it is implied that the tests were run for Test Level 3),
	Portable steel barriers	FHWA acceptance letter indicating acceptance at Test Level 3 unless otherwise required in the contract.

Category 1 devices that exceed the following weights and heights require certification that they meet the evaluation criteria of NCHRP Report 350 or MASH, Test Level 3. This certification may be a one-page affidavit signed by the vendor. Documentation supporting the certification (crash tests and/or engineering analysis) must be kept on file by the certifying organization. No certification is required for devices less than or equal to both the weight and height on the schedule below:

Device	Composition	Weight	Height
Cones	Rubber	20 lb.	36 in.
	Plastic	20 lb.	48 in.
Candles	Rubber	13 lb.	36 in.
	Plastic	13 lb.	36 in.
Drums	Hi Density Plastic	77 lb.	36 in.
	Lo Density Plastic	77 lb.	36 in.
Delineators	Plastic or Fiberglass	N/A	48 in.

643-3.01 GENERAL CONSTRUCTION REQUIREMENTS. Keep the work, and portions of the project affected by the work, in good condition to accommodate traffic safely. Provide and maintain traffic control devices and services inside and outside the project limits, day and night, to guide traffic safely.

Unless otherwise provided in this Section, keep all roadways, business accesses, and pedestrian facilities within the project limits open to traffic. Obtain the Engineer’s approval before temporarily closing residential, commercial, or street approaches. Provide access through the project for emergency vehicles and school and transit buses. Properly sign and/or flag all locations where the traveling public must be redirected or stopped. Organize construction operations so the total of all construction related stoppages experienced by a vehicle traveling through the project does not exceed 20 minutes except when indicated otherwise in the Contract.

Stop equipment at all points of intersection with the traveling public unless an approved TCP shows otherwise.

Continue to operate all illumination and signalization according to the requirements of Subsection 660-3.09. When moving approach lanes, realign signal heads as necessary according to the ATM. Coordinate any modifications to existing traffic signals with the agency that maintains and operates them. Operate flood lighting at night according to the ATM. Adjust flood lighting so that it does not shine into oncoming traffic.

Provide and maintain safe routes for pedestrians and bicyclists through or around traffic control zones at all times, except when regulations prohibit pedestrians or bicyclists.

Immediately notify the Engineer of any traffic related accident that occurs within the project limits as soon as an employee, or a subcontractor becomes aware of the accident.

643-3.02 ROADWAY CHARACTERISTICS DURING CONSTRUCTION. Obtain an approved TCP before starting construction. Maintain a clear area with at least 2 feet between the edge of traveled way and the work area. Use barricades, traffic cones, or drums to delineate this area. Place traffic control devices on the work side of the clear area. Space them according to the ATM.

If maintaining traffic on an unpaved surface, provide a smooth and even surface that public traffic can use at all times. Properly crown the roadbed surface for drainage. Before beginning other grading operations, place sufficient fill at culverts and bridges to permit traffic to cross smoothly and unimpeded. Use part-width construction techniques when routing traffic through roadway cuts or over embankments under construction. Excavate the material or place it in layers. Alternate construction activities from one side to the other. Route traffic over the side opposite the one under construction.

Detour traffic when the Plans or an approved TCP allows it. Maintain detour routes so that traffic can proceed safely. When detours are no longer required, obliterate the detour. Topsoil and seed appropriate areas.

If two-way traffic can't be maintained on the existing roadway or detour use half-width construction or a road closure if it is shown on an approved TCP. Make sure the TCP indicates closure duration and conditions. Schedule roadway closures to avoid delay school buses and peak-hour traffic. For road closures, post closure-start and road-reopen times at the closure site, within view of waiting traffic.

643-3.03 PUBLIC NOTICE. Give notice at least 3 days before major changes, delays, lane restrictions, or road closures to local officials and transportation organizations, including but not necessarily limited to:

- Alaska Trucking Association
- Alaska State Troopers
- Division of Measurement Standards
- Local Police Department
- Local Fire Department
- Local Government Traffic Engineer
- School and Transit Authorities
- Local Emergency Medical Services
- Local Media (newspapers, radio, television)
- Railroads (where applicable)
- U.S. Postal Service
- Major Tour Operators

Provide local traffic enforcement and maintenance agencies 24 hour notice before shutting down a traffic signal system. Provide notice as required by utility companies before repairing or replacing a utility.

Provide the Alaska State Troopers, local police and fire department with the radio frequencies used on the project and the 24-hour telephone numbers of the Worksite Traffic Supervisor and the Project Superintendent. These telephone numbers are used to alert when emergency vehicles must pass through the project. When notified of emergencies make every necessary effort to expedite rapid passage.

Additional notices may be given through the Navigator or 511 System for selected projects. Check the special provisions for those requirements.

643-3.04 TRAFFIC CONTROL DEVICES. Before starting construction, erect permanent and temporary traffic control devices required by the approved TCPs. The Engineer will determine advisory speeds when necessary.

For lane closures on multilane roadways, use sequential arrow panels. During hours of darkness when required by the approved TCP use flashing warning lights to mark obstructions or hazards and steady-burn lights for channelization.

Use only one type of traffic control device in a continuous line of delineating devices, unless otherwise noted on an approved TCP. Use drums or Type II barricades for lane drop tapers.

During non-working hours and after completing a particular construction operation, remove all unnecessary traffic control devices. Store all unused traffic control devices in a designated storage area which does not present a nuisance or visual distraction to traffic. If sign panels are post mounted and cannot be readily removed, cover them entirely with either metal or plywood sheeting. Completely cover signal heads with durable material that that fully blocks the view of signal head and will not be damaged or removed by weather.

Keep signs, drums, barricades, and other devices clean at all times.

Use only traffic control devices that meet the requirements of the “Acceptable” category in ATSSA (American Traffic Safety Services Association) “Quality Guidelines for Temporary Traffic Control Devices” and meet crashworthiness requirements per Section 643-2.02.

Immediately replace any devices provided under this Section that are lost, stolen, destroyed, inoperable or deemed unacceptable while used on the project. Stock repair parts for each Temporary Crash Cushion used on the project. Repair damaged crash cushions within 24 hours.

Maintain pre-existing roadside safety hardware at an equivalent or better level than existed prior to project implementation until the progress of construction necessitates removing the hardware. All existing hazards that are currently protected with roadside safety hardware or new hazards which result from project improvements shall be protected or delineated as required in the plans, specifications, and approved TCPs until permanent roadside safety hardware is installed.

All items paid under this Section remain the property of the contractor, unless noted otherwise in the contract. Remove them after completing the project.

1. Embankments. Install portable concrete or steel barrier, plastic drums, barricades, tubular markers, plastic safety fence, and cones as specified on the Plans or TCPs to delineate open trenches, ditches, other excavations and hazardous areas when they exist along the roadway for more than one continuous work shift.

2. Adjacent Travel Lane Paving. When adjacent travel lanes or paved shoulders are not paved to the same elevation before the end of the shift, install: CW8-11 (Uneven Lanes), CW8-9 (Low Shoulder), CW8-9A (Shoulder Drop-Off), CW14-3 (No Passing Zone), R4-1 (Do Not Pass), R4-2 (Pass with Care), and CW8-1 (Bump) signs as appropriate. Place additional signs every 1500 feet if the section is longer than 1/2 mile.

3. Fixed Objects And Construction Vehicles And Equipment Working On Or Next To The Traveled Way. Do not park equipment in medians. Locate fixed objects at least 30 feet from the edge of traveled way. Fixed objects that exist prior to construction activity are not subject to this requirement unless the proposed temporary traffic routing moves the edge of traveled way closer to the pre-existing fixed object. Vehicles and other objects within parking lots in urban environments are considered

preexisting fixed objects regardless of whether they are or are not present continuously throughout the day.

When worksite restrictions, land features, right of way limitations, environmental restrictions, construction phasing, or other construction conditions allow no practicable location meeting the preceding requirements, the Engineer may approve alternate locations for fixed objects. Alternate locations shall be as far as practicable from the edge of traveled way. When the alternate location provides 15 feet or more separation from the edge of traveled way, the Engineer may verbally approve the alternate location. When the alternate location provides less than 15 feet separation, written approval is required.

When the Engineer determines a fixed object or fixed objects present unacceptable hazard, use drums or Type II barricades with flashing warning lights, or use portable concrete or steel barriers, or temporary crash cushion to delineate or shield the hazard, as approved by the Engineer.

4. Flagging. Furnish trained and competent flaggers and all necessary equipment, including lighting of the flagging position during nighttime operations, to control traffic through the traffic control zone. The Engineer will approve each flagging operation before it begins and direct adjustments as conditions change.

   Flaggers must be certified as one of the following:

   a. Flagging Level I Certification by IMSA

   b. Flagger Certification by ATSSA

   c. Traffic Control Supervisor, ATSSA

   d. Work Zone Safety Specialist, IMSA

   e. ATSSA Flagging Instructor

   Flaggers shall maintain current flagger certification. Flaggers must be able to show their flagger certification anytime they are on the project.

   Flaggers must maintain their assigned flagging location at all times, unless another qualified flagger relieves them, or the approved traffic control plan terminates the flagging requirements. Remove, fully cover, or lay down flagger signs when no flagger is present. Keep the flaggers' area free of encumbrances. Keep the flagger's vehicle well off the roadway and away from the flagging location so the flagger can be easily seen.

   Provide approved equipment for two-way radio communications between flaggers when flaggers are not in plain, unobstructed view of each other.

   Obtain the Engineer's written approval before flagging signalized intersections. When flagging a signalized intersection, either turn off and cover the traffic signal or place it in the All-Red Flash mode. Coordinate changing traffic signal modes and turning off or turning on traffic signals with the agency responsible for signal maintenance and operation and the Engineer. Get their written approval in advance. Only uniformed police officers are permitted to direct traffic in an intersection with an operating traffic signal.

5. Pilot Cars. Use pilot cars when part of an approved TCP.

   Organize construction operations so the total of all stoppages experienced by a vehicle traveling through a project does not exceed 20 minutes. Coordinate multiple pilot-car operations within a project or adjoining projects to minimize inconvenience to the traveling public. Two or more pilot cars may be used to provide two-way traffic through the traffic control zone to reduce the waiting period. The flagger or pilot car operator must record each pilot car's departure time in a bound field book

furnished by the Engineer. Whenever practical, the flagger should tell the motorist the reason for and approximate length of the delay. Make every reasonable effort to yield right-of-way to the public and prevent excessive delay.

Use an automobile or pickup as the pilot car, with the company logo prominently displayed. Equip the pilot car with a two-way radio for contact with flaggers and other pilot cars. Mount a G20-4 sign (Pilot Car Follow Me) on the rear at least 5 feet above the driving surface. Use high intensity flashing strobe lights, oscillating beacons, or rotating beacons on all Pilot Cars. Vehicle hazard warning lights may supplement but are not permitted to be used instead of high intensity flashing strobe lights, oscillating beacons, or rotating beacons. Identify the last vehicle in the column.

When pilot car operations are approved, establish all required pilot car traffic control devices before beginning work. Continue pilot car operations until no longer necessary and an approved TCP is in place for operations without pilot car, including all required traffic control devices.

6. Street Sweeping. Keep all paved portions of the roadway and haul routes open to the public, including sections of roadway off the project where operations have deposited loose material free of loose material.

7. Watering. Furnish, haul, and place water for dust control and pavement flushing, as directed. Use water trucks that can provide a high-pressure water stream to flush the pavement and a light-water spray to control dust. If the flushing operations contaminate or fill adjacent catch basins, clean and restore them to their original condition. This requirement includes sections of roadway off the project where flushing is required. The Engineer will control water application.

   When taking water from a lake, stream, or other natural water body, first obtain a water removal permit from the Alaska Department of Natural Resources. Comply with the Alaska Department of Fish and Game screening requirements for all water removal operations.

8. Portable Changeable Message Board Signs. Furnish Changeable Message Signs when approved on a TCP. Display only messages approved on the TCP. Follow application guidelines in the ATM.

9. Truck Mounted Attenuator (TMA.) TMAs are mounted on the rear of work vehicles. Impact attenuators are defined by NCHRP 350 or MASH as a category 3 device. TMAs shall be mounted on a vehicle with a minimum weight of 15,000 pounds and a maximum weight in accordance with the manufacturer's recommendations. TMAs shall have an adjustable height so that it can be placed at the correct elevation during usage and to a safe height for transporting. Approach ends of TMAs shall have impact attenuator markings in accordance with the ATM. Do not use a damaged attenuator in the work. Replace any damaged TMA at your expense.

10. Traffic Control Vehicles. Use high intensity flashing strobe lights, oscillating beacons, or rotating beacons on the Work Zone Supervisor's vehicle and on vehicles being used to transport and set-up traffic control devices. Vehicle hazard warning lights may supplement but are not permitted to be used instead of high intensity flashing strobe lights, oscillating beacons, or rotating beacons.

643-3.05 AUTHORITY OF THE ENGINEER. The Engineer will provide written notice when conditions may adversely affect the traveling public's safety and/or convenienceThe notice will state the defect(s), the corrective action(s) required, and the time required to complete such action(s). If corrective action(s) are not taken within the specified time, the Engineer will immediately close down the offending operations until the defect(s) are corrected. The Engineer may require outside forces to correct unsafe conditions. The cost of work by outside forces will be deducted from any monies due under the terms of this Contract.

643-3.06 TRAFFIC PRICE ADJUSTMENT. A Traffic Price Adjustment, under Item 643(23), will be assessed for unauthorized lane closures or reductions. Unauthorized lane reductions will be assessed as one full lane closure, for each lane reduced without authorization

Authorized lane closures and/or lane reductions are those shown in the Contract, an approved TCP, or authorized in writing.

Unauthorized lane reductions include unacceptable roadway, pedestrian walkway or route, and bicycle route or pathway surfaces, such as severe bumps, ruts, washboarding, potholes, excessive dust or mud, and non-conforming or out of place traffic control devices. Failure to install temporary crash cushions or barriers, when required according to the Contract or TCP, is also considered an unauthorized lane reduction. The Engineer will make the sole determination whether unauthorized lane reductions or closures are present.

Adjustment Rates are listed in Table 643-3. These rates are liquidated damages which represent highway user costs, based on Average Daily Traffic (ADT). The Engineer will use the rate shown for the current ADT for this project, as published in the Regional Traffic Volume Report prepared by the Department's Planning Section. Adjustment rates for unauthorized reduction or closure of each lane of pedestrian walkways or route, and bicycle route or pathway, are the same as for one full roadway lane closure.

TABLE 643-3
ADJUSTMENT RATES

Published ADT	**Dollars/Minute of Unauthorized Lane Reduction or Closure**
Less than 1,000	$2
1,000-4,999	$10
5,000-9,999	$30
10,000+	$40

643-3.07 MAINTENANCE OF TRAFFIC DURING SUSPENSION OF WORK. Approximately one month before work is suspended for the season, schedule a preliminary meeting with the Engineer and Maintenance & Operations to outline the work expected to be completed before shutdownSchedule a field review with the Department for winter maintenance acceptance. At the field review the Engineer will prepare a punch list for implementation before acceptance.

To be relieved of winter maintenance responsibility, leave all roads with a smooth and even surface for public use at all times. Properly crown the roadbed surface for drainage and install adequate safety facilities. Make sure all illumination and signals, including vehicle detectors, are in good working order.

After the project is accepted for winter maintenance and until ordered to resume construction operations, the Department is responsible for maintaining the facility. The Department will accept maintenance responsibility only for portions of the work that are open to the public, as determined by the Engineer. The Department will not accept maintenance responsibility for incomplete work adjacent to accepted roads. The contractor is responsible for maintaining all other portions of the work. The Engineer will issue a letter of “Acceptance for Winter Maintenance” that lists all portions of the work that the Department will maintain during a seasonal work suspension. The contractor retains all contractually required maintenance responsibilities until receipt of this letter.

If the contractor suspends work due to unfavorable weather (other than seasonal) or due to failure to correct unsafe conditions, carry out Contract provisions, or carry out the Engineer’s orders. All costs for traffic maintenance during the suspended period will be born by the contractor.

When work is resumed, replace or renew any work or materials lost or damaged during temporary use. If the Department caused damage during winter suspension, payment will be made for repairs by unit pay item or in accord with Subsection 109-1.05, Compensation for Extra Work. When the Engineer directs, remove any work or materials used in the temporary maintenance. Complete the project as though work has been continuous.

643-3.08 CONSTRUCTION SEQUENCING. The construction sequencing detailed in these provisions, the Special Provisions, and the Plans is suggested only. The contractor may propose alternative construction sequencing.

Throughout the project, maintain the existing roadway, pedestrian walkway or route, and bicycle route or pathway configuration (such as the number of lanes and their respective widths) except for restrictions to traffic allowed in the Special Provisions or on the Plans, and addressed through approved TCPs. A restriction to traffic is any roadway surface condition, work operation, or traffic control setup that reduces the number of lanes or impedes traffic. Obtain an approved TCP before restricting traffic.

Do not restrict traffic or shut down signals during the times listed in the Special Provisions.

643-3.09 INTERIM PAVEMENT MARKINGS. Place permanent or interim pavement markings according to this Subsection, details shown on the Plans, approved TCPs, and Parts III and VI of the ATM before opening existing paved roadways, temporary paved roadways, detours, interim paving lifts, and roadways with seal coats and surface treatments for more than one continuous work shift. This work may include restriping the existing roadway before beginning construction, before seasonal suspension, and/or after seasonal suspension.

Remove conflicting pavement markings according to Subsection 670-3.04, Paint Removal.

Mark existing roadway sections that will be opened to traffic during the winter. Mark over the existing lines and markings, unless shown otherwise on the Plans or an approved TCP.

Maintain all interim pavement markings for their intended life including reapplication when necessary. There will be no compensation to upgrade interim pavement markings required for work operations lasting up to 2 weeks.

Use only temporary raised pavement markers as interim pavement markings on final pavement surfaces. Completely remove and dispose of them when placing the final markings. Completely remove any residual adhesive that might misguide motorists. Place final pavement markings on finished pavement surfaces and interim pavement surfaces before suspending work for the winter.

Stage construction to avoid routing traffic over conflicting markings for more than one continuous workshift. If traffic is routed over conflicting markings during a workshift, delineate the roadway with a complement of warning signs, channelizing devices, and flaggers as required by the ATM.

Use only temporary raised pavement markers meeting Subsection 712-2.16 as interim markings on seal coat and surface treatment pavements. Install the markers according to the manufacturer’s instructions before applying the asphalt surface material and cover coat. Remove the vinyl protective covers after applying the asphalt pavement.

On multicourse surface treatments, install the temporary raised pavement markers after applying the full width of the first layer of cover coat. Install the markers on each day's completed surface before removing the pilot car operations and allowing unescorted traffic on the surface treatment.

Do not place final pavement markings until traffic has traveled over the seal coat or surface treatment for at least 14 days. Apply final pavement markings within 10 days of completing the final sweeping or brooming of the mainline seal coat or surface treatment.

643-3.10 LIGHTING FOR NIGHT WORK

Illuminate the night work areas according to Table 643-4.

Table 643-4 does not provide a comprehensive list of operations that require lighting. Provide lighting for other operations when necessary.

Use balloon lighting as the main light sources. Do not use floodlights without prior approval by the Engineer. When approved, install floodlighting in a manner that minimizes glare for motorists, workers, and residents living along the roadway. Locate, aim, louver, and/or shield light sources to achieve this goal.

The Engineer shall be the sole judge of when glare is unacceptable, either for traffic or for adjoining residences. When notified of unacceptable glare, modify the lighting system to eliminate it.

TABLE 643-4
NIGHT WORK ILLUMINATION EQUIPMENT AND LOCATION REQUIREMENTS

Type of Work or Equipment	Lighting Configuration
Paving, Milling, Striping, Pavement Marking Removal, Rumble Strip Installation	At least one machine-mounted balloon light of at least 2000 watts. Provide additional lights or wattage if necessary to provide complete coverage.
Rolling, pavement sweeping	At least 4 sealed beam halogen lamps in the front and four in the back. Each should be at least 55 watts.
Flagging	One balloon light of at least 2000 watts, located within 30 feet of the flagger location. Locate so the flagger and the flagging location are illuminated. Provide additional lights or wattage if necessary to provide complete coverage of the flagging location.
Truck Crossings where haul vehicles cross or enter a road with more than 10,000 ADT, or where the haul vehicle crossing or entering location is controlled by portable traffic signals or flaggers	At least one balloon light of at least 2000 watts, located on the main road on the far right side of the intersection. Locate light within 30 feet of the edge of the side street. If there is a flagger at the crossing, locate the lights or lights so the lighting requirements for Flagging are also satisfied.

If the Contractor fails to provide required lighting equipment or provides lighting that creates unacceptable glare, the Contractor shall cease all construction activities that require illumination, including flagging operations, until the condition or conditions are corrected.

Use lighting equipment in good operating condition and that complies with applicable OSHA, NEC, and NEMA codes.

Provide suitable brackets and hardware to mount lighting fixtures and generators on machines and equipment. Design mountings so lights can be aimed and positioned as necessary to reduce glare. Locate mounting brackets and fixtures so they don't interfere with the equipment operator or overhead structures. Connect fixtures securely in a manner that minimizes vibration.

Ensure ground, trailer, and equipment-mounted light towers or poles are sturdy and freestanding without the aid of guy wires. Towers shall be capable of being moved as necessary to keep pace with the construction operation. Position ground and trailer-mounted towers and trailers to minimize the risk of being impacted by traffic on the roadway or by construction traffic or equipment.

Raise trailer or equipment mounted lights to maximum height, except do not exceed the clearance required for overhead objects such as overhead signals, overhead signs, trees, aerial utilities, or bridges. Aim and adjust lights to provide the required light levels. Provide uniform illumination on the hopper, auger, and screed areas of pavers. Illuminate the operator's controls on all machines uniformly.

Furnish each side of non-street legal equipment with a minimum of 75 square inches high intensity retroreflective sheeting in each corner, so at least 150 square inches of sheeting is visible from each direction. Provide red sheeting on the rear of the equipment and yellow sheeting elsewhere.

Existing street and highway lighting and conventional vehicle headlights may supplement but do not relieve the Contract requirement to provide lighting for night work, according to the requirements of Table 643-4.

Provide sufficient fuel, spare lamps, spare generators, and qualified personnel to ensure that all required lights operate continuously during nighttime operations. Ensure generators have fuel tanks of sufficient capacity to permit operation of the lighting system for a minimum of 12 hours. In the event of any failure of the lighting system, discontinue the operation that requires illumination until the required level and quality of illumination is restored.

Maintain a supply of at least twenty emergency flares for use in the event of emergency or unanticipated situations. Comply with local noise ordinances.

Install all post-mounted electroliers located within the clear zone, on NCHRP 350 or MASH compliant breakaway bases.

643-3.11 HIGH VISIBILITY GARMENTS. Ensure all workers within project limits wear outer garments that are highly visible and comply with the following requirements:

1. Standards. Use high visibility garments conforming to the requirements of ANSI/ISEA 107-2004, Class 2 for tops or Class E for bottoms, and Level 2 retroreflective material.

2. Labeling. Use garments labeled in conformance with Section 11.2 of ANSI/ISEA 107-2004 or ANSI/ISEA 107-2010.

3. Tops. Wear high visibility vests, jackets, or coverall tops at all times.

4. Bottoms. Wear high visibility pants or coverall bottoms during nighttime work (sunset to sunrise). Worksite traffic supervisors, employees assigned to traffic control duties, and flaggers wear high visibility pants or coverall bottom at all times.

5. Outer Raingear. Wear raingear tops and bottoms conforming to the requirements of this Subsection 643-3.11.

6. Exceptions. When workers are inside an enclosed compartment of a vehicle, they are not required to wear high visibility garments.

7. Condition. Furnish and maintain all vests, jackets, coveralls, rain gear, hard hats, and other apparel in a neat, clean, and presentable condition. Maintain retroreflective material to Level 2 standards.

Payment for high visibility garments for workers is subsidiary to other traffic contract items.

643-4.01 METHOD OF MEASUREMENT. Section 109 and as follows. Quantities will not be measured during winter suspension of work.

1. Traffic Maintenance. Calendar Day: Every day shown on the calendar, beginning and ending at midnight. Measurement begins on the day following receipt of the Notice to Proceed or on the first day of work at the project site, whichever is later, and ends on the date of project completion.

2. Traffic Control Device Items. By the number of units of each bid item shown on the bid schedule (or the Traffic Control Rate Schedule, if item 643(25), Traffic Control, is included) that are installed, accepted, and operational. Incomplete or unsatisfactory devices will not be measured. Special Construction Signs are measured by the total area of legend-bearing sign panel, as determined under Subsection 615-4.01. Items measured by the day are for each item per 24-hour period.

3. Traffic Maintenance Setup Items. By each lane closure or one-lane road in place per hour. By each detour or road closure in place per 24-hour period.

4. Portable Concrete Barrier. By each nominal 12.5 foot section placed according to the approved TCPs, for the initial placement and for each subsequent relocation when moved more than 10 feet in any direction. Each transition piece (sloping end) will be measured as a single section.

5. Temporary Crash Cushion. By each acceptable installation.

6. Interim Pavement Marking. By the single-stripe station. A single stripe is a marking or a temporary raised pavement marker 4 inches wide. Wider striping is measured in multiples of 4 inches. Centerline gaps are not deducted from measurements.

7. Flagging and Pilot Car. By the number of approved hours, supported by certified payroll.

8. Street Sweeping. By the number of operated hours, supported by certified payroll and approved by the Engineer.

9. Watering. By the 1,000 gallons (M-Gallon) of water applied. The Engineer may specify measurement by weight or volume. If by weight, convert to gallons at 8.34 pounds per gallon. If by volume, convert to gallons at 7.48 gallons per cubic foot.

10. Traffic Price Adjustment. By each minute that any lane of traffic is not open to full use by the traveling public, measured to the nearest minute. The Engineer will determine whether the roadway is opened to full use.

11. Traffic Control. By the units specified in the Special Provisions.

12. Portable Changeable Message Board Sign. By the 24-hour period for each sign, as shown on an approved TCP and displaying an approved message.

13. Plastic Safety Fence. By the linear foot, as placed, to protect or channelize pedestrian traffic as shown on an approved TCP. Any adjustments in configuration of the fence at the same location that does not result in an increased amount of fence is not measured. Opening and closing the fence to gain access to and from the worksite is not measured.

14. Temporary Sidewalk Surfacing. By the square yard as shown on an approved TCP.

15. Temporary Guardrail. By the linear foot, including end treatments, as shown on an approved TCP.

16. Portable Steel Barrier. By the linear foot placed according to the manufacturer's recommendation and approved TCPs, for the initial placement, and for each subsequent relocation when moved more than 10 feet in any direction.

643-5.01 BASIS OF PAYMENT.

1. Traffic Maintenance. The contract price includes all resources required to provide the Worksite Traffic Supervisor, all required TCPs and public notices, the Construction Phasing Plan, and the maintenance of all roadways, approaches, crossings, intersections and pedestrian and bicycle facilities, as required. This item also includes any Traffic Control Devices required but not shown on the bid schedule.

   Items required by the Contract that are not listed on the bid schedule or not included in other items are subsidiary to Item 643(1) or 643(2) Traffic Maintenance, except the following:

   Traffic Price Adjustment
   Traffic Maintenance Setup

2. Traffic Control Device Items. The contract price includes all resources required to provide, install, maintain, move, and remove the specified devices. Warning lights, high-level warning devices, vertical panels, and sign supports required for traffic control devices are subsidiary.

3. Traffic Maintenance Setup Items. Each setup consists of all traffic control devices, flaggers, pilot cars, and subsidiary items necessary to implement the TCP shown on the Plans. Warning lights, high-level warning devices, vertical panels, and sign supports required for traffic control devices are subsidiary.

   Construction and obliteration of temporary roadways, when required on the Plans or approved TCP under a traffic maintenance setup item, is paid for under their respective roadway pay items.

   When topsoil or seeding is required for detours, payment will be made under Sections 620 and/or 618.

4. Portable Concrete Barrier. The contract price includes all resources required to provide, install, maintain, and remove each barrier section.

5. Temporary Crash Cushion. The contract price includes all resources required to provide, install, maintain, repair, and remove each crash cushion.

6. Interim Pavement Marking. The contract price includes all resources required to provide, install, maintain, and remove the specified markings. Installation of word and symbol markings are subsidiary. The No-Passing Zone signing, described in Subsection 643-3.04, is subsidiary.

7. Flagging and Pilot Car. The contract price includes all required labor, vehicles, radios, flagger paddles and pilot car signs, and transportation to and from the worksite.

8. Street Sweeping. The contract price includes all resources required to keep the roadway free of loose material.

9. Watering. The contract price includes all resources required to provide watering, as directed.

10. Traffic Price Adjustment. If Item 643(23), Traffic Price Adjustment, is shown on the bid schedule, the total value of this contract will be adjusted, for unauthorized lane reductions or closures, at the rates listed in Table 643-3.

11. Traffic Control. Payment for Item 643(25), Traffic Control, will be made at the unit rate value contained in the Traffic Control Rate Schedule shown in the Special Provisions for the accepted units of traffic control devices.

12. Portable Changeable Message Board Sign. The contract price includes all resources required to furnish, move, and operate the sign.

13. Plastic Safety Fence. The contract price includes all resources required to install, maintain, and remove the fence.

14. Temporary Sidewalk Surfacing. The contract price includes all resources required to construct, maintain, and remove the surfacing.

15. Temporary Guardrail. The contract price includes all resources required to construct, maintain, and remove the guardrail.

16. Portable Steel Barrier. The contract price includes all resources required to provide, install, maintain, move and remove each barrier.

17. Lighting for Night Work. Payment for illuminating night work areas and any required adjustments to work zone illumination is subsidiary to other items.

Traffic control devices, barriers, and crash cushions required to delineate or shield fixed objects will not be measured or paid for separately, but will be subsidiary

Traffic control devices, barriers, and crash cushions required to delineate or shield guardrail posts or non-crashworthy ends will not be measured or paid for separately, but will be subsidiary, when required for failure to meet completion timelines in subsection 606-3.01.

Payment will be made under:

Pay Item	Pay Unit
643(1) Traffic Maintenance	Calendar Day
643(2) Traffic Maintenance	Lump Sum
643(3) Permanent Construction Signs	Lump Sum
643(4) Construction Sign	Day
643(5) Type II Barricade	Day
643(6) Type III Barricade	Day
643(7) Traffic Cone/Tubular Marker	Day
643(8) Plastic Safety Fence	Linear Foot
643(9) Drum	Day
643(10) Sequential Arrow Panel, Type C	Day
643(11) Special Construction Signs	Square Foot
643(12) Portable Concrete Barrier	Each
643(13) Temporary Crash Cushion	Each
643(14) Interim Pavement Marking	Station
643(15) Flagging	Hour
643(16) Pilot Car	Hour
643(17) Street Sweeping	Hour
643(18) Watering	M-Gallon
643(19) Lane Closure	Hour
643(20) Detour	Day
643(21) Road Closure	Day
643(22) One Lane Road	Hour
643(23) Traffic Price Adjustment	Contingent Sum
643(24) Portable Changeable Message Board Sign	Day
643(25) Traffic Control	Contingent Sum
643(26) Temporary Sidewalk Surfacing	Square Yard
643(27) Temporary Guardrail	Linear Foot
643(28) Power Brooming (Retired)	Hour
643(29) Steel F Shaped Barrier (Retired)	Linear Foot
643(30) Portable Steel Barrier	Linear Foot

STATEWIDE SPECIAL PROVISION **01/01/16**
SSP-36

Delete subsection 710-2.11 Guardrail Terminals and replace with the following:

SECTION 710
FENCE AND GUARDRAIL

710-2.11 GUARDRAIL TERMINALS. Meet coating requirements of AASHTO M 180, Class A, Type II. Galvanize after fabrication. Fabrication includes forming, cutting, shearing, punching, drilling, bending, welding and riveting. Provide one of the following terminal types, as shown on the plans, for single-rail W-beam guardrail. Provide terminals that pass NCHRP 350 or MASH Test Level 3 and meet the following requirements:

1. Controlled Release Terminal. Meet the requirements of Standard Drawing G-25.

2. Parallel Terminal.

    a. Requirements:

        (1) Crashworthiness: Provide terminals that pass NCHRP 350 or MASH Test Level 3.

        (2) Length: 50 feet.

        (3) End Offset: 0 to 2 feet (25:1 or flatter straight taper) Offset end as shown on the plans.

        (4) Posts: Use posts that are:

            (i) Steel post with hinge or

            (ii) Yielding or breakaway steel post in steel tube

    b. Acceptable models include the following or approved equivalent:

        (1) Sequential Kinking Terminal (SKT) manufactured by Road Systems, Inc., 3616 Old Howard County Airport, Big Spring, Texas 79720, Telephone 432-263-2435.

        (2) Extruder Terminal (ET-Plus) manufactured by Trinity Highway Products, L.L.C., 950 West 400 South, Centerville, Utah 84014, Telephone 801-292-4461.

    c. Install ASTM D4956 Type III, IV, or V retroreflective sheeting (2.0 square feet, minimum) on the end section of parallel terminals consisting of yellow and black bars sloping 45 degrees downward toward the traffic side of the terminal.

3. Buried in Backslope Terminal: Meet the requirements of Standard Drawing G-15.

STATEWIDE SPECIAL PROVISION **01/01/16**
SSP-37

Delete Section 615 Standard Signs and replace with the following:

SECTION 615
STANDARD SIGNS

615-1.01 DESCRIPTION. Furnish and install standard signs and delineators. Remove and relocate or remove and dispose of existing signs and markers, as specified.

615-2.01 MATERIALS. Use materials that conform to the following Subsections:

Sheet Aluminum	730-2.01
High Density Overlaid Plywood	730-2.02
Retroreflective Sheeting, ASTM D4956	730-2.03
Sign Posts	730-2.04
Delineator Posts	730-2.05
Acrylic Prismatic Reflectors	730-2.06

1. Shop Drawings. Submit shop drawings, for all signs that must meet the ASDS letter width and spacing charts, for approval before fabrication. Submit 4 sets of collated shop drawings prepared according to Subsection 105-1.02. Show the following on each sign drawing:

   a. Dimensions of all horizontal and vertical characters and spaces

   b. Overall dimensions

   c. Sign material and sheeting material type

   d. Panel thickness

   e. Legend and letter series

   f. Whether the sign will be framed

2. Sign Fabrication. Use ASTM D4956 Type IV retroreflective sheeting (for lettering, symbols, borders, and background) on sheet aluminum panels for all signs except the following:

   a. Orange Background Signs:

      Use ASTM D4956 Type VIII or Type IX fluorescent orange retroreflective sheeting. For temporary installations, place reflective sheeting on sheet aluminum, plastic, or plywood panels.

      For Roll-Up signs use 3M series RS 24, Reflexite Marathon Orange, or approved equal (based on durability and reflectivity, as determined by the Engineer). Use flexible signs with fluorescent retroreflective sheeting that is ASTM D4956 Type VI or better.

   b. Railroad Crossbucks and Vertical Crossbuck Supports: Use white ASTM D4956 Type VIII or Type IX retroreflective sheeting for background of sign and all strips.

   c. Non-Illuminated Overhead Signs with White Legends on Green Backgrounds: Use ASTM D4956 Type IX retroreflective sheeting for legends and background. Create the legend in one of the following ways:

      (1) Cut border and legend from white ASTM D4956 Type IX retroreflective sheeting and adhere them to a green ASTM D4956 Type IX background, or

(2) Cut stencil of border and legend out of green transparent acrylic film and use transparent adhesive to overlay the film on a white ASTM D4956 Type IX retroreflective background.

d. Fluorescent Yellow-Green School Area Signs: Use ASTM D4956 Type VIII or Type IX retroreflective sheeting for background.

Use a manufacturer-recommended clear coat on all screened signs.

Use sign layouts (including characters, symbols, corner radii, and borders) that conform to the ASDS.

Frame all rectangular signs over 53 inches (measured along the horizontal axis) and all diamond shape signs 60 x 60 inches and larger. Construct the frames of aluminum as indicated on the Plans.

3. Sign Posts and Bases. Use sign posts and bases of the types specified. The structural aspects of design and materials for sign supports must comply with the AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals. Do not splice sign posts.

   Use Class A concrete for steel-reinforced slip base and breakaway base foundations meeting the requirements of Section 501. Concrete for other sign foundations may be Class W.

4. Delineators. Use delineator assemblies that conform to the requirements shown on the Plans. Fabricate flexible delineators using ASTM 4956 Type III, IV, or V Retroreflective Sheeting.

5. Reflective Sheeting Warranty. Supply manufacturer's warranty for reflective sheeting, including retention of fluorescent yellow-green (measured in accordance with ASTM E2301) for ten years according to the following criteria:

   a. Minimum Fluorescent Luminance Factor Y_F: 20%

   b. Minimum Total Luminance Factor Y_T: 35%

   The warranty shall stipulate that: If the sheeting fails to meet the minimum fluorescence values within the first 7 years from the date of fabrication, the manufacturer shall, at the manufacturer's expense, restore the sign surface to its original effectiveness. If the reflective sheeting fails to meet the minimum fluorescence values within the 8th through 10th year from the date of fabrication, the manufacturer shall, at the manufacturer's expense, provide enough new replacement sign sheeting to the Department to restore the sign surface to its original effectiveness.

615-3.01 CONSTRUCTION REQUIREMENTS.

1. Place wooden posts in excavated holes to the depth shown on the Standard Drawings.

2. Backfill the space around the posts in the holes to finish ground with selected earth or sand, free of rocks or deleterious material. Place backfill in layers approximately 6 to 12 inches thick and thoroughly compact it.

3. Dispose of surplus excavated material neatly along the adjacent roadway as directed.

4. Install flexible delineator posts according to the manufacturer's recommendations.

5. Attach sign panels to posts, electroliers, traffic signal standards, bridge rails, piers, and abutments using the types and sizes of fastening hardware shown on the Plans.

6. If using existing signs and mileposts that are removed and relocated, ensure they conform to the details shown on the Plans or as directed.

7. Notify the Engineer 5 working days prior to beginning sign salvage activities. The Engineer will physically identify those signs to be salvaged. Protect all items from damage during salvaging and delivery. For each sign so designated, disconnect sign post from panel and group the panels together. Group posts together with their hardware. Deliver sign panels, posts and hardware to the

State Maintenance Yard noted in the Special Provisions. Do not deliver salvaged materials until they have been inspected and approved by the Engineer. Replace any items damaged by you at no additional cost to the Department.

Remove and dispose of project signs and/or parts designated for removal and not selected for salvage.

Dispose of foundations from salvaged existing signs in a manner approved of by the Engineer (remove and dispose, abandoned in place, or otherwise). If they are abandoned in place, remove the tops of the foundations, reinforcing steel, anchor bolts, and conduits to a depth of not less than 12 inches below roadway subgrade or unimproved ground, whichever applies. All signs and posts at a single installation will be considered as one unit.

8. All materials and finished signs are subject to inspection and acceptance in place.

    a. Surfaces exposed to weathering must be free of defects in the coating that impair serviceability or detract from general appearance or color match.

    b. Finished signs must be clean and have no chatter marks, burrs, sharp edges, loose rivets, delaminated reflective sheeting, or aluminum marks. Do not make repairs to the face sheet.

9. Install the various breakaway assemblies according to the manufacturer's written instructions.

10. Secure the anchors in templates and install them according to the manufacturer's written instructions.

11. Finish the foundation according to these tolerances:

    a. Do not use more than two shims per coupling.

    b. Do not use more than three shims to plumb each post.

12. Remove and replace all foundations requiring more than three shims to plumb a post without extra compensation.

13. Construct the top of any foundation located on a slope so that the finished slope passes through the top center of the foundation. Grade the area 24 inches up and down slope of the foundation edge so that no portion of the foundation projects above the surrounding slope and water will drain away from the foundation.

14. Attach a label to the back of all standard signs in the lower right corner. Make the label at least 15 square inches and show the year the sign was purchased from the manufacturer. Show the last two digits of the year in clear and bold numbers. Make the label from ASTM D4956 Type I or brighter retroreflective sheeting. Use background and legend colors meeting Table 615-1.

TABLE 615-1
DECAL COLORS

YEAR	BACKGROUND COLOR	LEGEND COLOR
XXX1	Yellow	Black
XXX2	Red	White
XXX3	Blue	White
XXX4	Green	White
XXX5	Brown	White
XXX6	Orange	Black
XXX7	Black	White
XXX8	White	Black
XXX9	Purple	White
XXX0	Strong Yellow-Green	Black

YEAR	BACKGROUND COLOR	LEGEND COLOR

Central values and tolerance limits for each color, as referenced in the MUTCD, are available from the Federal Highway Administration, (HHS-30), 400 7th St. SW, Washington, D.C. 20590

615-3.02 SIGN PLACEMENT AND INSTALLATION. The location and type of installation will be as shown on the Plans. Sign locations are approximate and subject to field adjustment by the Engineer.

Do not allow the top of the embedded steel tube to extend more than 2 inches above the surrounding ground and concrete foundation.

On all signs, install 2-inch diameter wind washers, colored to match the sign face, between the fastener head and the sign. Use rust-resistant washers fabricated from a material equal in strength to the sign blank.

Mount signs on mast arms level.

Bring existing signs that are to remain, into conformance with Standard Drawing S-05. Keep existing signs in service until they are no longer needed.

615-4.01 METHOD OF MEASUREMENT.

Standard Signs and Object Markers. By the total area of legend-bearing sign panel erected in place. No deductions in quantity for corner rounding will be made. Nominal dimensions for sign sizes indicated on the Plans will be used to calculate sign pay quantities. Octagons and round signs will be measured as rectangles. Only one side of each double-faced sign will be measured for payment.

Removal and Relocation. By each, complete in place.

Delineators. By each, complete in place. A single delineator consists of one post equipped with two reflectors.

Salvage Sign. By each complete sign delivered in acceptable condition.

615-5.01 BASIS OF PAYMENT. Sign posts, bases, and mounting hardware are subsidiary.

When Items 615(2), 615(3), or 615(6) do not appear on the bid schedule, this work is subsidiary.

Payment will be made under:

Pay Item	Pay Unit
615(1) Standard Sign	Square Foot
615(2) Remove and Relocate Existing Sign	Each
615(3) Remove and Relocate Milepost	Each
615(4) Delineator, Rigid	Each
615(5) Delineator, Flexible	Each
615(6) Salvage Sign	Each