

REPORT

*Phase 1 Intermediate Design Report
Hudson River PCBs Superfund Site*

Phase 1 Intermediate Design Specifications



**General Electric Company
Albany, New York**

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Draft – Not For Construction

BBL[®]
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engineers, scientists, economists

Section 02000s

Site Construction

MATERIALS AND PERFORMANCE – SECTION 02201

EARTHWORK

PART 1 - GENERAL

1.01 WORK SPECIFIED

- A. Excavation and backfilling, including the loosening, removing, refilling, transporting, storage, and disposal of all materials classified as “earth” necessary to be removed for the construction and completion of all work under the Contract.
- B. Excavation to the widths and depths shown on the Contract Drawings or as specified.
- C. Removal and disposal of water.

1.02 RELATED WORK SPECIFIED UNDER OTHER SECTIONS

Documents affecting work of this section include, but are not necessarily limited to the following:

TBD

1.03 SUBMITTALS

TBD

1.04 DEFINITIONS

- A. Excavation
 - 1. Removal of materials of whatever nature encountered, whether wet, frozen, or otherwise, including dense tills, hardpan, cemented materials, concrete fragments, asphalt pavement, boulders or rock fragments, and weathered rock which can be removed by ripping or excavating with heavy-duty mechanical construction equipment without drilling and blasting.
- B. Earth
 - 1. All materials such as sand, gravel, clay, loam, ashes, cinders, pavements, muck, roots, or pieces of timber, soft or disintegrated rock, not requiring blasting, barring, or wedging from their original beds, and specifically excluding all ledge or bedrock and individual boulders or masonry larger than ½ cubic yard in volume.

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- C. Backfill
 - 1. The refilling of excavation and trenches to grades shown on the Contract Drawings or as directed using materials suitable for refilling of excavations and trenches; and the compacting of all materials used in filling or refilling by rolling, ramming, or as may be required and approved by the _____.
 - D. Spoil
 - 1. Surplus excavated materials not required or not suitable for backfills or embankments.
 - E. Embankments
 - 1. Fills constructed above the original grade or such other elevation as specified or directed.
 - F. Limiting Subgrade
 - 1. The underside of the pipe barrel for pipelines.
 - 2. The underside of footing lines for structures.
 - 3. The bottom of the lowest course for pavement sections.
 - G. Excavation Below Subgrade
 - 1. Excavation below the limiting subgrades of structures, pipelines, or pavements.
 - 2. Where materials encountered at the limiting subgrades are not suitable for proper support of structures, pipelines, or pavement the _____ Contractor shall excavate to such new lines and grades as required.
- 1.05 APPLICABLE CODES, STANDARDS, AND SPECIFICATIONS
- A. American Society for Testing and Materials (ASTM).

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PART 2 - PRODUCTS

2.01 MATERIALS

A. Wood Sheeting and Bracing

1. Shall be sound and straight; free from cracks, shakes, and large or loose knots; and shall have dressed edges where directed.
2. Shall conform to National Design Specifications for Stress Grade Lumber having a minimum fiber stress of 1,200 pounds per square inch.
3. Sheeting and bracing to be left-in-place shall be pressure-treated in accordance with ASTM D1760 for the type of lumber used and with a preservative approved by the _____.

B. Steel Sheeting and Bracing

1. Shall be sound.
2. Shall conform to ASTM A328 with a minimum thickness of 3/8 inch.

C. General Fill Material

1. Free of rocks or lumps larger than 3 inches, loam, organic matter, very soft clays, swelling clays, or fine uniform sands that may be difficult to compact.
2. General fill may be obtained from existing on-site areas designated for excavation or from an off-site source approved by _____.
3. ASTM D2487 Group Symbol: Any, except CH, MH, OL, and OH.

PART 3 - EXECUTION

3.01 UNAUTHORIZED EXCAVATION

A. Description

1. Whenever excavations are carried beyond or below the lines and grades shown on the Contract Drawings, or as given or directed by the _____, all such excavated space shall be refilled with special granular materials, concrete or other materials as the _____ may

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direct. All refilling of unauthorized excavations shall be at the _____ Contractor's expense.

2. All material which slides, falls, or caves into the established limits of excavations due to any cause whatsoever, shall be removed and disposed of at the _____ Contractor's expense and no extra compensation will be paid to the _____ Contractor for any materials ordered for refilling the void areas left by the slide, fall, or cave-in.

3.02 REMOVAL OF WATER

A. General

1. The _____ Contractor shall, at all times, provide and maintain proper and satisfactory means and devices for the removal of all water entering the excavations, and shall remove all such water as fast as it may collect, in such manner as shall not interfere with the prosecution of the work or the proper placing of pipes, structures, or other work. Removal of water which enters excavations shall be coordinated with the _____.
2. Unless otherwise specified, all excavations which extend down to or below the static groundwater elevations shall be dewatered by lowering and maintaining the groundwater beneath such excavations at all times when work thereon is in progress, during subgrade preparation, and placing of the structure or pipe thereon.
3. Water shall not be allowed to rise over or come in contact with any masonry, concrete, or mortar until at least 24 hours after placement, and no stream of water shall be allowed to flow over such work until such time as the _____ may permit.
4. Where the presence of fine-grained subsurface materials and a high groundwater table may cause the upward flow of water into the excavation with a resulting quick or unstable condition, the _____ Contractor shall install and operate an approved well point system designed by a registered Professional Engineer to prevent the upward flow of water during construction.
5. Water pumped or drained from excavations, or any sewers, drains, or water courses encountered in the work, shall be disposed of in a suitable manner without injury to adjacent property, the work under construction or to pavement, roads, drives, and water courses. All water discharge points shall be approved by the _____. No water shall be discharged to sanitary sewers. Sanitary sewage shall be pumped to sanitary sewers or shall be disposed of by an approved method.

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6. Any damage caused by or resulting from dewatering operations shall be the sole responsibility of the _____ Contractor.

B. Work Included

1. Construction and removal of cofferdams, sheeting, and bracing and the furnishing of materials and labor necessary therefore.
2. Excavation and maintenance of ditches and sluiceways.
3. Furnishing and operation of pumps, well points, and appliances needed to maintain thorough drainage of the work in a satisfactory manner.

C. Well Point Systems

1. Installation

- a. The well point system shall be designed and installed by or under the supervision of an organization whose principal business is well pointing and which has at least five consecutive years of similar experience and can furnish a representative list of satisfactory similar operations.
- b. Well point headers, points, and other pertinent equipment shall not be placed within the limits of the excavation in such a manner or location as to interfere with the laying of pipe or trenching operations or with the excavation and construction of other structures.
- c. Detached observation wells of similar construction to the well points shall be installed at intervals of not less than 50 feet along the opposite side of the excavation from the header pipe and line of well points, to a depth of at least 5 feet below the proposed excavation. In addition, one well point in every 50 feet shall be fitted with a tee, plug, and valve so that the well point can be converted for use as an observation well. Observation wells shall be not less than 1½ inches in diameter.
- d. Standby gasoline or diesel-powered equipment shall be provided so that in the event of failure of the operating equipment, the standby equipment can be readily connected to the system. The standby equipment shall be maintained in good order and actuated regularly not less than twice a week.

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2. Operation
 - a. Where well points are used, the groundwater shall be lowered and maintained continuously (day or night) at a level not less than 2 feet below the bottom of the excavation. Excavation will not be permitted at a level lower than 2 feet above the water level as indicated by the observation wells.
 - b. The effluent pumped from the well points shall be examined periodically by qualified personnel to determine if the system is operating satisfactorily without the removal of fines.
 - c. The water level shall not be permitted to rise until construction in the immediate area is completed and the excavation backfilled.

3.03 STORAGE OF MATERIALS

- A. Sod
 1. Any sod cut during excavation shall be removed and stored during construction so as to preserve the grass growth. Sod damaged while in storage shall be replaced in like kind at the sole expense of the _____ Contractor.
- B. Topsoil
 1. Topsoil suitable for final grading shall be removed and stored separately from other excavated material.
- C. Excavated Materials
 1. All excavated materials shall be stored in locations approved by the _____ so as not to endanger the work, and so that easy access may be had at all times to all parts of the excavation. Stored materials shall be kept neatly piled and trimmed, so as to cause as little inconvenience as possible to public traveler or adjoining property holders.
 2. Special precautions must be taken to permit access at all times to fire hydrants, fire alarm boxes, police and fire department driveways, and other points where access may involve the safety and welfare of the general public.

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3.04 EXAMINATION

- A. Verify that survey benchmarks and existing and intended elevations are as shown on the Drawings.
- B. **Monitoring Wells Requiring Protection:** Contractor will locate and mark locations prior to commencement of excavation. Contractor shall protect existing monitoring wells from damage during performance of the work. Damage to existing monitoring wells resulting from Contractor activities shall be repaired by the _____ Contractor, to the satisfaction of the _____, at no additional cost to the _____.
- C. **Existing Installations:** Any installations identified during the pre-construction Site inspections that require protection shall be protected by the _____ Contractor during the entire duration of the project. Any damage to existing installations resulting from Contractor activities shall be repaired by the _____ Contractor, to the satisfaction of the _____, at no additional cost to the _____.

3.05 PREPARATION

- A. Prepare site for excavation work including clearing and grubbing; inspection and sealing of permanent structures; and establishment of property boundaries, excavation limits, and pre-excavation elevations.
- B. Demolish and dispose of all remaining non-permanent structures/items scheduled for removal or removal and replacement in-kind.
- C. Identify required lines, levels, contours, and datum locations.
- D. Locate, identify, and protect utilities from damage. Confirm locations of buried utilities and structures (if any) by suitable means.
- E. Arrange for utility company to identify utilities.
- F. Protect plant life, trees, and other features not scheduled for removal.
- G. Maintain and protect from damage benchmarks and survey control points, monitoring wells, utilities, buildings, building foundations, surface features, and any other structures encountered not designated for demolition or removal. In the event of disturbance of or damage to any such structures, immediately notify Engineer. Any damage or disturbance to such structures resulting from Contractor activities shall be repaired by the _____ Contractor, to the satisfaction of the _____, at no additional cost to the _____.

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- H. Install sediment and erosion control devices in accordance with the RA Work Plan and Pre-Construction Site Sediment and Erosion Control Plan.

3.06 DISPOSAL OF MATERIALS

A. Spoil Material

1. Spoil material shall be disposed off site at a location approved by the _____. Locating, maintaining, and transport to such sites shall be the responsibility of the _____ Contractor and no separate payment will be made for such work.

3.07 SHEETING AND BRACING

A. Installation

1. The _____ Contractor shall furnish, place and maintain such sheeting, bracing and shoring as may be required to support the side and ends of excavations in such manner as to prevent any movement which could, in any way, injure the pipe, structures, or other work; diminish the width necessary for construction; otherwise damage or delay the work of the Contract; endanger existing structures, pipes or pavements; or cause the excavation limits to exceed the right-of-way limits.
2. In no case will bracing be permitted against pipes or structures in trenches or other excavations.
3. Sheeting shall be driven as the excavation progresses and in such manner as to maintain pressure against the original ground at all times. The sheeting shall be driven vertically with the edges tight together, and all bracing shall be of such design and strength as to maintain the sheeting in its proper position.
4. The _____ Contractor shall be solely responsible for the adequacy of all sheeting and bracing.

B. Removal

1. In general, all sheeting and bracing, whether of steel, wood, or other material, used to support the sides of trenches or other open excavations, shall be withdrawn as the trenches or other open excavations are being refilled. That portion of the sheeting extending below the top of a pipe or structural foundation shall not be withdrawn, unless otherwise directed, before more than 6 inches of earth is placed above the top of the pipe or structural foundation and before any bracing is removed. The voids left by the sheeting shall be carefully refilled with selected material

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and rammed tight with tools especially adapted for the purposes or otherwise as may be approved.

2. The _____ Contractor shall not remove sheeting and bracing until the work has attained the necessary strength to permit placing of backfill.

C. Left in Place

1. If, to serve any purpose of his own, the _____ Contractor files a written request for permission to leave sheeting or bracing in the trench or excavation, the _____ may grant such permission, in writing, on condition that the cost of such sheeting and bracing be assumed and paid by the _____ Contractor.
2. The _____ Contractor shall leave in place all sheeting, shoring, and bracing which are shown on the Contract Drawings or specified to be left in place, or which the _____ may order in writing to be left in place. All shoring, sheeting, and bracing shown or ordered to be left in place will be paid for under the appropriate item of the Contract or by negotiated price, as applicable. No payment allowance will be made for wasted ends or for portions above the proposed cutoff level which are driven down instead of cut-off.
3. In case sheeting is left in place, it shall be cut off or driven down as directed so that no portion of the same shall remain within 12 inches of the street subgrade or finished ground surface.

3.08 BACKFILLING

A. General

1. All excavations shall be backfilled to original grade or to such other grades as may be shown, specified or directed.
2. Backfilling shall be done with suitable excavated materials which can be satisfactorily compacted during refilling of the excavation. In the event the excavated materials are not suitable, Special Backfill as specified or ordered by the _____ shall be used for backfilling.
3. Any settlement occurring in the backfilled excavations shall be refilled and compacted.

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- B. Unsuitable Materials
1. Stones, pieces of rock, or pieces of pavement greater than 1 cubic foot in volume or greater than 1½ feet in any single dimension shall not be used in any portion of the backfill.
 2. All stones, pieces of rock, or pavement shall be distributed through the backfill and alternated with earth backfill in such a manner that all interstices between them shall be filled with earth.
 3. Frozen earth shall not be used for backfilling.
- C. Compaction and Density Control
1. The compaction shall be as specified for the type of earthwork, i.e., structural, trenching, or embankment.
 - a. The compaction specified shall be the percent of maximum dry density.
 - b. The compaction equipment shall be suitable for the material encountered.
 2. Where required, to assure adequate compaction, in-place density test shall be made by an approved testing laboratory.
 - a. The moisture-density relationship of the backfill material shall be determined by ASTM D698, Method D.
 - 1) Compaction curves for the full range of materials used shall be developed.
 - b. In-place density shall be determined by the methods of ASTM D1556 or ASTM D2922 and shall be expressed as a percentage of maximum dry density.
 3. Where required, to obtain the optimum moisture content, the _____ Contractor shall add, at his expense, sufficient water during compaction to assure the specified maximum density of the backfill. If, due to rain or other causes, the material exceeds the optimum moisture content, it shall be allowed to dry, assisted if necessary, before resuming compaction or filling efforts.
 4. The _____ Contractor shall be responsible for all damage or injury done to pipes, structures, property or persons due to improper placing or compacting of backfill.

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EARTHWORK

3.09 OTHER REQUIREMENTS

A. Drainage

1. All materials deposited in roadway ditches or other water courses shall be removed immediately after backfilling is completed and the section, grades and contours of such ditches or water courses restored to their original condition, in order that surface drainage will be obstructed no longer than necessary.

B. Unfinished Work

1. When, for any reason, the work is to be left unfinished, all trenches and excavations shall be filled and all roadways, sidewalks and watercourses left unobstructed with their surfaces in a safe and satisfactory condition. The surface of all roadways and sidewalks shall be restored with temporary pavement.

C. Hauling Material on Streets

1. When it is necessary to haul material over the streets or pavement, the _____ Contractor shall provide suitable tight vehicles so as to prevent deposits on the street or pavements. In all cases where any materials are dropped from the vehicles, the _____ Contractor shall clean same as often as required to keep the crosswalks, streets, and pavements clean and free from dirt, mud, stone, and other hauled material.

D. Test Pits

1. For the purpose of obtaining detailed locations of underground obstruction, the _____ Contractor shall make excavations in advance of the work. The _____ Contractor shall consider such work as incidental to the work involved, and no separate payment will be made for such work.

- END OF SECTION -

MATERIALS AND PERFORMANCE – SECTION 02203

STRUCTURAL EXCAVATION, BACKFILL, AND COMPACTION

PART 1 - GENERAL

1.01 WORK SPECIFIED

- A. Excavation and backfill as required for the construction of structures in accordance with the applicable provisions of Section 02201 - Earthwork, unless modified herein.
- B. Removal and disposal of water.

1.02 RELATED WORK SPECIFIED UNDER OTHER SECTIONS

Documents affecting work of this section include, but are not necessarily limited to the following:

TBD

1.03 SUBMITTALS

TBD

PART 2 - PRODUCTS

NOT USED

PART 3 - EXECUTION

3.01 GENERAL

- A. Limits of Excavation
 - 1. Excavations shall be made to the elevations or subgrades specified and shall be only of sufficient size to allow suitable room for the proper construction of structures and appurtenances, including allowances for sheeting, dewatering, and other similar work necessary for completion of the Contract.
 - 2. Normal subgrade for structures shall be the underside of footing lines or mud mats, if installed.
 - 3. In no case will undercutting excavation faces be permitted.

MATERIALS AND PERFORMANCE – SECTION 02203

STRUCTURAL EXCAVATION, BACKFILL, AND COMPACTION

B. Subsurface Reinforcement

1. Where an unstable subgrade is encountered and subject to the approval of the _____, select fill may be used for subgrade reinforcement if satisfactory results can be obtained thereby. Such material shall be applied in thin layers; each layer being entirely embedded in the subsoil by thorough tamping.
2. All excess material shall be removed to compensate for the displacement by the select fill and the finished elevation shall not be above the specified subgrade.
3. Where subgrade reinforcement is unsatisfactory, a Class “D” concrete mud mat of sufficient thickness to withstand subsequent construction operations shall be installed below the specified elevation and the structural concrete deposited thereon.

C. Subsurface

1. Subsurface for all concrete structures shall be undisturbed original earth or, mud mat on undisturbed original earth, or where excavation below subgrade is ordered, it shall be thoroughly compacted special backfill or Class “D” concrete as specified or directed and shall be sufficiently stable to remain firm and intact during the preparation for the placing of concrete thereon.

D. Removal of Water

1. The _____ Contractor shall, at all times, provide and maintain proper and satisfactory means and devices for the removal of all water entering the excavations, and shall remove all such water as fast as it may collect, in such manner as shall not interfere with the performance of the work or the proper placing of pipes, structures, or other work.
2. The removal of water shall be in accordance with Section 02201 - Earthwork.

E. Backfilling

1. Backfilling shall be with suitable excavated materials which can be compacted as specified. In the event the excavated materials are not suitable, special backfill as specified or ordered by the _____ shall be used for backfilling.
2. Backfilling around structures shall not be commenced before the structure has developed sufficient strength to withstand the loads applied.

MATERIALS AND PERFORMANCE – SECTION 02203

STRUCTURAL EXCAVATION, BACKFILL, AND COMPACTION

No backfill material shall be allowed to fall directly on a structure until at least 12 inches of material has been hand-placed and compacted, nor shall any material be pushed directly against a structure in backfilling.

3. Backfill shall be deposited in horizontal layers and at no greater thickness than can be compacted to obtain the specified minimum densities.

F. Compaction

1. Where structures, driveways, sidewalks, or other features are to be constructed on the backfilled area, the entire backfill shall be compacted to obtain 95 percent maximum density. Other areas shall be compacted to obtain 90 percent density.
2. The density shall be determined as set forth in Section 02201 - Earthwork.

- END OF SECTION -

MATERIALS AND PERFORMANCE – SECTION 02204

TRENCHING, BACKFILLING, AND COMPACTING

PART 1 - GENERAL

1.01 WORK SPECIFIED

- A. Excavation and backfill as required for pipe installation or other construction in the trench in accordance with the applicable provisions of the section entitled Earthwork unless modified herein.
- B. Removal and disposal of water.

1.02 RELATED WORK SPECIFIED UNDER OTHER SECTIONS

Documents affecting work of this section include, but are not necessarily limited to the following:

TBD

1.03 SUBMITTALS

TBD

PART 2 - PRODUCTS

NOT USED

PART 3 - EXECUTION

3.01 EXCAVATION

- A. The trench excavation shall be located as shown on the Contract Drawings or as specified. Under ordinary conditions, excavation shall be by open cut from the ground surface. Where the depth of trench and soil conditions permit, tunneling may be required beneath cross walks, curbs, gutters, pavements, trees, driveways, railroad tracks, and other surface structures.
- B. Trenches shall be excavated to maintain the depths as shown on the Contract Drawings or as specified for the type of pipe to be installed.
- C. The alignment and depth shall be determined and maintained by the use of a string line installed on batter boards above the trench, a double string line installed along side of the trench or a laser beam system.
- D. The minimum width of trench excavation shall be 6 inches on each side of the pipe hub for 21-inch diameter pipe and smaller and 12 inches on each side of the pipe hub for larger diameter pipe.

MATERIALS AND PERFORMANCE – SECTION 02204

TRENCHING, BACKFILLING, AND COMPACTING

- E. Trenches shall not be opened for more than 300 feet in advance of pipe installation nor left unfilled for more than 100 feet in the rear of the installed pipe when work is in progress without the consent of the _____. Open trenches shall be protected and barricaded as required. There will be no trenches left open at the close of each working day unless properly protected.
- F. Bridging across open trenches shall be constructed and maintained where required, or as specified or directed.

3.02 SUBGRADE PREPARATION FOR PIPE

- A. Where pipe is to be laid on undisturbed bottom of excavated trench, mechanical excavation shall not extend lower than the finished subgrade elevation at any point.
- B. Where pipe is to be laid on special granular material the excavation below subgrade shall be to the depth specified or directed. The excavation below subgrade shall be refilled with special granular material as specified or directed, shall be deposited in layers not to exceed 6 inches and shall be thoroughly compacted prior to the preparation of pipe subgrade.
- C. The subgrade shall be prepared by shaping with hand tools to the contour of the pipe barrel to allow for uniform and continuous bearing and support on solid undisturbed ground or embedment for the entire length of the pipe.
- D. Pipe subgrade preparation shall be performed immediately prior to installing the pipe in the trench. Where bell holes are required, they shall be made after the subgrade preparation is complete and shall be only of sufficient length to prevent any part of the bell from coming in contact with the trench bottom and allowing space for joint assembly.

3.03 STORAGE OF MATERIALS

- A. Where pipe is to be laid under or near existing highways, traffic shall be maintained at all times in accordance with the applicable Highway Permits. Where no Highway Permit is required, at least one-half of the street must be kept open for traffic at all times unless otherwise approved by the _____, or as shown on the Contract Drawings.
- B. Where conditions do not permit storage of materials adjacent to the trench, the material excavated from a length as may be required, shall be removed by the _____ Contractor, at his cost and expense, as soon as excavated. The material subsequently excavated shall be used to refill the trench where the pipe had been built, provided it is of suitable character. The excess material shall be removed to locations selected and obtained by the _____ Contractor.

MATERIALS AND PERFORMANCE – SECTION 02204

TRENCHING, BACKFILLING, AND COMPACTING

1. The _____ Contractor shall, at his cost and expense, bring back adequate amounts of satisfactory excavated materials as may be required to properly refill the trenches.
- C. If directed by the _____, the _____ Contractor shall refill trenches with select fill or other suitable materials and excess excavated materials shall be disposed of as spoil.

3.04 REMOVAL OF WATER AND DRAINAGE

- A. The _____ Contractor shall at all times provide and maintain proper and satisfactory means and devices for the removal of all water entering the trench, and shall remove all such water as fast as it may collect, in such manner as shall not interfere with the prosecution of the work.
- B. The removal of water shall be in accordance with Section 02201 - Earthwork.

3.05 PIPE EMBEDMENT

- A. All pipe shall be protected from lateral displacement and possible damage resulting from superimposed backfill loads, impact or unbalanced loading during backfilling operations by being adequately embedded in suitable pipe embedment material. To ensure adequate lateral and vertical stability of the installed pipe during pipe jointing and embedment operations, a sufficient amount of the pipe embedment material to hold the pipe in rigid alignment shall be uniformly deposited and thoroughly compacted on each side, and back of the bell, of each pipe as laid.
- B. Concrete cradle and encasement of the class specified shall be installed where and as shown on the Contract Drawings or ordered by the _____. Before any concrete is placed, the pipe shall be securely blocked and braced to prevent movement or flotation. The concrete cradle or encasement shall extend the full width of the trench as excavated unless otherwise authorized by the _____. Where concrete is to be placed in a sheeted trench, it shall be poured directly against sheeting to be left in place or against a bond-breaker if the sheeting is to be removed.
- C. Embedment materials placed above the centerline of the pipe or above the concrete cradle to a depth of 12 inches above the top of the pipe barrel shall be deposited in such manner as to not damage the pipe. Compaction shall be as required for the type of embedment being installed.

3.06 BACKFILL ABOVE EMBEDMENT

- A. The remaining portion of the pipe trench above the embedment shall be refilled with suitable materials compacted as specified.

MATERIALS AND PERFORMANCE – SECTION 02204

TRENCHING, BACKFILLING, AND COMPACTING

1. Where trenches are within the ditch-to-ditch limits of any street or road or within a driveway or sidewalk, or shall be under a structure, the trench shall be refilled in horizontal layers not more than 8 inches in thickness, and compacted to obtain 95 percent maximum density, and determined as set forth in Section 02201 - Earthwork.
 2. Where trenches are in open fields or unimproved areas outside of the ditch limits of roads, the backfilling may be done by placing the material in the trench and mounding the surface.
 3. Hand tamping shall be required around buried utility lines or other subsurface features that could be damaged by mechanical compaction equipment.
- B. Backfilling of trenches beneath, across or adjacent to drainage ditches and water courses shall be done in such a manner that water will not accumulate in unfilled or partially filled trenches and the backfill shall be protected from surface erosion by approved means.
1. Where trenches cross waterways, the backfill surface exposed on the bottom and slopes thereof shall be protected by means of stone or concrete rip-rap or pavement.
- C. All settlement of the backfill shall be refilled and compacted as it occurs.
- D. Temporary pavement shall be placed as specified in Section 02207 - Restoration of Surfaces.

- END OF SECTION -

MATERIALS AND PERFORMANCE – SECTION 02205

SELECTED FILL

PART 1 - GENERAL

1.01 WORK SPECIFIED

- A. Selected fill materials shall be used in either embedment or special backfill as specified or as directed by the _____.

1.02 RELATED WORK SPECIFIED UNDER OTHER SECTIONS

Documents affecting work of this section include, but are not necessarily limited to the following:

TBD

1.03 SUBMITTALS

- A. TBD
- B. The name and location of the source of the material.
- C. Samples and test reports of the material.

1.04 REFERENCES

- A. American Society for Testing and Materials (ASTM)
 - 1. C117 - Standard Test Method for Materials Finer than 75- μ m (No. 200) Sieve in Mineral Aggregates by Washing.
 - 2. C136 - Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
 - 3. D422 - Standard Test Method for Particle-Size Analysis of Soils.
 - 4. D2487 - Standard Classification of Soils For Engineering Purposes (Unified Soil Classification System).
 - 5. D2974 - Standard Test Method for Moisture, Ash and Organic Matter of Peat and Other Organic Soils.
 - 6. D4318 - Standard Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.
 - 7. D4972 - Standard Test Methods For pH of Soils.

MATERIALS AND PERFORMANCE – SECTION 02205

SELECTED FILL

1.05 DEFINITIONS

A. Embedment or Lining

1. Any type granular material specified or directed placed below an imaginary line drawn one foot above the crown of the pipe and within the trench limits.

B. Special Backfill

1. Pipelines

Any selected fill material specified or directed placed above an imaginary line drawn one foot above the crown of the pipe and within the trench limits.

2. Structures

Any selected fill material specified or directed placed within the excavation limits, either in, under, or adjacent to the structure.

C. Special Granular Material

1. Special granular material shall mean any of the granular materials listed below or other materials ordered by the _____.

PART 2 - PRODUCTS

2.01 GRANULAR MATERIALS

A. Type “A”

1. Crushed Gravel

Thoroughly washed, crushed, durable, sharp, angled fragments of gravel free from coatings. Crushed particles shall be a minimum of 85 percent by weight of the particles with at least two fractured faces. The total area of each fractional face shall exceed 25 percent of the maximum cross-sectional area of the particle.

Crushed gravel shall have the following gradation by weight:

MATERIALS AND PERFORMANCE – SECTION 02205

SELECTED FILL

<u>Percent (%)</u> <u>Passing</u>	<u>Sieve (inch)</u>
100%	1-1/2
0-25%	3/4
0-5%	1/2

B. Type “B”

1. Crushed Stone

Thoroughly washed clean, sound, tough, hard crushed limestone or approved equal free from coatings. Gradation for crushed stone shall be the same as specified for Type “A” material.

C. Type “C”

1. Crushed Stone

Thoroughly washed, clean, sound, tough, hard, crushed limestone or approved equal free from coatings. It shall have a gradation by weight of 100 percent passing a 1-inch square opening and 0 - 15 percent passing a 1/4-inch square opening.

D. Type “D”

1. Washed Sand

Washed coarse sand having the following gradation by weight:

<u>Percent (%)</u> <u>Passing</u>	<u>Sieve</u>
100	3/8 inch
95 - 100	No. 4
80 - 100	No. 8
50 - 85	No. 16
25 - 60	No. 30
10 - 30	No. 50
2 - 10	No. 100

MATERIALS AND PERFORMANCE – SECTION 02205

SELECTED FILL

E. Type “E”

1. Run-of-Bank Gravel

Run-of-bank gravel or other acceptable granular material free from organic matter with a gradation by weight of 100 percent passing a 1½-inch square opening, 30 to 65 percent passing a ¼-inch square opening and not more than 10 percent passing a No. 200 mesh sieve as determined by washing through the sieve in accordance with ASTM D422.

F. Type “F”

1. Run-of-Crusher Stone

Run-of-crusher hard durable limestone or approved equal having the following gradation by weight:

<u>Percent (%)</u> <u>Passing</u>	<u>Square Opening</u> <u>(inches)</u>
100	1-1/2
95 - 100	1
65 - 80	1/2
40 - 60	1/4
0 - 10	#200 Sieve

G. Type “G”

1. A mixture of Type “E” material and Portland cement mixed in a ratio of 15:1 and placed and compacted in a dry state.

H. Type “H”

1. A specially blended mixture of materials as specified in the Payment Items.

PART 3 - EXECUTION

3.01 GENERAL

- A. Special granular material as specified or directed for pipeline embedment shall be placed in accordance with Section 02204 - Trenching, Backfilling, and Compacting.

MATERIALS AND PERFORMANCE – SECTION 02205

SELECTED FILL

- B. Special backfill, where specified or directed, shall be placed in accordance with the backfilling provisions of Section 02204 - Trenching, Backfilling, and Compacting and Section 02201 - Earthwork.
- C. Materials displaced through the use of the above materials shall be wasted or disposed of by the _____ Contractor and the cost of such disposal shall be borne by the _____ Contractor.
- D. Any settlements in the finished work shall be made good by the _____ Contractor at his cost and expense.

- END OF SECTION -

MATERIALS AND PERFORMANCE – SECTION 02207

RESTORATION OF SURFACES

PART 1 - GENERAL

1.01 WORK SPECIFIED

- A. All types of surfaces, sidewalks, curbs, gutters, culverts and other features disturbed, damaged or destroyed during the performance of the work under or as a result of the operations of the Contract, shall be restored and maintained, as specified herein or as modified or described in the Special Conditions.
- B. The quality of materials and the performance of work used in the restoration shall produce a surface or feature equal to or better than the condition of each before the work began, as approved by the _____.

1.02 RELATED WORK SPECIFIED UNDER OTHER SECTIONS

Documents affecting work of this section include, but are not necessarily limited to the following:

TBD

1.03 SUBMITTALS

- A. TBD
- B. A schedule of restoration operations shall be submitted by the _____ Contractor for review prior to the start of work specified herein.

1.04 SCHEDULE OF RESTORATION

- A. After an accepted schedule has been agreed upon, it shall be adhered to unless otherwise revised with the approval of the _____.
- B. In general, permanent restoration of paved surfaces will not be permitted until six months time has elapsed after excavations have been completely backfilled as specified. A greater length of time, but not more than nine months may be allowed to elapse before permanent restoration of street surfaces is undertaken, if additional time is required for shrinkage and settlement of the backfill.
- C. The replacement of surfaces at any time, as scheduled or as directed, shall not relieve the _____ Contractor of responsibility to repair damages by settlement or other failures.

MATERIALS AND PERFORMANCE – SECTION 02207

RESTORATION OF SURFACES

PART 2 - PRODUCTS

NOT USED

PART 3 - EXECUTION

3.01 TEMPORARY PAVEMENT

- A. Immediately upon completion of refilling of the trench or excavation, the _____ Contractor shall place a temporary pavement over all disturbed areas of streets, driveways, sidewalks and other traveled places where the original surface has been disturbed as a result of his operations. Temporary pavement shall be the following material:

Type P: Asphalt Concrete

1. From May through October, or when local blacktop plants are operating, the temporary paving shall be New York State Department of Transportation (NYSDOT) Type 3 Asphalt Concrete Binder plant mix, 2-inch compacted thickness. When temporary pavements are to be maintained through a winter season then a 4-inch compacted thickness shall be placed.
2. From November through April, or when local blacktop plants are not operating, the cold-mix bituminous surfacing shall be NYSDOT Maintenance Specifications 15.403.2001, placed to a 4-inch compacted thickness.

Compaction of the temporary asphalt concrete shall be performed with smooth wheel rollers of sufficient size and number to satisfactorily compact the asphalt mixture while it is still in a workable condition. Rolling shall continue until all roller marks and creases are removed. Surfaces shall be maintained free from bumps, ridges, potholes, and other nonconformities (exceeding $\frac{3}{4}$ inch as measured by a 10-foot straight edge), including the use of additional material to maintain satisfactory driving surfaces.

- B. Where weather and seasonal limitations prevent the placement of the referenced “hot-mixing” topping, cold patch, compacted to a minimum thickness of 2 inches shall be used, unless otherwise directed.
- C. For dust prevention, the _____ Contractor shall treat all surfaces not covered with cold patch as frequently as may be required.

MATERIALS AND PERFORMANCE – SECTION 02207

RESTORATION OF SURFACES

- D. The temporary pavement shall be maintained by the _____ Contractor in a safe and satisfactory condition until such time as the permanent paving is completed. The _____ Contractor shall immediately remove and restore all pavement that becomes unsatisfactory.

3.02 PERMANENT PAVEMENT REPLACEMENT

- A. The permanent and final repaving of all streets, driveways, and similar surfaces where pavement has been removed, disturbed, settled, or damaged by or as a result of performance of the Contract shall be repaired and replaced by the _____ Contractor by a new and similar pavement.
1. The top surface shall conform with the grade of existing adjacent pavement and the entire replacement shall meet the current specifications of the local community for the particular types of pavement and/or as shown on the Contract Drawings.
 2. Where the local community has no specification for the type of pavement, the work shall be done in conformity with the State Department of Transportation Standard which conforms the closest to the type of surfacing being replaced, as determined by the _____.
- B. The permanent asphalt pavement replacement for streets, driveways and parking area surfaces shall be replaced with bituminous materials of the same depth and kind as the existing unless otherwise specified.
- C. Prior to placing of any bituminous pavement, a sealer shall be applied to the edges of the existing pavement and other features.
- D. The furnishing, handling and compaction of all bituminous materials shall be in accordance with the NYSDOT Standard Specifications.

3.03 STONE OR GRAVEL PAVEMENT

- A. All pavement and other areas surfaced with stone or gravel shall be replaced with material to match the existing surface unless otherwise specified.
1. The depth of the stone or gravel shall be at least equal to the existing.
 2. After compaction, the surface shall conform to the slope and grade of the area being replaced.

3.04 LAWNS AND IMPROVED AREAS

- A. The area to receive topsoil shall be graded to a depth of not less than 4 inches or as specified, below the proposed finish surface.

MATERIALS AND PERFORMANCE – SECTION 02207

RESTORATION OF SURFACES

1. If the depth of existing topsoil prior to construction was greater than 4 inches, topsoil shall be replaced to that depth.
 - B. When required to obtain germination, the seeded areas shall be watered in such a manner as to prevent washing out of the seed.
 - C. Any washout or damage which occurs shall be regraded and reseeded until a good sod is established.
 - D. The _____ Contractor shall maintain the newly seeded areas, including regrading, reseeding, watering, and mowing, in good condition.
- 3.05 CULTIVATED AREA REPLACEMENT
- A. Areas of cultivated lands shall be graded to a depth to receive topsoil of not less than the depth of the topsoil before being disturbed. All debris and inorganic material shall be removed prior to the placing of the topsoil.
 - B. Grass areas shall be reseeded using a mixture equal to that of the area before being disturbed, unless otherwise specified.
- 3.06 OTHER TYPES OF RESTORATION
- A. Trees, shrubs, and landscape items damaged or destroyed as a result of the construction operations shall be replaced in like species and size.
 1. All planting and care thereof shall meet the standards of the American Association of Nurserymen.
 - B. Water courses shall be reshaped to the original grade and cross-section and all debris removed. Where required to prevent erosion, the bottom and sides of the water course shall be protected.
 - C. Culverts destroyed or removed as a result of the construction operations shall be replaced in like size and material and shall be replaced at the original location and grade. When there is minor damage to a culvert, and with the consent of the _____, a repair may be undertaken if satisfactory results can be obtained.
 - D. Fences destroyed or removed as a result of the construction operations shall be replaced in like size and material and shall be replaced at the original location.

MATERIALS AND PERFORMANCE – SECTION 02207

RESTORATION OF SURFACES

3.07 MAINTENANCE

- A. The finished products of restoration shall be maintained in an acceptable condition for and during a period of one year following the date of Substantial Completion or other such date as set forth elsewhere in the Contract Documents.

- END OF SECTION -

MATERIALS AND PERFORMANCE – SECTION 02208

CLEARING

PART 1 - GENERAL

1.01 WORK SPECIFIED

- A. Clearing and grubbing within the limits indicated of the following:
 - 1. Topsoil
 - 2. Pieces of rock up to ½-cubic yard in volume
 - 3. Trees and Bushes
 - 4. Pavements
 - 5. Brush
 - 6. Logs and Stumps
 - 7. Refuse and Rubbish
 - 8. Decayed and Growing Organic Matter
 - 9. Snow and Ice

- B. All material, except topsoil and that material suitable for fill, shall be disposed of at a location selected by the _____ Contractor and approved by the _____.

- C. The _____ Contractor shall remove, replace, support, and protect all power and telephone poles and posts as required.

1.02 RELATED WORK SPECIFIED UNDER OTHER SECTIONS

Documents affecting work of this section include, but are not necessarily limited to the following:

TBD

1.03 SUBMITTALS

TBD

PART 2 - PRODUCTS

2.01 QUALITY OF MATERIALS

- A. New power and utility poles and posts and the supporting and protecting of all poles and posts shall be in accordance with the requirements of the local power and telephone companies.

- B. Stakes for tree protection shall be 2-inch diameter steel pipe, unless otherwise shown on the Contract Drawings.

MATERIALS AND PERFORMANCE – SECTION 02208

CLEARING

PART 3 - EXECUTION

3.01 GENERAL

A. Tree Protection

1. Any tree which will not, in the opinion of the _____, hinder construction or landscaping shall be protected by stakes placed in a circle having a radius of not less than 5 feet as measured from the base of the trunk around the tree. The stakes shall extend at least 4 feet above the existing ground. Each circle shall consist of at least six stakes. Landscaping within the circle shall be accomplished by hand unless otherwise permitted by the _____.

B. Debris Removal

1. Debris shall not be burned unless written permission or permit is issued by the Fire Marshal having jurisdiction in the area. A copy of the permit shall be submitted to the _____ prior to beginning any burning operation. The _____ Contractor shall adhere to all limitations and conditions set forth in the permit.
2. If burning is not permitted, all brush and trees shall be removed from the area and disposed of at a site selected by the _____ Contractor and in conformance with local and state regulations.

3.02 ENVIRONMENTAL PROTECTION

A. Prohibited Construction Procedures

1. Prohibited construction procedures include, but are not limited to:
 - a. Dumping of spoil material into any 100-year flood hazard area, stream corridor, wetlands, surface waters, or at unspecified locations.
 - b. Indiscriminate, arbitrary, or capricious operation of equipment in any stream corridors, wetlands, or surface waters.
 - c. Pumping of silt-laden water from trenches or other excavations into any surface waters, stream corridors, or wetlands.
 - d. Damaging vegetation beyond the extent necessary for construction of the facilities.

MATERIALS AND PERFORMANCE – SECTION 02208

CLEARING

- e. Disposal of trees, brush, and other debris in any stream corridors, wetlands, surface waters, or at unspecified locations.
- f. Permanent or unspecified alteration of the flow line of the stream.
- g. Placing of wet concrete so it comes in contact with stream water.

B. Site and Access Clearing

- 1. Except where directed or shown, no trees shall be removed or damaged. All trees that, in the opinion of the _____, have been damaged by the _____ Contractor shall be removed and replaced by the _____ Contractor at his own expense.
- 2. Straggling roots shall be pruned. Trees which must be pruned shall be cut cleanly and painted with tree paint. If the tree is damaged, the wood shall be repaired and painted with material approved by the _____.
- 3. After interfering vegetation has been removed, the _____ Contractor shall strip any and all topsoil from the site to be excavated and stockpile it for future use.

C. Erosion and Sediment Control

- 1. Erosion control procedures, inclusive of mulching, shall be utilized on the site in accordance with the approved plans. Erosion control shall occur as required and immediately following (weather permitting) completion of site and access clearing.
- 2. To allow sediment to settle out of water that interferes with construction before such water enters any surface waters, de-watering operations shall direct pumpage as far from the stream bank as possible. Care should be taken not to damage or kill vegetation by excessive water or by damaging silt accumulation in the discharge area. Stormwater sediment basins constructed under this project should be used on the _____ direction or as otherwise required to protect vegetation and to achieve environmental objectives.

D. Critical Impact Areas

- 1. “Critical Impact Area” means and includes any area, condition or feature which is environmentally sensitive, or which, if disturbed during construction, would adversely affect the environment. Critical impact areas include, but are not limited to, stream corridors; streams; inland

MATERIALS AND PERFORMANCE – SECTION 02208

CLEARING

wetlands; estuaries; coastal wetlands; slopes greater than 15 percent; highly acidic, highly erodible, and adverse mineral soil conditions (such as highly glauconitic soils); natural surface and man-made surface and subsurface drainage facilities and features; areas of high water table; and mature stands of native vegetation. Work performed in critical impact areas shall be restored as follows:

- a. Slopes exceeding 15 percent require special treatment such as water diversion berms, sodding, or the use of jute or excelsior blankets.
- b. Right-of-way slopes at surface water crossings or drainageways shall be protected by rip-rapping, sand bagging, sodding, or the use of jute or excelsior blankets as the conditions require. If adverse acidic or mineralized groundwater is present, a relatively impermeable soil shall be used for backfill at the crossing to minimize discharge of such water.
- c. Clayey material having a pH of 4.0 or less exposed during construction shall be covered with at least 1 foot of soil having a pH of 5.0 or more before seed bed preparation.
- d. To maintain natural groundwater levels and flow patterns, relatively impermeable soils should be incorporated in backfilling as blankets and anti-seep collars.

E. Dust Control

1. Dust shall be controlled by water spray and sweeping on paved areas and by water spray and mulching in unpaved areas. The use of calcium chloride is prohibited.

- END OF SECTION -

MATERIALS AND PERFORMANCE – SECTION 02315

STRUCTURAL STEEL H PILES AND PILE DRIVING

PART 1 - GENERAL

1.01 WORK SPECIFIED

- A. All plant, labor, equipment, services, supplies, appliances, materials, and all operations incidental to the furnishing and driving of all Structural Steel H Piles.

1.02 RELATED WORK SPECIFIED UNDER OTHER SECTIONS

Documents affecting work of this section include, but are not necessarily limited to the following:

TBD

1.03 SUBMITTALS

- A. TBD

- B. Prior to Driving

- 1. Location Plan and Shop Drawings

- a. Identify each pile by number and station.
 - b. Dimensions to control points established by the _____.
 - c. Cut off elevations.
 - d. Method, sequence and schedule of driving.
 - e. Splicing details.
 - f. Welding procedures.
 - g. Cast steel point details.

- 2. Certificates of Pre-Qualification for all welders.

- 3. Equipment

- a. Amount and character of all equipment.
 - b. Type of leads.
 - c. Hammer energy.
 - d. Method of measuring energy during driving.
 - e. Manufacturer's literature.
 - f. Details of proposed cushion block.
 - g. Expected operating noise levels in decibels.

- 4. Mill Certificates

- a. Compliance with specifications.

MATERIALS AND PERFORMANCE – SECTION 02315

STRUCTURAL STEEL H PILES AND PILE DRIVING

- b. Mill rejects, reclassified piles, used piles, or piles not meeting the specifications shall be rejected.
 - 5. Load Test
 - a. Method and procedure for load testing and dynamic testing.
 - b. Applicable data listed in American Society for Testing and Materials (ASTM) D1143 Report.
 - c. Remarks about unusual circumstances or occurrences during the load test.
 - d. Dynamic monitoring and Case Pile Wave Analysis Program (CAPWAP) analyses report.
- C. During and After Driving
- 1. Driving Records
 - a. Date.
 - b. Identification number and structure.
 - c. Pile hammer used.
 - d. Tip elevation.
 - e. Cut-off elevation.
 - f. Location of splice.
 - g. Location of obstruction if encountered.
 - h. Deviation from tolerances.
 - i. Number of blows for each foot of driving.
 - j. Energy at each change.
 - k. Number of blows for each inch for the final 6 inches of driving.
 - l. Type of tip.
 - m. Type of cushion block.
 - n. Number of blows for each foot of re-driving if applicable.
 - o. Number of blows for each inch for the final 6 inches of re-driving if applicable.
 - 2. Surveys
 - a. Records of pile elevation changes (heaving) and lateral movement.
 - b. Plan showing actual:
 - 1) pile location;

MATERIALS AND PERFORMANCE – SECTION 02315

STRUCTURAL STEEL H PILES AND PILE DRIVING

- 2) pile orientations;
- 3) tip elevations; and
- 4) cut off elevations.

1.04 QUALITY ASSURANCE

A. _____ Contractor Qualifications

1. Shall have a minimum of three years experience in pile driving, including experience with similar subsurface conditions, pile sizes, and special techniques required.
2. Shall submit written description of equipment and techniques proposed for use, and the name of three similar projects completed in the last three years.

B. Welder Qualifications

1. All welders, welding operators, and tackers employed on this project shall have been qualified by the appropriate tests as prescribed in the current edition of American Welding Society (AWS) D1.1.

C. Testing Agency Qualifications

1. Shall have a minimum of three years experience in conducting soil explorations and pile load tests.
2. Shall submit evidence of ability to perform the appropriate tests and inspection services including qualifications of personnel and list of similar projects completed.

D. Applicable Codes, Standards, and Specifications

1. The following specifications of ASTM:
 - a. A36 Standard Specification for Structural Steel.
 - b. D1143 Standard Method of Testing Piles Under Axial Compressive Load.
 - c. A27 Mild-To-Medium Strength Carbon-Steel Castings for General Application.
 - d. A233 Specifications for Mild Steel Arc-Welding Electrodes.
2. AWS.

MATERIALS AND PERFORMANCE – SECTION 02315

STRUCTURAL STEEL H PILES AND PILE DRIVING

3. American Institute of Steel Construction, Inc. (AISC).
 4. All governing state and local building codes.
- E. Allowable Tolerances
1. The center of the pile at the cutoff elevation (head) shall not deviate from the plan location specified by more than 3 inches.
 2. Alignment
 - a. Vertical piles: plumb within 4 percent of pile length.
 - b. Battered piles: within 4 percent of batter specified.
 3. Any pile out of tolerance for either location or plumbness by more than the amounts stated above may be rejected. Should a pile be rejected for reasons stated above, the _____ Contractor shall install an additional pile or piles at locations as directed by the _____ at no additional cost to the _____.
 4. The design and construction of the foundation shall be modified, at the _____ Contractor's expense, as necessary to properly resist the resulting vertical and lateral forces at all locations where piles do not meet the tolerance requirements.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Piles shall be:
 1. Rolled steel H piles.
 2. ASTM A36.
 3. In conformance with AISC standard mill tolerances.
 4. All new and unused piles.
- B. Cast steel points, ASTM A0233.
- C. Structural shapes and plates, ASTM A36.
- D. Welding rods, E70XX Series (electrodes shall be suitable for the positions and conditions of intended use).

MATERIALS AND PERFORMANCE – SECTION 02315

STRUCTURAL STEEL H PILES AND PILE DRIVING

- E. Coating, bituminous as manufactured by Koppers, Tnemec or equal, for permanent installations. The upper 60 feet of each permanent pile installed shall be coated.

2.02 PILE TIP TREATMENTS

- A. All piles shall have cast steel points to reinforce the pile tip. Attach to pile end with minimum weld of 5/16-inch along end flange.

PART 3 - EXECUTION

3.01 PILE SPLICES

- A. The minimum length of member to be spliced shall be ten feet.
- B. The splice shall introduce no eccentricity, camber, or sweep into the pile.
- C. The splice shall be as strong as the unspliced sections of the pile.
- D. Full Penetration Butt Weld Splices
 1. Single bevel groove weld at butt joint.
 2. Minimum root opening shall be 5/32-inch.
 3. Minimum groove angle shall be 45 degrees.
 4. Across both flanges and the web.
 5. Flanges shall be accurately aligned with plates and wedges.
- E. Plate and Butt Weld Splice
 1. Butt weld flanges and web.
 2. Add plates to flanges and web.
 3. Plate thickness shall be equal to thickness of the pile metal.
 4. Flange Plates
 - a. Length shall equal nominal depth of pile section.
 - b. Inside or outside flanges.
 - c. Width shall be the maximum which will allow a fillet weld along each edge.

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STRUCTURAL STEEL H PILES AND PILE DRIVING

- 5. Web Plate
 - a. Square plate 3 inches less than the width between flanges.
 - b. Attach on a diagonal if preferred.

F. Prefabricated Steel HPile Splicer

- 1. Install in strict accordance with manufacturer's written instructions.

G. Only one splice shall be allowed for each pile.

3.02 SURVEYS

- A. The _____ Contractor shall establish pile locations from reference points provided by the _____.
- B. The _____ Contractor shall be responsible for the installation of all piles in the proper location as shown on the Drawings.
- C. Prior to cutting off top of pile and driving adjacent piles, the _____ Contractor shall:
 - 1. Provide reference elevation mark on remaining pile section.
 - 2. Record elevation of reference mark.
 - 3. Monitor and record any changes in elevation while driving other piles.
 - 4. Promptly provide the _____ with records of each elevation change due to driving other piles.
- D. After the piles in a group or area have been completely driven and before construction of pile caps or other construction related to the piles has started, the _____ Contractor shall promptly provide the _____ with a survey of all piles including abandoned piles and replacements for approval.

3.03 PILE HAMMER

- A. Hammer shall be single or double acting steam or air developing at least 24,000 foot-pounds of energy per blow.
- B. Hammer shall be in good operating condition at all times during driving. Any hammer not operating in accordance to the manufacturer's recommendations shall be unsatisfactory and be removed from the site.

MATERIALS AND PERFORMANCE – SECTION 02315

STRUCTURAL STEEL H PILES AND PILE DRIVING

1. Double-acting hammers shall be operated at full-rated pressure and speed during final driving of pile.
2. Single-acting hammers shall have valve mechanism maintained in first-class condition to maintain length of stroke.

C. Cushion Blocks

1. Wood cushion blocks are prohibited.
2. Cushion blocks shall consist of a steel plate as alternate layers of micarta and aluminum or other similar materials.
3. Cushion block shall be maintained in good condition at all times.

D. Pile Driving Leads

1. Piles shall be driven using fixed leads.
2. Leads shall:
 - a. Afford freedom of movement to the hammer.
 - b. Hold the pile firmly in the correct position.
 - c. Maintain vertical and axial alignment with the hammer.

3.04 PILE LOAD TESTS

- A. Prior to driving any production piles, the _____ Contractor shall perform two static load tests.
- B. The _____ shall select the pile locations to be tested and the test driving criteria.
- C. No work which shall interfere or affect the pile tests shall be performed for the duration of the tests.
- D. Static Load Test
 1. The method of testing shall conform to ASTM D1143-81 Standard Method of Testing Piles Under Axial Compressive Load with Direction as specified herein.

MATERIALS AND PERFORMANCE – SECTION 02315

STRUCTURAL STEEL H PILES AND PILE DRIVING

- a. The _____ Contractor shall furnish all labor, materials, equipment, instruments, and services required to set up, perform, and remove load test.
 - b. Loading procedures shall meet ASTM D1143-81 4.2 Standard Loading Procedures.
 - c. Primary measuring system for axial movement of the pile butt shall meet ASTM D1143-81 3.2.1 Dial Gauges. Secondary measuring system shall meet ASTM D1143-74 3.2.2 Wire, Mirror, and Scale.
 - d. Pile movement measuring procedures shall meet ASTM D1143-81 5.2 Standard Measuring Procedures.
 - e. The load test results shall contain the applicable data listed in ASTM D1143-81 6. Report.
- F. The pile driving criteria for the remaining piles shall be determined by the _____ upon review of the pile test data.

3.05 INSTALLATION

- A. The _____ Contractor shall mark piles prior to their being driven.
- B. Jetting, auguring, or other methods of pre-excavation will not be allowed.
- C. Followers will not be allowed.
- D. The _____ Contractor shall promptly notify the _____ of any abnormality in the driving of the piles.
- E. Any pile driven in a manner other than in accordance with this Specification will be rejected.
- F. Driving of all piles shall be continuous except when splicing is required, and in any event, shall be continuous from the time the pile enters very compact sand until acceptable driving resistance is achieved.
- G. In no case shall piles be driven within 40 feet of structures or pile caps in which concrete is less than three days old.

3.06 PILE DRIVING CRITERIA

- A. Piles shall be driven to the following bearing resistance based on a minimum 24,000 foot-pound hammer:

MATERIALS AND PERFORMANCE – SECTION 02315

STRUCTURAL STEEL H PILES AND PILE DRIVING

<u>Pile Capacity</u>	<u>Last 12 Inches of Penetration Blows per Inch</u>	<u>Last Inch of Penetration Blows per Inch</u>
30 Tons Each (HP10x42)	3	20
75 Tons Each (HP10x57)	10	20

The driving resistances listed are based on a 24,000 foot-pound hammer. If the _____ Contractor intends to use a larger hammer, he shall submit data on the hammer characteristics to the _____, who will determine new required driving resistances.

3.07 REDRIVING OF PILES

- A. Forty-eight hours after driving, and before cutting off piles to their required elevation, the _____ Contractor shall re-drive at least 10 percent of all piles.
- B. The elevation of all in-place piles shall be recorded before any adjacent piles are driven or re-driven, and if any show signs of heaving and lifting in excess of ¼-inch caused by the driving of adjacent piles or by other cause, they shall be re-driven to the required re-driving resistance.
- C. The required re-driving criteria shall be determined by the _____ based on hammer characteristics and data obtained from the load test and the test drives.

3.08 PREPARATION OF PILE TOPS

- A. Subsequent to driving and prior to placement of concrete pile caps and slabs, the top section of each pile shall be:
 - 1. Cut off at the pile cut-off elevation and ground flush to provide uniform bearing.
 - 2. Cleaned of all deleterious substances.
 - 3. Field coated to repair any damaged areas of bituminous material.

- END OF SECTION -

MATERIALS AND PERFORMANCE – SECTION 02411

FACILITY STEEL SHEETING

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. All labor, materials, equipment, surveys, and services necessary for or incidental to the following.
 - 1. Furnishing and driving of the Steel Sheeting.
 - 2. Furnishing and installing of wales and bracing.
 - 3. Removal of temporary sheeting, wales, and bracing.

1.02 RELATED WORK SPECIFIED UNDER OTHER SECTIONS

Documents affecting work of this section include, but are not necessarily limited to the following:

TBD

1.03 SUBMITTALS

- A. TBD
- B. Shop Drawings
 - 1. Plans and/or elevation locating and defining all materials furnished. All structures, utilities, poles, and pertinent items shall be shown and dimensioned.
- C. Certificates
 - 1. Certify that materials are new and meet or exceed specification requirements.
- D. Design Calculations
 - 1. Prepared by a Professional Engineer properly licensed to provide engineering services in the State of New York.

1.04 QUALITY ASSURANCE

- A. Driving and Erecting: Regularly engaged in the driving and erection of steel sheeting.

MATERIALS AND PERFORMANCE – SECTION 02411

FACILITY STEEL SHEETING

- B. Qualifications of Welders: In accordance with the American Welding Society (AWS). Qualified within the past year.
- C. Codes and Standards
 - 1. AWS.
 - 2. American Society for Testing and Materials (ASTM).
 - 3. American Institute of Steel Construction (AISC).

PART 2 - PRODUCTS

2.01 MATERIALS AND EQUIPMENT

- A. Steel Sheet Piling - Shall meet or exceed one of the following.
 - 1. ASTM A328
 - 2. ASTM A572 - Grade 50 and 55
 - 3. ASTM A690
- B. Structural Shapes
 - 1. ASTM A36
- C. Hammer
 - 1. Single- or double-acting air or steam hammer.
 - 2. Vibratory hammer.
- D. Permanent steel sheet piling shall be new and unused.

PART 3 - EXECUTION

3.01 PREPARATION FOR DRIVING

- A. Determine piling layout.
- B. Establish necessary lengths.
- C. Locate and protect all underground utilities, piping, structures, etc.

MATERIALS AND PERFORMANCE – SECTION 02411

FACILITY STEEL SHEETING

3.02 INSTALLATION

- A. Any material which stops the driving shall be removed by the _____ Contractor.
- B. Plumb within 4 percent of pile length.
- C. Sheeting shall be constructed so as to keep the excavations free from earth, water, ice, or snow.
- D. Sheeting shall be constructed to meet all safety requirements.
- E. All sheets shall interlock.

- END OF SECTION -

MATERIALS AND PERFORMANCE – SECTION 02620

GEOTEXTILE FABRIC

PART 1 - GENERAL

1.01 WORK SPECIFIED

Furnishing all plant, labor, supervision, equipment, appliances, and materials necessary to perform all operations in connection with the installation of geotextile fabric.

1.02 RELATED WORK SPECIFIED UNDER OTHER SECTIONS

Documents affecting work of this section include, but are not necessarily limited to the following:

TBD

1.03 SUBMITTALS

A. TBD

B. Submit the pre-qualified list of installation subcontractors to the _____ for review.

C. Certification: The _____ Contractor shall provide to the _____ a certificate stating the name of the manufacturer, product name, style number, chemical composition of the filaments or yarns, and other pertinent information to fully describe the geotextile. The Certification shall state that the furnished geotextile meets _____ (MARV) requirements of the specification as evaluated under the manufacturer's quality control program. Certification shall be attested to by a person having legal authority to bind the manufacturer.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Manufacturer

Mirafi Construction Products
365 South Holland Drive
Pendergrass, GA, USA 30567
1-888-795-0808
1-706-693-2226
1-706-693-2083, fax
www.mirafi.com

MATERIALS AND PERFORMANCE – SECTION 02620

GEOTEXTILE FABRIC

B. Geotextile

1. The geotextile shall be manufactured with fibers consisting of long-chain synthetic polymers composed of at least 95 percent by weight of polyolefins or polyesters. They shall form a stable network such that the filaments or yarns retain their dimensional stability relative to each other, including selvages.
2. Woven slit film geotextile (i.e., geotextile made from yarns of a flat, tape-like character) shall not be allowed.
3. The geotextile shall meet the requirements of Table 1. All numeric values in Table 1, except Apparent Opening Size (AOS), represent MARV in the weakest principal direction. Values for AOS represent maximum average roll values.
4. Acceptable geotextiles are as follows:

Elongation < 50%: Mirafi Filterweave 700

Table 1 - Subsurface Drainage Geotextile

Property	Test Method (ASTM)	Units	Elongation < 50% ¹
Grab Tensile Strength	D4632	N (lbs)	1,100 (247)
Sewn Seam Strength ²	D4632	N (lbs)	990 (222)
Tear Strength ³	D4533	N (lbs)	400 (90)
Puncture Strength	D4833	N (lbs)	400 (90)
Burst Strength	D3786	kPa (psi)	2,700 (391)
Permittivity	D4991	sec ⁻¹	0.2
Apparent Opening Size	D4751	mm (U.S. Sieve)	0.25 max (60)
Ultraviolet Stability ⁴	D4355	%	50

ASTM = American Society for Testing and Materials.

¹ Measured in accordance with ASTM D4632.

² When sewn seams are required.

³ The required MARV Tear Strength for woven monofilament geotextile is 250 N (56 lbs).

⁴ After 500 hrs.

C. Quality Control

1. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and methods needed for proper performance of the Work of this section, and qualified by the Geosynthetic Accreditation Institute (GAI) Laboratory Accreditation Program (LAP) and the American Association for Laboratory Accreditation.

MATERIALS AND PERFORMANCE – SECTION 02620

GEOTEXTILE FABRIC

2. The _____ reserves the right of approval of the subcontractor pre-qualified and selected for this portion of the Work by the _____ Contractor. Approval will be based, in part, on documented successful experience in performing work of a similar nature.
3. Manufacturing Quality Control: Testing shall be performed at a laboratory accredited by GAI-LAP for tests required for the geotextile, at a frequency meeting or exceeding ASTM D4354.
4. Geotextile properties, other than Sewn Seam Strength, Burst Strength, and Ultraviolet Stability, shall be tested by _____ (NTPEP) to verify conformance with this Specification.
5. Sewn Seam Strength shall be verified based on testing of either conformance samples obtained using Procedure A of ASTM D4354, or based on manufacturer's certifications and testing of quality assurance samples obtained using Procedure B of ASTM D4354. A lot size for conformance or quality assurance sampling shall be considered to be the shipment quantity of the given product or a truckload of the given product, whichever is smaller.
6. Ultraviolet Stability shall be verified by an independent laboratory on the geotextile or a geotextile of similar construction and yarn type.

D. Product Delivery and Storage

1. Geotextile labeling, shipment, and storage shall follow ASTM D4873. Product labels shall clearly show the manufacturer or supplier name, style name, and roll number.
2. Each geotextile roll shall be wrapped with a material that will protect the geotextile from damage due to shipment, water, sunlight, and contaminants.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Preparation

Excavation shall be done in accordance with details of the project plans. In all instances, excavation shall be done in such a way so as to prevent large voids from occurring. The graded surface shall be smooth and free of debris.

MATERIALS AND PERFORMANCE – SECTION 02620

GEOTEXTILE FABRIC

B. Installation

1. Geotextile shall be placed loosely with no wrinkles or folds, and with no void spaces between the geotextile and the ground surface. Successive sheets of geotextile shall be overlapped a minimum of 300 mm (12 inches), with the upstream sheet overlapping the downstream sheet.
2. In trenches equal to or greater than 300 mm (12 inches) in width, after placing the drainage aggregate, the geotextile shall be folded over the top of the backfill material in a manner to produce a minimum overlap of 300 mm (12 inches). In trenches less than 300 mm (12 inches) but greater than 100 mm (4 inches) wide, the overlap shall be equal to the width of the trench. Where the trench is less than 100 mm (4 inches), the geotextile overlap shall be sewn or otherwise bonded. All seams shall be subject to the review of the _____.
3. Should the geotextile be damaged during installation or drainage aggregate placement, a geotextile patch shall be placed over the damaged area extending beyond the damaged area a distance of 300 mm (12 inches) or the specified seam overlap, whichever is greater.
4. Placement of drainage aggregate shall proceed immediately following placement of the geotextile. The geotextile shall be covered with a minimum of 300 mm (12 inches) of loosely placed aggregate prior to compaction. If a perforated collector pipe is to be installed in the trench, a bedding layer of drainage aggregate shall be placed below the pipe, with the remainder of the aggregate placed to the minimum required construction depth.
5. The aggregate shall be compacted with vibratory equipment to a minimum of 95 percent standard _____ (AASHTO) density unless the trench is required for structural support.

- END OF SECTION -

MATERIALS AND PERFORMANCE – SECTION 02645

BITUMINOUS CONCRETE PAVEMENTS

PART 1 - GENERAL

1.01 WORK SPECIFIED

- A. Construction of bituminous concrete pavement on a prepared base laid to the required grade, thickness and cross-section as shown on the Contract Drawings or as specified in this section.
- B. Construction of bituminous (hot mix asphalt) curbs as shown on the Contract Drawings.
- C. The quality of materials and performance of the work shall be in accordance with the Standard Specifications of the New York State Department of Transportation (NYSDOT) unless otherwise specified in this section.

1.02 RELATED WORK SPECIFIED UNDER OTHER SECTIONS

Documents affecting work of this section include, but are not necessarily limited to the following:

TBD

1.03 SUBMITTALS

TBD

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Bituminous Concrete Products
 - 1. Base course shall be NYSDOT Type 1, Base Course.
 - 2. Binder course shall be NYSDOT Type 3, Binder Course.
 - 3. Wear course shall be NYSDOT Type 6, Top Course.
 - 4. Bituminous curb shall conform to NYSDOT Standard Specification Section 714-06.

MATERIALS AND PERFORMANCE – SECTION 02645

BITUMINOUS CONCRETE PAVEMENTS

PART 3 - EXECUTION

3.01 PAVEMENT INSTALLATION

A. Subgrade

1. The subgrade shall be shaped to line and grade and compacted with self-propelled rollers. Compaction shall be to 95 percent throughout the subgrade.
2. All depressions which develop under rolling shall be filled with acceptable material and the area re-rolled.
3. Soft areas shall be removed and filled with acceptable materials and the area re-rolled.
4. Should the subgrade become rutted or displaced prior to the placing of the subbase, it shall be reworked to bring to line and grade.

B. Subbase

1. The subbase shall consist of 12 inches of Type E material, as specified in Section 02205 – Selected Fill.
2. Provide subbase over excavated areas only and/or as directed by the _____.
3. Rolling shall begin at the sides and continue toward the center and shall continue until there is no movement ahead of the roller. Compaction shall be to 95 percent compaction throughout the subbase as determined by American Society for Testing and Materials (ASTM) D698.
4. After completion of the subbase rolling, there shall be no hauling over the subbase other than the delivery of material for the top course.

C. Bituminous Material

1. The thickness of the bituminous courses shall be as shown on the Plans.
2. Prior to placing any bituminous pavement, a sealer shall be applied to the edges of existing pavement, curbing, gutters, manholes, and other structures.

D. Testing

MATERIALS AND PERFORMANCE – SECTION 02645

BITUMINOUS CONCRETE PAVEMENTS

1. The finish pavement shall be to the grades and cross-section as shown on the Contract Drawings.
 - a. The surface tolerance shall not exceed ¼ inch in 10 feet.
 - b. There shall be no depressions which will retain standing water.
2. Variations exceeding ¼ inch or depressions shall be satisfactorily corrected.

3.02 CURB INSTALLATION

A. Preparation of Surface

1. The curb shall be placed on a clean, dry surface. The surface shall be thoroughly swept or cleaned by compressed air prior to placement of curb. A tack coat of an approved NYSDOT asphalt emulsion shall be applied to the surface immediately prior to the placement of bituminous material.

B. Placement of Curb

1. Curb shall be placed by means of a machine capable of producing the curb to the dimensions shown on the Contract Drawings. The machine shall be self-propelled and produce curb of uniform shape, density, and texture.
2. Short sections of curb or sections with short radii may be formed by other means approved by the _____.

- END OF SECTION -

MATERIALS AND PERFORMANCE – SECTION 02711

GALVANIZED CHAIN LINK FENCE

PART 1 - GENERAL

1.01 WORK SPECIFIED

- A. A complete fence enclosure system, including gates, as shown on the Contract Drawings and as specified.

1.02 RELATED WORK SPECIFIED UNDER OTHER SECTIONS

Documents affecting work of this section include, but are not necessarily limited to the following:

TBD

1.03 SUBMITTALS

- A. TBD
- B. Samples of fabric, wires, ties, and post sections if other than specified.
- C. Drawings, showing details of fence height, size of post, rails, braces, gates, accessories, and grounding equipment.
- D. Copies of the manufacturer's certification.

1.04 QUALITY ASSURANCE

- A. The manufacturer shall certify that all materials furnished conform to the specified standards.
- B. Perform work of this section in accordance with American Society for Testing and Materials (ASTM) F567.

1.05 APPLICABLE CODES, STANDARDS, AND SPECIFICATIONS

- A. ASTM:
 - 1. A116 - Standard Specification for Zinc-Coated (Galvanized) Steel Woven Wire Fence Fabric.
 - 2. A121 - Standard Specification for Zinc-Coated (Galvanized) Steel Barbed Wire.
 - 3. A780 - Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings.

MATERIALS AND PERFORMANCE – SECTION 02711

GALVANIZED CHAIN LINK FENCE

4. C94 - Standard Specification for Ready-Mixed Concrete.
 5. F567 - Standard Practice for Installation of Chain-Link Fence.
 6. F668 - Standard Specification for Poly (Vinyl Chloride) (PVC)-Coated Steel Chain-Link Fence Fabric.
 7. F669 - Standard Specification for Strength Requirements of Metal Posts and Rails for Industrial Chain Link Fence.
 8. F1083 - Standard Specification for Pipe, Steel, Hot-Dipped Zinc-Coated (Galvanized) Welded, for Fence Structures.
- B. Chain Link Fence Manufacturers Institute (CLFMI): Product Manual.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Deliver chain link fence fabric in firmly tied tight rolls.
- B. Tag each roll clearly indicating class of coating, specified wire size, mesh size, height of fabric, ASTM A392 and ASTM F668 designation, and manufacturer's name.
- C. Store and handle materials in accordance with manufacturer's instructions. In the event of damage, make repairs or replacements approved by _____.
- D. Protect zinc-coated surfaces from damage and protect fencing materials from distortion or bending.
- E. Repair damaged zinc-coated surfaces as specified.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Structural and roll-formed shapes may be used in lieu of pipe sections. The structural or roll-formed shapes shall have a bending strength greater than the pipe section when measured under a 6 foot cantilever load and be galvanized in accordance with ASTM A123.
- B. Posts, Rails, and Braces
 1. Schedule 40 steel pipe, galvanized, in accordance with ASTM A120.
 2. Dimensions and Weights (Minimum):

MATERIALS AND PERFORMANCE – SECTION 02711

GALVANIZED CHAIN LINK FENCE

	<u>Outside Dia. (In.)</u>	<u>Weight/ Ft. (lbs)</u>
End, Corner and Pull Posts	2.875	5.79
Line Posts (Heavy Duty)	2.375	3.65
Top Rails and Braces	1.66	2.27
Gate Posts:		
Leaves 6 ft. Wide or Less	2.875	5.79
Leaves Over 6 Feet, Including 13 Feet Wide	4.00	9.11
Leaves Over 13 Feet Wide	As shown on Contract Drawings	

C. Chain Link Fabric

1. One piece 9 gauge steel wire fabric, width as shown on the Contract Drawings, 2-inch mesh galvanized after weaving in accordance with ATM A392, Class 2.
2. Twisted and barbed at the top and bottom. (TBD)
3. 7'-0" high when installed. (TBD)

D. Accessories

1. Barbed wire supporting arms, stretcher bars and bands, and hardware shall be galvanized in accordance with ASTM A153.
2. Barbed wire supporting arms shall be of pressed steel or malleable iron, shall support three strands of barbed wire and have passage for top rail. Top most barbed wire shall be 12 inches above the top of the fabric.
3. Barbed wire shall be 2 strand, 12½ gauge steel wire, 14 gauge, 4 point round barbs spaced at 3 inches, galvanized in accordance with ASTM A121, Class 3.
4. Stretcher bars shall be a minimum of ½" x ¾" steel and attached to posts with heavy steel bands.
5. Tension wire shall be 7 gauge galvanized coil spring steel.

E. Gates

1. Gates shall be of the type shown on the Contract Drawings.

MATERIALS AND PERFORMANCE – SECTION 02711

GALVANIZED CHAIN LINK FENCE

2. Welded fabrication shall be of not less than 1.90-inch outside diameter (O.D.) Schedule 40 steel pipe.
 - a. Braces and minimum 3/8-inch diameter trusses to provide rigidity without sag or twist.
 - b. Galvanized after fabrication in accordance with ASTM A120.
3. Locking devices, latches, stops, and other hardware as required for a complete operating gate.
 - a. Operate from either side.
 - b. Padlock shall be a high security padlock with precision 5-pin tumbler mechanism, 2-inch laminated steel case with resilient bumper, 7/16-inch diameter case hardened allow steel shackle with dual steel levers that lock each shackle leg independently. The padlock shall be cadmium rust-proofed and shall be furnished with six like keys. Padlock shall be as manufactured by Master Lock Company or approved equal. (TBD)
4. Three strands of barbed wire. (TBD)
5. Fabric of gates shall be the same as chain link fence.

F. Miscellaneous

1. Concrete for footings shall be minimum 3,000 psi (at 28 days) mix.
2. Wire ties or clips shall be minimum of 6 gauge.
 - a. Hog rings may be used to tie fabric to tension wire.

PART 3 - EXECUTION

3.01 INSTALLATION

A. General

1. Installation shall be in accordance with ASTM F567 - Installation of Chain-Link Fence, unless otherwise modified.

B. Posts

1. Space line posts equidistant at intervals not exceeding 10 feet.

MATERIALS AND PERFORMANCE – SECTION 02711

GALVANIZED CHAIN LINK FENCE

2. Post holes shall be of a diameter to provide not less than 4 inches of concrete outside the post and 3 inches below the bottom of post.
3. Set plumb and align in concrete base to a depth of:
 - a. 36 inches for line post.
 - b. 42 inches for pull, corner, and gate posts.
 - c. Greater if shown on Contract Drawings or recommended by fence manufacturer.
4. Crown concrete 2 inches above finish grade to shed water.
5. Concrete shall cure a minimum of 72 hours before further work is done on post.

C. Braces

1. Provide at all ends, gate, and in both tangents at pull and corner posts.

D. Top Rails and Tension Wire

1. Attach top rail securely to each gate, corner, pull, and end posts.
 - a. Support at each intermediate post to form a continuous brace from end to end.
2. Bottom tension wire shall be taut and 6 inches above finished grade.

E. Fabric

1. Tighten to provide a smooth uniform appearance free from sags.
2. Attach to terminal post using stretcher bars with tension bands to maximum 14-inch intervals or other approved method.
3. Install fabric 2 inches above finished grade.
4. Fasten to line post at intervals not exceeding 14 inches.
5. Fasten to top rail, braces, and tension wire at intervals not exceeding 24 inches.

MATERIALS AND PERFORMANCE – SECTION 02711

GALVANIZED CHAIN LINK FENCE

- F. Barbed Wire
1. Supporting arm installed angling out unless otherwise shown on the Contract Drawings.
 2. Pull taut to remove all sags, firmly install at extension arms, and secure to end and corner posts.
 3. End and corner posts shall extend above fabric to receive barbed wire.
- G. Gates
1. Install true to opening, plumb, and to open as shown on the Contract Drawings.
 2. Adjust hardware for smooth operation.
- H. The area shall be left neat and free of any debris caused by the erection of the fence.

- END OF SECTION -

MATERIALS AND PERFORMANCE – SECTION 02826

TRACK LAYOUT

PART 1 - GENERAL

1.01 WORK SPECIFIED

- A. The _____ Contractor shall field survey and stake the proposed horizontal and vertical track alignments. The alignments shall be the same as those shown on the Contract Drawings.
- B. Staking shall be done a minimum of two times: Once after the sub-ballast has been placed to ensure that it has been placed in compliance with the Contract Drawings, and again after final ballasting to ensure that the track has been placed in compliance with the Contract Drawings.

1.02 RELATED WORK SPECIFIED UNDER OTHER SECTIONS

Documents affecting work of this section include, but are not necessarily limited to the following:

TBD

1.03 SUBMITTALS

TBD

PART 2 - PRODUCTS

NOT USED

PART 3 - EXECUTION

3.01 EXECUTION

- A. Trackwork control points shall be offset and protected by the _____ Contractor. Lost or destroyed survey reference points, bench marks, and control points shall be restored by the _____ Contractor.
- B. Field staked points shall be a hard wood hub with a tack or a center punched iron pin. Stakes shall be driven into the ground or ballast a minimum of 12 inches and shall not be easily disturbed.
- C. Tangent track and curves flatter than 5 degrees shall be staked along the centerline of track at intervals of 50 feet or less.

MATERIALS AND PERFORMANCE – SECTION 02826

TRACK LAYOUT

- D. Track with curves of 5 degrees or sharper shall be staked along the centerline of track at intervals of 25 feet or less.
- E. Tracks with super elevation shall have their profile or vertical alignment follow the low rail. The low rail shall be the inside rail of the curve.
- F. All turnouts must be staked on the centerline of track at the point of switch (PS), turnout point of intersection (TOPI), and half inch point of frog (PF).
- G. Crotched turnouts and turnouts on curves shall be staked as described for all turnouts, and also as described for track on curves.
- H. The top of rail elevation shall be set to within 0.01 feet of the designed profile elevation shown on the Contract Drawings.
- I. Horizontal control points shall be set to within 0.01 feet of the coordinates shown on the Contract Drawings.

- END OF SECTION -

MATERIALS AND PERFORMANCE – SECTION 02828

REMOVE TRACK/TURNOUTS

PART 1 - GENERAL

1.01 WORK SPECIFIED

- A. Work consists of removing the track and includes removing rails, ties, rail connections, and other track material.

1.02 RELATED WORK SPECIFIED UNDER OTHER SECTIONS

Documents affecting work of this section include, but are not necessarily limited to the following:

TBD

1.03 SUBMITTALS

TBD

PART 2 - PRODUCTS

2.01 MATERIALS

- A. The _____ Contractor is responsible for all salvageable material which is damaged as a result of the _____ Contractor's operations. The _____ Contractor shall replace all such damaged material with new or used material which is in a condition equal to or better than the originally undamaged salvageable material.

PART 3 - EXECUTION

3.01 INSPECTION

- A. The _____ shall determine which track material (both timber and metal) is salvageable and which is not salvageable and will so mark the material in the field.
- B. The non-salvageable material shall become the property of the _____ Contractor and hauled off the site and properly disposed of.
- C. The salvageable material, which is the property of the railroad, shall be stockpiled as directed by the _____.

MATERIALS AND PERFORMANCE – SECTION 02828

REMOVE TRACK/TURNOUTS

- D. Metal track material not to be reused in this project shall be loaded in cars provided by the railroad or as directed by the _____.

- END OF SECTION -

MATERIALS AND PERFORMANCE – SECTION 02833

RAIL CONNECTIONS

PART 1 - GENERAL

1.01 WORK SPECIFIED

- A. Railroad shall furnish and the _____ Contractor shall install rail connections.
- B. Joints required to connect tracks to turnouts will be covered under the item for turnouts and not as a part of any track item.
- C. Compromise joints will not be allowed unless approved by the _____.

1.02 RELATED WORK SPECIFIED UNDER OTHER SECTIONS

Documents affecting work of this section include, but are not necessarily limited to the following:

TBD

1.03 SUBMITTALS

TBD

1.04 REFERENCES

- A. American Railway Engineering and Maintenance Association (AREMA).
- B. “CSXT Welders Manual,” MWI-801-01, dated January 27, 1997, or latest.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Six-hole joint bars shall be used with rail sections weighing 100 pounds per yard and greater.
- B. Bolted rail joints consist of either head free or head contact standard bars and head contact compromise joint bars held in position by track bolts.
- C. Compromise joint bars shall be new.
- D. Compromise joints shall adequately connect both sections of rail and provide a smooth rail surface over the top of the joint.
- E. Compromise joint bars shall be factory manufactured.

MATERIALS AND PERFORMANCE – SECTION 02833

RAIL CONNECTIONS

- F. Correct compromise bars shall be used as determined by the weight and section of the rail, wear on the rail, whether the joint is designated right hand, left hand, or no hand, and whether the joint bar is gage side or field side.
- G. Joint bars shall be free from all cracks or breaks after installation.
- H. Insulated joints shall be pre-fabricated factory epoxy-bonded joint assemblies, 19.5 feet long, field-welded in place, as manufactured by Portec, Inc.
- I. Where field welding of rail is indicated, the _____ Contractor shall furnish all labor, supervision, and equipment to make field butt welds by thermite welding. Defective welds and rails shall be removed and replaced.
- J. The _____ Contractor shall furnish all material, equipment, labor, and supervision for field welding the rail using field weld kits.
- K. The _____ Contractor shall furnish new standard heat-treated carbon steel track bolts, nuts, and washers in accordance with AREMA recommendations, and conforming to the type and weight of track materials being used.
- L. Splices - Joint bars designed for the specified rail section shall be installed, fully bolted. Six-hole joint bars shall be used with rail sections weighing 100 pounds per yard and greater.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Where joints in conventional track are required, rails shall be placed so that the joints in each line of rail shall be within the middle half of the opposite rail length.
- B. The tops of the heads and the gauge faces of adjoining rails shall match within one eighth (1/8) inch of each other.
- C. Abutting rail ends shall be fastened together by bolted standard or compromise joints, insulated joints or glued joints, except where butt welded.
- D. Holes for bolting of cut rails shall be drilled by an approved type of rail drill. The use of a torch for cutting bolt holes will not be permitted.
- E. Bolted joints are to be centered on a tie, and field welded joints are to be centered between ties; glued insulated joints are to be centered on a sound, smooth tie.
- F. All rail cut in the field shall be cut squarely with a rail saw. Cutting rail with a torch will not be allowed.

MATERIALS AND PERFORMANCE – SECTION 02833

RAIL CONNECTIONS

- G. The ends of field cut rail for permanent bolted joints shall be de-burred, beveled, chamfered, or peened and end-hardened.
- H. Before applying bolted rail joints, the _____ Contractor shall coat the joint bats and rail ends within the joint bar areas, including webs, fishing surfaces, bolt holes, and inside surfaces, with an approved oil or grease.
- I. When butting used rail with new rail, welding shall be used to build up the end of used rail to match the new rail to provide a smooth transition over the joint. The same process shall be used when it is necessary to butt used rail to new frogs, switches, etc. (Reference “CSXT Welders Manual,” MWI-801-01, dated January 27, 1997, or latest.)
- J. Joint bars shall be applied with their full number of bolts, nuts, and washers.
- K. All defective joint bars shall be removed and replaced before work will be accepted.
- L. The _____ Contractor shall perform field welding of all joints in accordance with the Welder’s Manual.
- M. Defective welds shall be cut out using a power rail saw. Replacement rail shall be welded into the string of rail. The entire rail shall be removed wherever longitudinal defects or transverse defects in non-control cooled rails are involved.

- END OF SECTION -

MATERIALS AND PERFORMANCE – SECTION 02850

BALLASTED TRACK CONSTRUCTION

PART 1 - GENERAL

1.01 WORK SPECIFIED

- A. This section specifies the furnishing of all necessary materials and the installation of ballasted track as shown on the Contract Drawings and specified herein. Unless otherwise specified, all materials incorporated into the work shall be new and provided by _____ Contractor.
- B. Removals and disposals include all materials and items which interfere with construction and are shown to be within the limits shown on the Contract Drawings or specified herein.

1.02 RELATED WORK SPECIFIED UNDER OTHER SECTIONS

Documents affecting work of this section include, but are not necessarily limited to the following:

TBD

1.03 SUBMITTALS

- A. TBD
- B. Submit the following in accordance with the requirements of Section 01330 – Submittals, for review and approval by the _____:
 - 1. Submit a list of proposed equipment for use in construction. The list shall be submitted to the _____ thirty days before start of work and shall include the name of the manufacturer, dimensions, and weights of the equipment and the intended use.
 - 2. Submit the proposed construction and installation procedures for ballasted trackwork for review by the _____.
 - 3. Submit the manufacturer’s certificate of compliance to the _____ for all materials that are incorporated into the work.
 - 4. Submit a tie, timber, and rail steel plan for the entire trackwork alignment to include all ballasted track and special trackwork. Provide at least the following information:
 - a. The length of all rails and the location of all field welds and joints.
 - b. The location of all rail joints, rail lengths and end details for all emergency guard rails.

MATERIALS AND PERFORMANCE – SECTION 02850

BALLASTED TRACK CONSTRUCTION

- c. A location and spacing plan for all ties and timbers.
 - d. The length and location of variations from standard gage (56½").
 - e. A destressing and welding plan for _____ (CWR) running rail. All rail joints in the running rail shall be welded wherever possible. Jointed and welded rail shall be destressed before final clipping. The desired neutral temperature of welded rail is from 95 degrees F to 115 degrees F. Rails shall be destressed and welded after surface and alignment work is complete.
5. Submit a detailed rail plan showing the layout and the location of all shop welds, field welds, insulated joints, and any compromise bars. This plan shall be provided for ballasted track, direct fixation track, and special trackwork.
 6. Submit a shop drawing of the track bumping posts to be provided.
 7. Submit a shop drawing of the type of rail lubricators to be furnished and installed by the _____ Contractor.
 8. Submit the proposed methods and equipment to distribute, compact and/or tamp bottom and top ballast. This submittal shall specify which equipment and methods will be used for conventional trackwork and special trackwork.
 9. Submit the ultrasonic calibration and ultrasonic test results of all welds made and equipment used on the project.
- B. Submit to the _____ Material Testing Laboratory for review and approval, a representative sample of stone ballast from each source proposed for use under this Contract subject to the following:
1. Submit sample in two clean, sturdy containers or bags that will not permit loss of any of the material and each of which contains 75 pounds of the sample.
 2. Clearly label each container or bag of the sample with: Contract title, number and location, name of the material supplied, and location of the source.
 3. Do not deliver ballast from any source until the _____ has approved the sample from the source.
- C. Submit a sample of all track bolts and security locknuts to the _____ for review and approval.

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BALLASTED TRACK CONSTRUCTION

- D. Submit an as-built plan of all trackwork and special trackwork that is constructed using conventional survey techniques for review and approval by the _____.

1.04 QUALITY ASSURANCE

- A. Except as modified by these Specifications or the Contract Drawings, trackwork construction and materials shall conform to the current American Railway Engineering and Maintenance Association (AREMA) Manual for Railway Engineering and Portfolio of Trackwork Plans and/or current Canadian Pacific Railway (CPR) Engineering Department plans and practices.
- B. The work to be performed shall be supervised at all times by a superintendent and a foreman in charge of field operations who are well experienced in track construction, and who are fully qualified to direct and supervise the installation of ballasted trackwork on railroad systems. The _____ Contractor shall furnish resumes for the superintendent and foremen who are to be employed in the work to the _____ for review and approval prior to the start of work.
- C. The _____ Contractor shall provide to the _____ for review and approval a quality assurance plan for the work to be performed for this project.

1.05 REFERENCES

- A. AREMA Manual for Railway Engineering and Portfolio of Trackwork Plans.
- B. CPR Engineering Department plans and practices.
- C. _____ (AWPA).

1.06 CONSTRUCTION EQUIPMENT AND TRACK TOOLS

- A. Hi-rail construction equipment shall operate on standard North American railroad track except as otherwise authorized by the _____.
- B. Track tools shall conform to the AREMA “Specifications and Plans for Track Tools.” Tools and equipment shall be maintained in such condition that they will not damage the work and shall be subject to inspection by the _____. Any tool not conforming to standard shall be “dressed” to AREMA standards or better, or shall be replaced. Substitution of tools which are not of standard design shall be permitted only with approval of the _____.
- C. The _____ Contractor shall furnish all tools and equipment necessary to furnish and install the ballasted trackwork.

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BALLASTED TRACK CONSTRUCTION

- D. The _____ Contractor shall furnish for review and approval by the _____ the type of tamping, aligning, and compacting equipment to be used for surfacing and aligning ballasted track and special trackwork. In general, the _____ Contractor shall provide a 16 tool tamper that is capable of tamping both the ballasted trackwork and ballasted special trackwork. The _____ Contractor shall provide one or more ballast regulators and provide a ballast stabilizer. The _____ Contractor's surfacing and aligning consist shall be submitted to the _____ for review and approval by the _____ before the equipment is brought to the jobsite.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Rail
1. New steel head hardened tee rails used for special trackwork shall meet all requirements of the specifications for Steel Rails of the AREMA Manual, Chapter 4, Part 2, and CPR Standards except as modified herein. See Section 02854 - Rail and Joint Bars.
 2. Special trackwork rail shall be new fully head hardened AREMA Section 115 RE rail or as approved by CPR. Only No. 1 quality rail shall be used. Rail shall be supplied in 78 feet or longer lengths; drilled in accordance with AREMA and/or CPR standards.
 3. All special trackwork rail shall be heat-treated to a Brinell hardness of 341 to 388 in accordance with AREMA and/or CPR Specifications. Rails shall be head hardened; partial treatment will not be accepted. Head hardened rails shall be marked in accordance with AREMA Paragraph 2.1.15 - Markings, and stamped in the same manner as required in AREMA Paragraph 2.1.6 - Branding and Stamping.
 4. The sheared side of restraining rail shall be opposite the raised lettering side of rail. Rails scheduled for shearing shall meet all requirements for tee rails; including head hardening. The rail base shall be sheared to dimensions shown on the Contract Drawings; gas and electric burning will not be permitted.
 5. Unless otherwise shown on the Contract Drawings, rails shall be sawed square to the centerline of the rail. A variation of more than 1/32 inch will not be acceptable. All burrs shall be removed and the ends of the rails made smooth with the use of a hand grinder.
 6. Complete records for all manufacturers, mill inspections, and testing performed shall be sent to the _____.

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BALLASTED TRACK CONSTRUCTION

7. All rail is subject to approval by the _____.

B. Nuts, Bolts, Spring Washers, and Spikes

1. Except as noted on the Contract Drawings, nuts and bolts shall be new material and conform to the material requirements of AREMA, Chapter 4, Paragraph 2.9 “Specifications for Heat Treated Carbon Steel Track Bolts and Carbon Steel Nuts.” Track bolts shall be a proper size for the track joint in conformance with AREMA and/or CPR Standards.
2. Spring washers as required shall be new, single coil, helical, and shall conform to AREMA “Specifications for Spring Washers,” Chapter 4, Paragraph 2.10. Grade 8 bolts with security lock nuts require a flat washer. See Contract Drawings.
3. Cut spikes, if required, shall be new, 6 inches by 5/8 inch, reinforced throat and conform to AREMA “Specification for Soft Steel Track Spikes” and “Design of Cut Track Spikes.”
4. Screw spikes shall be new, manufactured from high quality steel and measure 7/8-inch diameter by 5¼ inches long. Screw spikes are to be used to fasten all Pandrol plates and special trackwork components to wood ties and timbers.

2.02 RESILIENT RAIL FASTENING ASSEMBLIES

- A. New rolled tie plates with resilient rail fastening shall be used in the areas of ballasted track construction. The rail clip assembly shall be the Pandrol type “e” 2055 or CPR approved equal.
- B. Tie plates shall be new, manufactured for use with the rail section and as shown on the Contract Drawings for all locations.
- C. Rail clips shall be new, “e” series design and provide a clamping force of 5,000 lbs. with a nominal toe load of 2,750 lbs. at a working deflection of 7/16 inch.

2.03 INSULATED RAIL JOINTS

- A. Insulated joints shall be new bonded or non-bonded encapsulated. Bonded insulated shall use head hardened rail. See Section 02852 - Insulated Joints. All insulated joint locations shall be coordinated with the signal contractor or subcontractor.

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BALLASTED TRACK CONSTRUCTION

2.04 BALLAST

- A. Ballast shall be either traprock or granite and shall be broken into angular fragments. Stone shall be obtained from quarries that are approved by the _____ as containing material of the desired quality in accordance with these Specifications.

- B. Physical Properties: The methods of determining the physical and chemical properties shall be in accordance with this Specification and Paragraph 2.4 of AREMA Manual of Railway Engineering, Chapter 1, Part 2, entitled "Property Requirements." For stone ballast, the following characteristics will govern.

<u>Property</u>	<u>Maximum Value (%)</u>	<u>Minimum Value</u>	<u>ASTM Test Method</u>
Percent passing No. 200 sieve	1.0	---	C117
Bulk-Specific Gravity Rock	---	2.60	C127
Absorption Rock	1.0	---	C127
Clay Lumps and Friable Particles	0.5	---	C142
Degradation 25 percent (traprock)	35	---	C535
Soundness (Sodium Sulfate) -- 5 Cycles	5	---	C88
Flat or Elongated Particles	5	---	D4791

- C. Grading: The ballast shall be Size No. 4. When tested with standard laboratory sieves having square openings, and complying with the requirements of ASTM E11, the percentage, by weight, of ballast finer than each sieve shall be within the following limits:

<u>Nominal Sieve Size Square Opening (inch)</u>	<u>Percent Passing</u>
2	100
1-1/2	90-100
1	20-55
3/4	0-15
3/8	0-5

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BALLASTED TRACK CONSTRUCTION

- D. Cleaning: The ballast shall be washed and free from dirt, loam, dust, or rubbish. When the rock is of such nature that when crushed and screened it is not free from dust, it shall be washed at the quarry before being transported to the site.
- E. Handling
1. Broken stone for ballast shall be delivered from the screens directly to the conveyance or to clean bins provided for the storage of the output of the crusher.
 2. Ballast must be loaded into conveyances that are in good order and tight enough to prevent leakage and waste of material and are clean and free from sand, dirt, rubbish, or any other substance which would foul or damage the ballast material.
- F. Inspection
1. The _____ and/or CPR may inspect ballast at its source.
 2. Samples shall be delivered by the _____ Contractor to the _____'s lab to be tested by the _____ for conformance to these Specifications.
 3. All materials not meeting the _____'s specifications shall be removed from the track or site and replaced with materials meeting the specifications at the _____ Contractor's expense.

2.05 **TIMBER TIES**

- A. Timber ties shall be new and conform to the current AREMA Specifications for "Ties and Wood Preservation," except as modified herein. All references to railway, railroad, or railroad company shall mean the Project and/or CPR.
- B. Timber cross-ties shall be 8.5 feet in length and conform to AREMA 7-inch Grade:
1. Cross-ties shall be 7 inches by 9 inches in cross section with a maximum of 1 inch of wane in the rail bearing area. The rail bearing area is defined as the center sections of a cross-tie between 20 and 40 inches from the center of tie.
 2. The length, thickness, and width specified are minimum values. Ties over 1 inch longer or shorter, thicker, or wider shall be rejected. Tie dimensions shall not be averaged.

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BALLASTED TRACK CONSTRUCTION

- C. Material: Ties shall be produced from oak. Water oak is not acceptable. Hardwoods other than oak listed in the “Specifications for Timber Ties” of the AREMA Manual, Chapter 3, Part 2, are permissible when approved by the _____.
- D. Quality
1. The timber from which the ties are produced shall be cut from straight sound trees. All ties shall be free from any defects that would impair their durability or strength as ties, such as decay, large shakes or large splits, large or numerous holes or knots, or grain with a slant greater than 1 in 15.
 2. All ties shall be straight and have four sides well sawed and parallel. All ties shall be cut square at both ends and have all bark removed.
- E. Inspection Defects
1. In an unseasoned tie, a split of more than four inches long and one-eighth-inch wide are not permitted.
 2. Shakes not greater than one-third of the width of the tie will be allowed provided they are no closer than one inch from any surface of the tie.
 3. A large hole is a cavity more than 1/2 inch in diameter and three inches deep within the rail bearing section of the tie, or more than one-quarter the width of the surface on which it appears and three inches deep outside the rail bearing area of the tie. Numerous holes are any number equaling a large hole in damaging effect.
 4. A large knot is one which the diameter exceeds one-third the width of the surface on which it appears, but such a knot may be allowed if it occurs outside the rail bearing area of the tie. Numerous knots are any number equaling a large knot in damaging effect.
 5. Ties with continuous checks over one-half inch in width on any face and longer in aggregate than two-thirds of the tie length, will be rejected.
 6. The meaning of the terms above shall be in accordance with the definitions in the Specifications for Timber Cross-ties and Switch-ties of the AREMA Manual, Chapter 3, Parts 1 and 2, and in grading rules issued by the Southern Pine Inspection Bureau.

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BALLASTED TRACK CONSTRUCTION

- F. Dimensions: A tolerance of plus or minus one-quarter inch in width and thickness, and plus or minus one inch in length from the dimensions specified, will be permitted.
- G. Seasoning: Conditioning and seasoning shall conform to the requirements of AWPA C6 for the individual wood species, as well as the requirements of this specification. Timber cross-ties and switch-ties shall be well seasoned. Timber ties manufactured from red or white oak shall be dried to an oven dry moisture content of 50 percent or less prior to preservative treatment. Timber ties manufactured from other allowable wood species shall be dried to an oven dry content of 45 percent or less prior to preservative treatment. The wood may be air-dried, vapor-dried, or bouldenized. Submittals shall indicate the type of seasoning to be utilized.
1. Ties that are to be dried by artificial means shall be seasoned and treated as soon as possible after sawing, but in no case more than 30 days later.
 2. The temperature used for bouldenizing shall be as high as possible, but in no case less than 200 degrees F.
 3. Vapor-dried ties shall be transferred from drying cylinders to treatment cylinders as quickly as possible to avoid loss of heat from the seasoned ties.
- H. Incising: Timber cross-ties and switch-ties shall be incised on all four sides in the pattern specified in the AREMA Manual for Railway Engineering, Chapter 3, Part 6 “Wood Preserving.”
- I. Preservative Treatment: Timber cross-ties and switch-ties shall be pressure treated in accordance with Chapter 3, Part 6 “Wood Preserving” of the AREMA Manual by the empty cell process with a 60/40 creosote/coal tar solution (Grade C) to a minimum retention of eight pounds per cubic foot of wood. The _____ Contractor shall record treatment as specified in the current AWPA Standard M-2 “Standard For Inspection of Treated Timber Products.”
- J. Anti-Splitting Devices
1. All timber cross-ties and switch-ties shall be equipped with anti-splitting devices of the type specified regardless of whether or not the wood has shown any tendency to split. Products used shall conform to the AREMA “Specifications for Devices to Control the Splitting of Wood Ties” given in Chapter 3, Part 1 of the “Manual for Railway Engineering” and are shown on the Contract Drawings.
 2. All timber cross-ties and switch-ties shall be equipped on each end with gang nails (nail end plates).

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3. The gang nails shall be manufacture galvanized.
4. The gang nails shall be installed by mechanical equipment capable of pressing the tie together closing all splits before application.
5. Splits in timber cross-ties and switch-ties shall be closed before treatment by selectively applying anti-splitting devices of the type as shown on the Contract Drawings. Products used shall conform to the AREMA “Specifications for Devices to Control the Splitting of Wood Ties.”

K. Marking: Prior to preservative treatment, a brand showing the vendor’s name, the place of manufacture, and the month and year of treatment shall be stamped on the top and in the middle of each tie, with letters and numerals not less than one-half inch high. Such brand shall be placed only on the top surface of each tie.

L. Inspection

1. The _____ may inspect ties at any time, before, during or after treatment for conformance to these specifications. Each tie will be judged independently without regard for decisions on other ties in the same lot.
2. The _____ will inspect materials and process relative to preservative treatment of ties in accordance with the provisions of the “Standard Methods of Analysis” of the AWP. A.
3. The _____ may make any additional inspections of the ties after delivery in order to determine conformity to this Specification. However, the plant inspection shall be considered final with respect to the treatment materials and processes.

M. Tie Plugs: All tie plugs shall be cedar, new and shall conform to the requirements of AREMA Chapter 3, Section 1.5.

2.06 TIMBER SWITCH-TIES

A. Furnish and install timber switch-ties for special trackwork in accordance with Section 02855 - Timber Switch-Ties.

2.07 TRACK BUMPING POSTS

A. Furnish and install track bumping posts for tracks as shown on the Contract Drawings.

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BALLASTED TRACK CONSTRUCTION

2.08 RAIL LUBRICATORS

- A Furnish and install four double-back of rail flange or gage face lubricators at the direction of the _____. Lubricators to be M&S 761 Hydrolube or approved equal. Powerblock plunger to be modified for gage side use.

PART 3 - EXECUTION

3.01 INSPECTION

- A. New trackwork and special trackwork shall be constructed as shown on the Contract Drawings and meet the alignment of the existing tracks to which it shall be connected. The final track alignment shall be continuous throughout and within the tolerances specified in this section.
- B. The _____ Contractor is advised that the new track will connect to tracks that are now owned and operated by the Delaware & Hudson Railway Company, a subsidiary of the Canadian Pacific Railway.
- C. The actual centerline of track shall be within $\pm 3/8$ " of the design value. The top of rail elevation shall be within $\pm 1/4$ " of the design value. There is no reverse elevation allowed in spirals or curves.
- D. The _____ Contractor shall measure and verify horizontal and vertical track alignment, track geometry and gage by conventional survey methods by the _____ Contractor subject to the satisfaction of the _____. Measurement of alignment and profile, track geometry and gage will also be subject to verification by the _____. The _____ Contractor shall provide an "as built" survey performed by a New York State licensed land surveyor of all track installations. This survey shall include the grid coordinates and stations of all points shown on the plan and profile for all track and special trackwork within the limit of the work.
- E. In addition to Paragraph C, surface and alignment of ballasted track shall be within the following tolerances. The _____ Contractor, at the _____ Contractor's expense, shall correct any deviations above the allowable specified hereafter.

<u>Track Surface and Alignment</u>	<u>Construction Tolerance (inches)</u>
Deviation from uniform profile on either rail at the midordinate of a 62-foot chord shall not exceed.	3/8
Deviation from zero cross level at any two	

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points less than 62 feet apart on tangents or specified elevation on curves shall not exceed. 1/4

The difference in cross level between any two points less than 62 feet apart on tangents or curves shall not exceed. 3/8

Deviation from uniform alignment between any two points less than 62 feet apart on tangent and curved track shall not exceed. 3/8

F. The _____ will require the operation of multiple test trains prior to placing the track into service. The _____ Contractor shall make the track available for use by the _____ at least 30 days prior to the track being cut over for service.

G. Final Track Inspections

1. The final surface, alignment, gage, cross level, and super-elevation shall be within the tolerances specified in Paragraph F. In order to determine the acceptability of finished track, the _____ Contractor shall make a final inspection and field survey to establish that track construction is within the tolerances specified herein. This information shall be provided in an as-built drawing form to the _____ prior to non-revenue testing.
2. The _____ Contractor and _____ shall participate in track inspections.
3. Track deviations, as disclosed by the inspection described above, which exceed tolerances specified herein shall be corrected by the _____ Contractor at the _____ Contractor's expense.
4. The _____ Contractor shall make necessary reinspections to ascertain that corrections have been made.
5. The _____ Contractor shall notify the _____ two weeks in advance before requesting any track inspection.

3.02 REMOVAL/DEMOLITION

A. The _____ Contractor shall remove existing track to the limits shown on the Contract Drawings for construction of new trackwork.

3.03 TIMBER AND TIES

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BALLASTED TRACK CONSTRUCTION

- A. New cross-ties and timbers shall be installed within the construction limits shown on the Contract Drawings. Ties and timbers shall be spaced as shown on the Contract Drawings. Ties shall be placed on 24” centers and/or on centers as specified by CPR. The _____ Contractor shall provide a tie and timber arrangement drawing for review and approval by the _____.
 - B. Ties and timbers shall be placed normal to the centerline of track. Ties shall be installed with the heartwood face down. Adzing of ties and timbers will not be permitted without prior review and approval of the _____.
 - C. Unnecessary handling, redistribution, and reloading of ties shall be avoided. Any tie or timber that is respiked or drilled for a coach screw more than once shall be removed and replaced at the _____ Contractor’s expense. Ties and timbers damaged as a result of improper handling by the _____ Contractor and rejected by the _____ shall be removed and replaced with undamaged ties.
- 3.04 **RUNNING RAIL AND INSULATED JOINTS**
- A. Rails shall be handled in a manner that will prevent nicks, dents, kinks, and permanent bends. The procedure for loading, transporting, and storage shall be approved by the _____.
 - B. Where required for tie-in, rail shall be cut square and clean by means of rails saws or abrasive cutting wheels. Holes of proper diameter for the size of bolt required for complete bolting of cut rails shall be properly spaced and drilled with equipment approved by the _____. Lengths of rails to be used in permanent construction shall be approved by the _____. Minimum rail lengths of 39 feet shall be used. The preferred rail length is 78 feet. The _____ Contractor shall furnish a rail plan as specified in 1.03 B.5 of this section. Torch cutting of rails or bolt holes shall not be permitted. The sawing and drilling of rails will be accomplished with equipment that is approved by the _____.
 - C. Field welding by the thermite process shall be performed in accordance with Section 02857 - Thermite Welding.
 - D. Wherever possible, all running rails and glued plug insulated joints shall be welded. This includes all special trackwork.
 - E. In the event of lipped or uneven joints at connections to existing rails the _____ Contractor shall “build-up” the uneven joint with weld material as directed by the _____. Grinding of the weldment shall be made with a profile rail grinder. Grinding of new rail to remove a mismatched joint condition shall not be permitted.

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BALLASTED TRACK CONSTRUCTION

- F. When placing rail the _____ Contractor shall ensure that all tie and switchplates are cleaned to allow full bearing of the rails. The _____ Contractor shall install tie plates for completing the work.
- G. All running rail shall be welded and then clipped or anchored at a neutral temperature from 95 degrees F to 115 degrees F. The _____ Contractor shall provide the details of the proposed rail distressing program for review and approval by the _____. The _____ Contractor shall make and furnish to the _____ all rail expansion and welding records. Before laying rail, the _____ Contractor shall submit for review and approval to the _____, the _____ Contractor's rail laying and distressing form.
- H. The distance between the jointed rail ends shall be adjusted according to the temperature at which the rails are laid. The opening between the ends of rails for different rail temperatures shall be as follows:

<u>Rail Temperature (°F)</u>	<u>39 Foot Rail (in.)</u>	<u>78 Foot Rail (in.)</u>
-10 to 14	1/4	1/4
15 to 34	3/16	3/16
35 to 59	1/8	1/8
60 to 85	1/16	1/16
over 85	0	0

- 1. A standard rail thermometer shall be used to determine the rail temperature. The thermometer shall be laid close to the web on the side of the rail base which is shaded from the sun's rays in advance of the laying operation and left there long enough to accurately record the temperature. The supervisory employee in charge shall see that rail temperature is checked frequently and that proper tail expansion shims are used. The _____ Contractor shall provide a record of all rail temperatures and the required expansion shims.
- 2. The space between the rails at insulated joints shall be as recommended by the joint manufacturer.
- I. Except as otherwise shown on the Contract Drawings, rails shall be placed so that the joints of one line of rails shall be opposite the quarter point of rails in the other line.
- J. Short rails less than 33 feet long shall not be used in track unless approved by the _____ and shall be shown on the _____ Contractor's steel plan (see 1.03, B.4 of this section).

3.05 BOLTED TRACK JOINTS (TEMPORARY AND PERMANENT)

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BALLASTED TRACK CONSTRUCTION

- A. Permanent joints shall be bolted and joined, as specified herein. It is intended to eliminate joints in the running rail wherever possible.
 - B. Bolted joints shall consist of standard or compromise joint bars held in position by track bolts with the tension specified to firmly support abutting rail ends and also permit their longitudinal movement in the joint to accommodate expansion and contraction due to variation in temperature.
 - C. Joint bars shall be applied with their full number of bolts, nuts, and spring washers. In tightening, bring bolt tension, on standard track bolts, to within a range of 20,000 to 25,000 foot-pounds. Tighten bolts beginning with the two center bolts and progress to end bolts.
 - D. All temporary rail joints shall be removed and field welds made in accordance with Section 02857 - Thermitic Welding, after the distance between the rail ends is adjusted in accordance with 3.04H of this section.
- 3.06 COACH SCREW SPIKING AND CLIPPING (ANCHORING)
- A. Plates shall be affixed to ties and timbers with screw spikes (7/8 inch) at the plate holding locations as shown on the Contract Drawings. Coach screw holes shall be field-bored to 5/8 inch in diameter and 5¼ inch in depth, or as recommended by the manufacturer.
 - B. Screw spikes shall be started vertically, squared, and turned in straight; straightening of started screw spikes will not be permitted. Plate holding screw-spikes shall be turned down firmly to the top of the plate in accordance with the manufacturer's specifications. Care shall be exercised to prevent over tightening the screw spikes.
 - C. Track anchoring shall consist of the application of rail clips. Rail clips shall be applied in conformance with the manufacturer recommendation and with proper joint openings for the rail temperature or after destressing of CWR has been accomplished as described in 3.04.
- 3.07 TRACK BUMPING POSTS
- A. Install track bumping posts at locations as indicated on the Contract Drawings.
- 3.08 RAIL LUBRICATORS
- A. Furnish and install rail/wheel lubricators in accordance with the manufacturer's recommendations as directed by the _____.

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BALLASTED TRACK CONSTRUCTION

3.09 BALLASTING, SURFACING, AND DRESSING

- A. After placing the bottom ballast, the ballast shall be dumped spread and compacted with a five-ton steel-wheeled roller to 90 percent relative density to within 3 inches of the final elevation of the bottom of tie. Care should be taken to prevent any damage to the ballast mat during the placement and compaction of ballast.
- B. Following the installation of the trackwork on the compacted ballast, stone ballast shall be distributed in sufficient quantity to properly surface, align and tamp the track. Equipment and methods used for ballast installation shall be subject to approval by the _____.
- C. Ballast shall be uniformly tamped under both sides of each tie, directly under each running rail for a distance of 15 inches on both sides of the rail. Tamping shall be done with a vibratory tamper with the tamping tools and limit switches set so that the tamping operation does not cause damage to the existing concrete deck structure on the existing viaduct and the concrete invert in the tunnel/portal areas or to the ballast mat. Submit specific equipment and methods as specified in 1.03 of this section. The _____ Contractor shall use a moveable head, sixteen tool tamper, and ballast consolidator.
- D. After ballasting and surfacing operations are completed, the trackwork shall be “dressed” manually or by machine to provide the ballast section shown on the Contract Drawings. There shall be no ballast material left on the base of the rails, tie plates, or ties.
- E. The rail shall be destressed and welded after final surfacing and alignment.

- END OF SECTION -

MATERIALS AND PERFORMANCE – SECTION 02851

BALLASTED TURNOUTS

PART 1 - GENERAL

1.01 WORK SPECIFIED

- A. The work of this section shall include the furnishing and installation of special trackwork materials, incidental work related to special trackwork installations, all as shown in the Contract Documents and as otherwise required for the proper and timely completion of the work.

1.02 RELATED WORK SPECIFIED UNDER OTHER SECTIONS

Documents affecting work of this section include, but are not necessarily limited to the following:

TBD

1.03 SUBMITTALS

- A. TBD
- B. The _____ Contractor shall submit a timber and steel layout plan for all special trackwork a minimum of thirty calendar days prior to commencement of work. The timber layout plan shall eliminate all weave ties and indicate the lengths, spacings, and the locations of new timber. In addition it will show the lengths of all rails and locations of all field welds, bolted joints and insulated joints.
- C. The _____ Contractor's steel layout diagram for all special trackwork will clearly show the dimensions and type of all components to be utilized in each turnout.

1.04 REFERENCES

- A. Except as modified by the Contract Documents, trackwork construction and material shall comply with the following:
 - 1. American Railway Engineering Association (AREA) "Manual for Railway Engineering," Current to July 31, 1998, Published Annually.
 - 2. AREA, "Portfolio of Trackwork Plans," Current to July 31, 1998, Published Annually.
 - 3. Canadian Pacific Railroad, Standard Practices Circular.

MATERIALS AND PERFORMANCE – SECTION 02851

BALLASTED TURNOUTS

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Switch-ties shall be furnished under the provisions of Section 02855 - Timber Switch-Ties.
 - 1. Switch-ties required for electric switch machines will be as shown on the Contract Drawings.

- B. Rail and Joint Bars
 - 1. Rail and joint bars used in special trackwork construction shall be furnished under the provisions of Section 02854 - Rail and Joint Bars.
 - 2. All rail used in special trackwork shall be as shown on the Contract Drawings. In general, new turnouts built in ballasted track shall be constructed of new heat treated 115RE rail with 132RE restraining rails.
 - 3. Joint bars in all 115RE turnouts as well as on the 132RE restraining rails shall be six-hole or four-hole head free toeless joint bars. Rails shall be cut to lengths as indicated on the Contract Drawings. Joints in turnouts may be jointed, insulated, or welded as shown on the Contract Drawings.

- C. Other Track Materials used in special trackwork construction shall be as indicated under the provisions of Section 02858 - Other Track Materials.

- D. Frogs, Switches, Guardrails, and Turnout Appurtenances shall be new for all turnouts. All of the materials used in all new turnouts shall be of the same weight and similar section.
 - 1. New switches for 150-foot centerline radius turnouts shall be 13' - 0" curved undercut split switches with graduated risers generally conforming to MBTA Plan Number T-e-111352. Turnouts shall be installed by the _____ Contractor in ballasted track as shown on the Contract Drawings. Joints shall be field welded.
 - 2. Heel blocks shall be manufactured (welded) from machined steel shapes and be new. For all turnouts, new heel block assemblies with new bolts and thimbles shall be provided and shall be heat treated. Bent joint bars shall be new and manufactured for this purpose.
 - 3. Gage plates, switch plates, slide plates, hook plates, heel plates, and switch rods shall be new for special trackwork.

MATERIALS AND PERFORMANCE – SECTION 02851

BALLASTED TURNOUTS

4. All adjustable rail braces used in ballasted track construction shall be new and of a resiliently fastened type.
 5. All slide plates, brace plates and turnout plates between the switch and frog shall be new and of a resiliently fastened type.
 6. Vertical switch rods and rocker clips shall be new for new 115RE special trackwork.
 7. All brace plates and slide plates shall be attached to the timber with timber screws.
- E. Frogs shall be new cast manganese steel, flange bearing frogs as indicated on the Contract Drawings. Frogs used in 115 lb. turnout rehabilitation shall conform to the 150 foot centerline radius switch and to MBTA plan Number T-e-103861-1.
1. Frog joint bar assemblies shall be a toeless head-free type, 24 inches long, with four holes in accordance with AREA Chapter 4.
 2. Hook twin tie plates used under the frog shall be new and shall be of the designs and lengths indicated on AREA Plans Nos. 112, 114, and 241 except that they shall be modified to be resiliently fastened and self aligning.
 3. All frog bolts, nuts, lock washers, and headlocks shall all be new and in good condition capable of being completely tightened. Bolts shall be tight with the lock washer compressed against the frog wing rails.
- F. All materials shall be shop assembled, match marked, then disassembled, and palletized and banded by major component for delivery to the job site.
- G. Each major component shall be tin tagged with the corresponding turnout number.
- H. Switch Machines
1. Switch machines shall be new and are specified in the signal specification sections.
 2. Switch banners shall be an electric lamp type as specified in the signal specification sections.
- I. Ballast shall conform to the requirements of Section 02850 - Ballasted Track Construction.

MATERIALS AND PERFORMANCE – SECTION 02851

BALLASTED TURNOUTS

PART 3 - EXECUTION

3.01 CONSTRUCTION METHODS

- A. Turnout Installation: Includes all turnouts and special trackwork which is to be constructed in place at locations as indicated on the Contract Drawings.
1. Special trackwork and turnouts shall be constructed at the locations indicated on the Contract Drawings. Dimensions, details and configuration of the turnout shall be as indicated on the Contract Drawings and in the MBTA Plans. Switch-ties shall be placed as indicated on the Contract Drawings. In no case shall the end of a switch-tie be within 14 inches of a spike, lock spike, or screw spike.
 2. The _____ Contractor shall submit a timber plan for approval to the _____ which shows the proposed timber plan to the frog area and long timbers from frog to switch point at all crossover locations.
 3. All turnout components such as switch points/stock rails, restraining rails, rail joints and frog castings, shall fit properly and be of the proper match. Both rail ends at all rail joints throughout the turnout and at the joints at the frog shall be matched on both the top (tread portion) and on the gage side of the rail. Rail end welding and grinding and slotting shall be performed to achieve a good match. After assembling turnouts, all bolted joints will be slotted per AREA Standard Plan No. 1005-40.
 4. All special trackwork shall be assembled within 0.15 foot of theoretical alignment prior to ballasting work. A layer of bottom ballast shall be placed over the ballast mat and compacted with a vibratory roller in lifts of not more than four inches. The final elevation of the compacted ballast layers in embedded track shall be not more than three inches below the final bottom elevation of the switch timber. The timber and steel special trackwork components shall then be placed on the compacted ballast and built before final surfacing and alignment of trackwork. Care shall be taken during turnout construction and placement to minimize disturbance to the ballast and sub-ballast.
 5. The final surfacing and alignment lift of the rehabilitated turnout shall not exceed three inches and be accomplished with a sixteen tool, split head, vibratory switch tamper, accompanied by a crib and shoulder consolidator. Tamping, ballast dressing requirements, and alignment tolerances shall be as indicated in this section. Ballast level in cribs beneath the connecting rod, switch point rails, and switch rods shall be at least 2 inches below any turnout steel.

MATERIALS AND PERFORMANCE – SECTION 02851

BALLASTED TURNOUTS

6. Switch machines and electric lamps shall be installed and the switch operating mechanisms adjusted so that the switch operates smoothly, without excessive force being required. All switch plates and connection points in the switch rod shall be lubricated with a graphite-based switch lubricant. All cotter pins shall be installed in upright and connecting rod bolts, as well as at the appropriate heel block bolts.

- END OF SECTION -

MATERIALS AND PERFORMANCE – SECTION 02852

INSULATED JOINTS

PART 1 - GENERAL

1.01 WORK SPECIFIED

- A. This section specifies furnishing and installing all conventional and bonded insulated joints as shown on the Contract Drawings and the _____ Contractor's special trackwork shop drawings. Wherever possible, bonded insulated joints should be used. Bonded insulated joints shall be used at wayside signal locations. Conventional insulated joints may be used in turnouts and special trackwork.

1.02 RELATED WORK SPECIFIED UNDER OTHER SECTIONS

Documents affecting work of this section include, but are not necessarily limited to the following:

TBD

1.03 SUBMITTALS

- A. TBD
- B. Shop Drawings

In accordance with the requirements of _____, submit ____ copies of the following for approval.

1. Catalog cuts or other descriptive literature on insulated joints and fasteners to be provided.
2. Field Installation (to include bolt torque) and Test Procedures.
3. Locations where rail cutting and welding is required for bonded insulated joints and conventional insulated joints.

1.04 QUALITY ASSURANCE

Inspect insulated joints for conformance to material specifications before installation in track. Inspect insulated joints after installation to ensure conformance with the approved field installation and test procedures.

- A. Qualification Test – Bonded Insulated Joints – Plug Rails
1. Electrical Resistance Test – Assemble rail joint in accordance with manufacturer's recommendations and support on non-conducting material. With 500 Vdc applied to rail across the bonded insulated joint for a duration of three minutes, measure current flow through the joint to

MATERIALS AND PERFORMANCE – SECTION 02852

INSULATED JOINTS

the nearest 0.01 micro ampere. Ten megohms is the minimum acceptance resistance for the test. With 50 Vac applied to the rail across the bonded insulated joint for a duration of three minutes, measure impedance with an accuracy of plus or minus 2 percent. Repeat this test three times, once with a frequency in the range from 20Hz to 100 Hz, again with a frequency in the range from 200 Hz to 1000 Hz, and again in the range from 2,000 Hz to 10 KHz. The minimum acceptable impedance for any of these tests shall be 10,000 ohms.

2. Rolling Load Test – Mount rail joint used in Electrical Resistance Test on a 33-inch stroke rolling load test machine supported on 36-inch centers with the joint centered between the supports. Apply a 44,000 pound wheel load on the rail for 2,000,000 cycles. Measure and record deflection of rail at the centerline of the joint to the nearest 0.001 inch. Measure deflection at the ends of the joint at every 500,000 cycles. The wheel patch shall travel from a point six inches from the center of the joint to a point nine inches outside the opposite end of the joint. Deflection of the joint shall not exceed 0.065 inches during the test and the joint shall show no evidence of failure by bending. Repeat Electrical Resistance Test. Test results shall be within the acceptance criteria specified.
3. Longitudinal Compression test – Saw assembled joint in half where rails are joined together to prevent overheating and damage to the epoxy bond. Make the cut perpendicular to centerline of top of rail. Use a fixture or device so that the reaction at the sawn ends occurs only on the face of the joint bars when a load is applied to the centroid of the rail at the opposite end. Apply the load in increments of 25,000 pounds, maintaining each load increment until the deflection of the rail stops before increasing the load. Increase the load to 650,000 pounds and a record of loading and differential movement of the rail measure to 0.00 inch shall be measured for each increment. The joint shall show no indication of slippage prior to reaching a compressive load of 650,000 pounds and the movement shall be less than 1/8 in any direction. Relative position of the rail and joint bar shall be within 1/32 inch of its original value when load is removed.
4. Submit certification and test results of insulated joint passing the qualification testing as specified herein.

1.05 REFERENCES

- A. American Railway Engineering and Maintenance Association (AREMA) Manual for Railway Engineering.
- B. American Society for Testing and Materials (ASTM) A490 – Quenched and Tempered Alloy Steel Bolts for Structural Steel Joints.

MATERIALS AND PERFORMANCE – SECTION 02852

INSULATED JOINTS

C. _____ (AAR) Signal Manual.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Insulated Joints

1. Conventional (Bolted) Insulated Joints

- a. Provide insulated joints consisting of two joint bars of same general configuration as 6-hole standard joint bars conforming to the dimensional requirements of 115 and/or 132 pound RE rail section (running rail and vertical restraining rail). Provide insulated joint bars of rolled, heat treated steel core surrounded by uniform, single pour, polymeric insulation material similar to that manufactured by Portec, Inc., 3M, or approved equal.
- b. Provide bar, end post and bushing insulation material impervious to oil, grease and water, and with electrical resistance characteristics equal to or greater than fiber insulation meeting the requirements of AAR Signal Manual Part 14.5.1 Provide insulated joints highly resistant to abrading, cracking, cutting, spalling, and fatigue failure under impact loads, which shall exhibit deflection characteristics comparable to standard steel rail joints.
- c. Provide insulated joints complete with bars, 3/16" end posts, bushings, and washer plates and high strength bolts.
- d. Fasteners
 - 1) Provide bolts, nuts, and flat washer conforming to the chemical and mechanical requirements of ASTM Designation A490, Quenched and Tempered Alloy Steel Bolts for Structural Steel Joints, and having Class 2A and 2B thread fit. Provide a positive means for maintaining the tension in the bolts through in service vibrations by a prevailing lock nut complying with Industrial Fastener Institute Standard IFI-100 and IFI-101, or approved equivalent. Locate and size the bolt holes in conformance to drilling for 115 and/or 132 pound RE rail as specified in the AREMA Manual. Flat washer, if required, shall be hardened A-325 or A-490 and tempered carbon steel.

MATERIALS AND PERFORMANCE – SECTION 02852

INSULATED JOINTS

e. Tie Plates

Wherever possible, insulated joints shall be suspended. Tie plates for supported insulated joints shall be polymer, insulated steel plates, or approved equal.

f. Special Bolted Insulated Joints

There may be a need to furnish and install special bolted insulated joints in special trackwork and in areas where there is a vertical restraining rail. See Contract Drawings.

2. Bonded Insulated Joints

a. Furnish bonded insulated joints, shop fabricated into plug rails, 39 feet – 0 inches in length, for installation into CWR.

b. Furnish head hardened plug rails. See Section 02854 - Rail and Joint Bars.

c. Furnish joints bars fabricated from quenched carbon steel conforming to AREMA Manual for Railway Engineering, Chapter 4, Specification for Quenched Carbon – Steel Joint Bars.

d. Furnish full face contact joint bars conforming to the configuration of 115 pound RE rail, as required. Joint bars shall be smooth and straight. Furnish inside face of joint bars with pre-bonded insulating material, smooth with no branding or stamping. Furnish end posts and high strength bolts.

e. Fabrication Tolerances

1) Finishing Height: Within plus or minus 1/64 inch of dimension shown on Contract Drawings.

2) Straightness: Portions of joint bars adjacent to rail shall be straight within a tolerance of plus or minus 1/32 inch, measured with a 36-inch straight edge.

3) Length: Within plus or minus 1/8 inch of dimension shown on _____ Contractor's shop drawings.

f. Insulating Material: High pressure, laminated design, impervious to oil, grease and water with electrical-resistance characteristics equal to or greater than fiber insulation, and meeting the requirements of AAR Manual, Par 14.5, furnish end posts which

MATERIALS AND PERFORMANCE – SECTION 02852

INSULATED JOINTS

project ¼ inch, plus or minus 1/16 inch, below base of rail and 3/16-inch thick.

- g. Cement bond insulated joints together with adhesive and bolt together with six high strength, 1-inch diameter bolts. Furnish bolts, nut, and flat washers conforming to chemical and mechanical requirements of ASTM A490, Quenched and Tempered Alloy Steel Bolts for Structural Steel Joints, and having Class 2A and 2B thread fit. Furnish positive means for maintaining tension in bolts through in-service vibrations by a prevailing lock nut complying with Industrial Fastener Institute Standard IFI-100 and IFI-101, or approved equivalent. Locate and size bolt holes in conformance to drilling for 115 RE rail as specified in AREMA specifications. Flat washers, if required, shall be hardened A325 or A490 and tempered carbon steel.
 - h. Bolts shall alternate so that all nutlocks are not on one side of the joint.
3. Furnish new Pandrol-modified “e” clips for insulated joint locations.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install insulated joints in accordance with the _____ Contractor’s special trackwork shop drawings and with signal drawings. Provide location of all joints in a shop drawing for review and approval by the _____.
- B. Conventional Insulated Joints
 - 1. Install insulated joints in special trackwork in accordance with the applicable requirements of AAR Signal Manual Part 8.6.35 and approved installation procedures. Determine final location in the field.
 - 2. At each location requiring two insulated joints, perform installation in such a manner that insulated joints have a minimum 40-inch stagger at each signal or cut section location and in accordance with AAR Signal Manual, Part 2.1.20, A through D. The 40-inch stagger requirements do not apply to insulated joints located in track switches between the frog and switch points.

MATERIALS AND PERFORMANCE – SECTION 02852

INSULATED JOINTS

- C. Bonded Insulated Joints
1. Install bonded insulated joint plug rails at signal locations in track as shown on the signal plans, and as provided in the track and the _____ Contractor's rail and joint shop drawing.
 2. Destress rail and weld bonded insulated joints into the running rail in accordance with Section 02857 - Thermite Welding, Section 02851 - Ballasted Track Construction, and Section ____ - Direct Fixation Track Construction **.

** To be provided in Final Design.

- D. Install insulated joints as suspended joints wherever possible. In ballasted track, re-space existing cross-ties to achieve this requirement.
- E. Secure insulated joints with modified "e" clips.

3.02 TESTS

- A. Test insulated joints in accordance with the requirements of AAR Signal Manual Part 8.1.10 and Section _____ - Signal Tests.
- B. Remove and replace insulated joints at the _____ Contractor's expense for those joints that do not meet the testing requirements.

- END OF SECTION -

MATERIALS AND PERFORMANCE – SECTION 02854

RAIL AND JOINT BARS

PART 1 - GENERAL

1.01 WORK SPECIFIED

- A. This section specifies furnishing running rail, vertical restraining rail, emergency guard rail, joint bars, and compromise joint bars for ballasted and direct fixation track construction as indicated and as otherwise required for the proper and timely completion of the work.
- B. Insulated joints shall be manufactured and tested per Section 02852 - Insulated Joints.

1.02 RELATED WORK SPECIFIED UNDER OTHER SECTIONS

Documents affecting work of this section include, but are not necessarily limited to the following:

TBD

1.03 SUBMITTALS

- A. TBD
- B. Manufacturer's Catalog Data
 - 1. Within 30 days of receipt of the Notice to Proceed, and before installation of the materials, a complete schedule of the materials proposed for installation and the source of the material shall be submitted to the _____ for review and approval. Information to be provided on rail shall include: rail weight, rail section, drilling, typical rail length, date rolled, and the name of the mill where the rail was rolled. The design of the joint bars and compromise joint bars proposed to be furnished with each rail section shall also be provided.
- C. Certificates of Compliance
 - 1. The _____ Contractor shall submit Manufacturer's Data and Certificates of Compliance for the following materials:
 - a. Head hardened 115RE Rail (running rail).
 - b. Head hardened 132RE Rail.
 - c. Joint Bars.
 - d. Compromise Joint Bars (if required).

MATERIALS AND PERFORMANCE – SECTION 02854

RAIL AND JOINT BARS

- D. Shop Drawings for joint bars and compromise joint bars shall be prepared and submitted in accordance with Section 01300 - Submittals.
- E. Submit a rail handling plan for the unloading and installation of all stick and welded rail. Submit a rail bending plan for review and approval by the _____.
- F. Submit a plan showing the proposed location of all rail lengths and location and type of joints.
- G. Approval of Materials
 - 1. Within 20 calendar days of the _____ Contractor's submittal of Manufacturer's Data or Certificates of Compliance the _____ will notify the _____ Contractor of the materials acceptance or rejection. Rejected materials that have already been delivered to the project site shall be promptly segregated from the approved materials and removed from the premises. If materials are rejected, acceptable replacement materials shall be furnished by the _____ Contractor at the _____ Contractor's expense. Initial approval of materials will not prevent the removal and replacement of materials not meeting the requirements of this specification or defective materials discovered during construction and routine quality control/quality assurance operations. If requested by the _____ Contractor, the _____ will make an offsite inspection of the rail and joint bars proposed for use in this project. The _____ Contractor shall bear all expenses incurred for this inspection.

1.04 **QUALITY ASSURANCE**

- A. The dimensions and general arrangement of all rail and joint bars shall conform to:
 - 1. American Railway Engineering and Maintenance Association (AREMA), Manual for Railway Engineering (current to July 31, 1997), Chapter 4 (Published Annually).
 - 2. Canadian Pacific Railway (CPR), Track Maintenance Standards.
- B. The _____ Contractor shall be alert to the presence of defects in rail and joint bars being installed. Rail and joint bars that are found to be defective shall not be installed in track.
- C. Upon completion of track construction the _____ Contractor will have the rail and welds tested by ultrasonic methods. Rails or welds which are found to be defective at that time shall be removed and replaced by the _____ Contractor at the _____ Contractor's expense. The _____ Contractor

MATERIALS AND PERFORMANCE – SECTION 02854

RAIL AND JOINT BARS

furnished joint bars and compromise joint bars that are found to be cracked or broken shall be removed and replaced at the _____ Contractor's expense.

1.05 REFERENCES

- A. AREMA Manual for Railway Engineering (current to July 31, 1997), Chapter 4 (Published Annually).
- B. CPR Track Maintenance Standards.

1.06 HANDLING

- A. Handle all rail and joint bars in a manner that will prevent damage to the materials during transportation, stock piling, and performance of the actual work.
- B. Handling of all rail will be accomplished in accordance with the _____ Contractor's rail handling plan. See Paragraph 1.03 D.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Rail
 - 1. The following new head hardened Tee rail sections shall be utilized on this Project in conjunction with turnout and track construction:

115RE Running Rail
132RE Rail
 - 2. New head hardened rail shall conform to the specifications in Chapter 4, of the AREMA "Manual for Railway Engineering" and/or;
 - 3. CPR "Track Maintenance Standards."
 - 4. It is the goal of the _____ to have as few welds or joints as possible. Rail shall be furnished in 78' sections wherever possible. In no case shall rail be furnished in lengths of less than 39 feet; unless approved by the _____. Rail drilling shall be approved by the _____. Drilling shall be uniform and match existing drillings. Rail drillings shall be as specified in AREMA, Chapter 4, Part 1. Running rail ends and emergency guard rails that are not welded shall be drilled with 6 holes. Restraining rail ends will be drilled with 4 holes. The rail to be field-welded shall have blank ends or only the rear hole drilled. The rail to be plant welded shall have blank ends.

MATERIALS AND PERFORMANCE – SECTION 02854

RAIL AND JOINT BARS

5. End Condition
 - a. Rail fishing in the joint bar area shall match the appropriate rail section.
 - b. Any necessary bolt holes shall be drilled.
 - c. Rail ends shall be square and shall be cut with an approved abrasive rail saw. Torch-cut rails will not be accepted.
 - d. Chipped rail ends greater than 1/16 inch shall not be allowed. Rail chips of 1/16 inch or less shall be removed by rail end slotting per AREMA Plan No. 1005-40.

6. Straightness
 - a. Rail ends shall have a deviation from a lateral (horizontal) line not to exceed a maximum mid-ordinate of 0.030 inch in 3 feet or 0.023 inch at the end quarter point of a 3-foot chord.
 - b. Rails shall be straight horizontally except that not more than 10% of the order may have lateral sidesweep not greater than that indicated by a midordinate of 1/2 inch in thirty feet.
 - c. Rails and rail ends shall be straight vertically with no upsweep or droop permissible.
 - d. Rail shall be in standard 39- or 78-foot lengths.

- B. Joint Bars
 1. New toeless, six-hole, 36-inch joint bars shall be used for permanent or temporary joints in running rails. New joint bars shall be of the size, shape, and punching pattern (3½-6-6) to fit the rail being joined. New joint bars shall conform to the requirements of "Specifications For High-Carbon Steel Joint Bars" or "Specifications For Quenched Carbon-Steel Joint Bars and Forged Compromise Joint Bars" specified in Chapter 4, Part 2 of the AREMA "Manual For Railway Engineering."
 2. Compromise joint bars, if required, shall be new and of the size, shape, and punching pattern to fit the rail sizes and sections being joined. Compromise joint bars shall conform to the requirements of "Specifications For Quenched Carbon-Steel Joint Bars and Forged Compromise Joint Bars" found in Chapter 4, Part 2 of the AREMA "Manual For Railway Engineering." Only factory designed and produced (forged or cast) six-hole compromise joint bars shall be used to join rails of different sizes and/or sections. Compromise bars shall be manufactured to take into account the wear of the adjoining rails.

MATERIALS AND PERFORMANCE – SECTION 02854

RAIL AND JOINT BARS

3. The _____ Contractor shall furnish shop drawings of all joint bars to be furnished to the _____ for approval.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. The _____ may examine any materials furnished by the _____ Contractor for defects, damage, or non-conformance prior to installation. Materials not meeting the requirements of Part 2 of the Specifications or that are determined to be damaged or defective shall be removed from the project site and shall be replaced by acceptable materials at the _____ Contractor's expense.

3.02 INSTALLATION

- A. Rail, joint bars, and compromise joint bars shall be installed in accordance with Section 02850 - Ballasted Track Construction and Section 02851 - Ballasted Turnouts.
- B. Rail shall be handled by methods that will not result in damage to the rail.

- END OF SECTION -

MATERIALS AND PERFORMANCE – SECTION 02855

TIMBER SWITCH-TIES

PART 1 - GENERAL

1.01 WORK SPECIFIED

- A. This section specifies the requirements for the manufacture, treatment, and delivery of timber switch-ties used in turnouts and crossovers.

1.02 RELATED WORK SPECIFIED UNDER OTHER SECTIONS

Documents affecting work of this section include, but are not necessarily limited to the following:

TBD

1.03 SUBMITTALS

- A. TBD

- B. The following information shall be submitted to the _____ prior to ordering ties:

1. Name of the tie manufacturer, the name(s) and location(s) of the sawmill, the seasoning yard and the treatment plant.
2. Description of manufacturer's equipment, type, age, and present condition. Particular attention shall be made concerning equipment used to artificially season ties, if proposed. Gauges and thermometers on seasoning and treatment equipment shall have been calibrated within six months of the date of seasoning and treatment.
3. Wood species proposed and the quantities of each. Shop drawings of all tie layouts showing appropriate dimensions and spacing of timber switch-ties.
4. Product data for ties to be furnished.
5. Contracts with suppliers and carriers who will be involved in the furnishing of ties. Such contracts shall include applicable requirements of this Contract.
6. Copy of timber tie fabrication plant's quality control program not less than 30 days before the start of preservation treatment.

- C. Subsequent to treatment and a minimum of one week prior to any ties being used in the construction of any panelized special trackwork unit, provide notarized records concerning the seasoning and treatment of ties. Such records shall

MATERIALS AND PERFORMANCE – SECTION 02855

TIMBER SWITCH-TIES

include certification that the ties have been inspected and released for shipment by the inspection service indicated in 1.04 of this section.

1.04 QUALITY ASSURANCE

- A. Timber switch-ties shall be manufactured and treated in accordance with the “Specifications for Cross-ties of the Railway Tie Association;” the “Specifications for Switch-ties of the Railway Tie Association;” and Chapter 3 of the American Railway Engineering and Maintenance Association (AREMA) “Manual for Railway Engineering,” except as those documents may be amended by this specification.
- B. The _____ Contractor’s Inspection - Obtain the services of an independent tie inspection service (Service) to perform inspections that will assure compliance with the Contract.
1. Require cross-tie supplier to provide suitable facilities, equipment, and assistance necessary for the Service’s inspector to work efficiently.
 2. Perform an initial inspection of each tie prior to seasoning.
 3. Ties shall be judged independently without regard to decisions made on other ties in the same lot. Ties too muddied for ready examination shall be rejected.
 4. Examine top, bottom, sides, and ends of each tie in accordance with AREMA Specification for Timber Cross-ties, Article 1.1.5 - Inspection. Ties handled by hoist shall be turned over for inspection.
 5. Ties accepted for seasoning shall be subject to additional inspections by the Service at any time and at any stage of preparation for treatment.
 6. Test the preservative used in treatment of the ties. Service shall have the right to take samples from any container in which the preservative is stored or used.
 7. Service shall examine and pass judgment on the adequacy of each piece of equipment used during any step of the manufacture and treatment of the ties.
 8. Service shall examine records of preservatives used and treatment of the ties and shall not approve ties for shipment until such records indicate that the ties are in compliance with the requirements of this Section.
- C. _____ Inspection - The _____ may elect to perform additional inspections of the ties at any time. Final acceptance of ties will occur only at the

MATERIALS AND PERFORMANCE – SECTION 02855

TIMBER SWITCH-TIES

time of delivery and acceptance of the panelized special trackwork in which the ties will be incorporated.

1.05 REFERENCES

- A. “Specifications for Cross-ties of the Railway Tie Association.”
- B. “Specifications for Switch-ties of the Railway Tie Association.”
- C. Chapter 3 of the AREMA “Manual for Railway Engineering.”
- D. AWP Standard M-2 “Standard For Inspection of Treated Timber Products.”

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Timber switch-ties other than headblock ties shall be seven inch grade and shall be of the lengths indicated on approved shop drawings submitted by the _____ Contractor and approved by the _____. Refer to C of this paragraph for additional requirements.
- B. Head block ties (switch-ties used beneath switch machines) shall be 9 inches by 9 inches in cross-section and shall be 15 feet, 0 inches in length. Framing dimensions for headblock ties will be furnished by the _____ Contractor for review and approval by the _____. Framing dimensions shall be coordinated with the switch machine supplier and _____ Contractor.
- C. Determine the quantities of timber switch-ties required and submit a shop drawing for review and approval by the _____. Show the location and length of timber switch-ties on the shop drawings for the various turnouts, and crossovers included in the contract. Coordinate switch-tie length selection to ensure that no tie is spiked within 14 inches of either end. Provide switch-ties in 6-inch increments only. Timber switch-ties in crossovers and in the diamond crossover shall be butted as required. See Contract Drawings.
- D. Except in hereinafter provided, all switch-ties shall be free from any defects that may impair their strength or durability as ties, such as decay, large splits, large shakes, large or numerous holes or knots, or grain with slant greater than one in fifteen.
- E. A switch-tie is not well manufactured when its surfaces are cut into with score-marks more than ½-inch deep and will be rejected.
- F. The top and bottom of a switch-tie will be considered parallel if any differences in the thickness at the side or ends does not exceed ½ inch.

MATERIALS AND PERFORMANCE – SECTION 02855

TIMBER SWITCH-TIES

- G. For unseasoned switch-ties, the thickness and width specified are minimal excepting wane allowance. Switch-ties over 1-inch thicker or wider than the specified size will be rejected. Switch-ties over 2 inches longer or 1 inch shorter than the specified length will be rejected.
 - H. All thickness, width and face dimensions apply to the rail bearing area. All determinations of width will be made on the top of the switch-tie, which is the narrower of the two horizontal surfaces.
- 2.02 ACCEPTABLE WOOD SPECIES
- A. Timber ties shall be manufactured from live timber. Switch-ties shall be oak.
- 2.03 SEASONING
- A. Timber ties shall be well seasoned. Timber ties manufactured from red or white oak shall be dried to an oven dry moisture content of 50 percent or less prior to preservative treatment. The wood may be air-dried, vapor-dried, or bouldenized. Submittals shall indicate the type of seasoning to be utilized.
 - B. Ties which are to be dried by artificial means shall be seasoned and treated as soon as possible after sawing but in no case more than 30 days later.
 - C. The temperature used for bouldenizing shall be as high as possible but in no case less than 200 degrees F.
 - D. Vapor-dried ties shall be transferred from drying cylinders to treatment cylinders as quickly as possible to avoid loss of heat from the seasoned ties.
- 2.04 SAWING
- A. Ties shall be sawn on top, bottom and, sides. Tie surfaces shall not vary more than one inch from a straight line: 1) when measured along top of tie from the middle of one end to the middle of other end, and 2) when measured along the side of tie from the middle of one end to the middle of other end.
- 2.05 INCISING
- A. Timber ties shall be incised on all four sides in the pattern specified in the AREMA Manual for Railway Engineering, Chapter 3, Part 6 “Wood Preserving.”
- 2.06 MACHINING
- A. Machining operations shall be performed prior to preservative treatment.

MATERIALS AND PERFORMANCE – SECTION 02855

TIMBER SWITCH-TIES

- B. Prior to the installation of gang nail type anti-splitting devices, a kerf shall be cut on the top surface of tie. The top surface shall be the wider face of the tie which is furthest from the heartwood.

2.07 PRESERVATIVE TREATMENT

- A. Timber cross-ties and switch-ties shall be pressure treated in accordance with Chapter 3, Part 6 “Wood Preserving” of the AREMA Manual by the empty cell process with a 60/40 creosote/coal tar solution (Grade C) to a minimum retention of eight pounds per cubic foot of wood. The _____ Contractor shall record treatment as specified in the current AWPAs Standard M-2 “Standard For Inspection Of Treated Timber Products.”

2.08 ANTI-SPLITTING DEVICES

- A. Timber ties shall be equipped with anti-splitting devices of the type indicated below regardless of whether or not the wood has shown any tendency to split. Products used shall conform to the AREMA “Specifications for Devices to Control the Splitting of Wood Ties.”
- B. Timber switch-ties shall be equipped with steel dowels or approved gang nail plates. Dowels shall be of the four-fluted type and be a minimum of six inches in length. Each switch-tie shall be equipped with four dowels. Each dowel shall be located 4 inches from the end of the tie and 2 inches from the top or bottom surface of the tie.
- C. The gang nails shall be galvanized in accordance with AREMA Specifications.
- D. The gang nails shall be installed by mechanical equipment capable of pressing the tie together closing all splits before application.
- E. Splits in timber cross-ties and switch-ties shall be closed before treatment by selectively applying anti-splitting devices of the type as shown on the Contract Drawings. Products used shall conform to the AREMA “Specifications for Devices to Control the Splitting of Wood Ties.”
- F.

PART 3 - EXECUTION

3.01 HANDLING

- A. Timber cross-ties and switch-ties shall be carefully handled to avoid damage in accordance with the AREMA specification “The Handling of Ties From the Tree Into the Track.”

MATERIALS AND PERFORMANCE – SECTION 02855

TIMBER SWITCH-TIES

- B. Establish handling requirements in writing with carriers involved in the transportation of ties. The type or types of handling equipment and tie downs which will be allowed shall be detailed in the purchase orders for ties.

3.02 SEASONING AND TREATMENT

- A. Shall be in accordance with the AREMA Manual, Chapter 3, Part 6 “Wood Preserving.” The _____ Contractor shall provide the _____ with 14 days written notice of the date(s) scheduled for artificial seasoning and treatment of ties.

3.03 INSTALLATION

- A. Switches shall be installed in special trackwork in accordance with Section 02850 - Ballasted Track Construction and Section 02851 - Ballasted Turnouts.

- END OF SECTION -

MATERIALS AND PERFORMANCE – SECTION 02856

TIMBER TIES

PART 1 - GENERAL

1.01 WORK SPECIFIED

- A. The _____ shall provide new ties for replacement and installation under the proposed tracks.
- B. The _____ Contractor shall install ties under the proposed track. The _____ will mark ties to be replaced.

1.02 RELATED WORK SPECIFIED UNDER OTHER SECTIONS

Documents affecting work of this section include, but are not necessarily limited to the following:

TBD

1.03 SUBMITTALS

TBD

1.04 REFERENCES

- A. American Railway Engineering and Maintenance Association (AREMA).

PART 2 - PRODUCTS

2.01 MATERIALS

- A. All ties furnished under this item shall be new.
- B. Ties used in track shall conform to specifications in Section _____ - Timber Cross-Ties and Section 02855 – Timber Switch-Ties.
- C. Ties used in main tracks, yard leads, ladders, and running tracks shall be Grades 4 and 5. At least 70 percent shall be Grade 5.
- D. Ties used in yard body tracks may be Grades 2 and 3. At least 70 percent shall be Grade 3.
- E. Wood preservatives shall conform to the current AREMA specifications.
- F. All ties shall be free from defects that may impair their strength or durability such as large splits, large shakes, and large holes and knots.

MATERIALS AND PERFORMANCE – SECTION 02856

TIMBER TIES

- G. Tie plugs shall be new, treated, 5 inches long, and conform to the current AREMA Specifications For Tie Plugs.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. The _____ Contractor shall place ties, install tie plugs as required, tie plates, spikes, and anchors, and tamp the ties.
- B. Ties shall not be placed until the _____ has advised that the road bed is satisfactory.
- C. Cross ties shall be spaced 21 inches for mainline tracks and 24 inches for secondary tracks, in accordance with _____ “Maintenance of Way Regulations and Instructions.”
- D. Ties shall be pre-bored to accommodate the spiking arrangement specified in Section 02858 - Other Track Material. The cost of pre-boring shall be included in the cost for installing ties.
- E. Spiking pattern will be governed by _____ Standard Drawings No. _____, or latest revision.
- F. When necessary to adz ties, an adzing machine shall be used. The adzing must be done so as to give the tie plate a full bearing across the tie and parallel with the plane of track.
- G. All ties shall be placed in track at right angles to the center line of the track. The end of the tie on the line side shall be 4 feet, 3 inches from the center line of the track. The line end of the ties shall be to the right hand side of the track, facing north or east (timetable direction) except where these are sidings and multiple tracks, where ties in the two outside tracks are lined to the outside. Switch ties shall be lined on the straight side, except as noted on the Plans.
- H. When handling or spacing ties, care shall be taken to prevent damage with picks and hammers. Pulling ties into position by picks will not be permitted; tie tongs shall be used for this purpose.

- END OF SECTION -

MATERIALS AND PERFORMANCE – SECTION 02857

THERMITE WELDS

PART 1 - GENERAL

1.01 WORK SPECIFIED

- A. This section includes specifications for all thermite welds for permanent track as shown on the Plans.

1.02 RELATED WORK SPECIFIED UNDER OTHER SECTIONS

Documents affecting work of this section include, but are not necessarily limited to the following:

TBD

1.03 SUBMITTALS

- A. TBD
- B. Prior to initiation of thermite welding submit detailed specifications showing proposed quick preheat, self tapping thermite weld kit and method and procedure for thermite welding. Specifications submitted shall comply with these Specifications and those of weld kit manufacturer.
- C. Submit qualification certification for each supervisor and field welder who will perform work on this Contract. Weld supervisors and welders shall be required, upon request of the _____, to submit their qualification certificate throughout the duration of the project.
- D. Submit name of independent testing contractor and certification that testing laboratory and persons who shall perform ultrasonic testing of field welds have previously tested a minimum of 250 welds.
- E. Submit documentation that sample thermite welds have been tested and that welds meet or exceed requirements of this section.
- F. Submit certified ultrasonic inspection results for field welds.

1.04 QUALITY ASSURANCE

- A. The thermite welding process can only be successful if it is carried out by thoroughly trained and well disciplined personnel. It will be the responsibility of the _____ Contractor to organize and coordinate all preparation and training activities for its personnel, including participation by welding kit supplier as required. The _____ Contractor is also responsible for documenting the preparation and training activities for submittal to the _____. Cost of all preparation and training activity shall be included in the Contract line item for field welding.

MATERIALS AND PERFORMANCE – SECTION 02857

THERMITE WELDS

B. General

1. Perform sample weld testing and inspection at no additional cost to the _____.
2. Sample weld testing and inspection shall be performed by an approved certified independent testing laboratory. The _____ may audit operations to ensure that inspection and tests are being performed in accordance with approved procedures and in compliance with these specifications.
3. To be accepted, sample welds must fulfill the requirements of these Specifications.

C. Field Weld Qualification Inspection and Testing

1. Prior to field welding, welds and each welding crew shall be qualified as specified below. Welding crews shall prepare, in accordance with method and procedure for thermite field welding, submitted and approved under 1.03B, of this section, at least three samples of each type of thermite weld; high strength rail welded to high strength rail, high strength rail welded to standard rail, and standard rail welded to standard rail. Each welding crew shall perform at least one of each type of sample weld. Sample welds shall join two pieces of each type of running rail a minimum of 30 and a maximum of 36 inches in length each.
2. Test three sample welds from each type of rail as follows:
 - a. Perform Radiographic Test on all sample welds from each type of rail.
 - b. Perform Rolling Load Test as specified in this section on one sample weld from each type of rail.
 - c. Perform Slow Bend Test specified in this section on second sample weld from each type of rail.
 - d. Perform Hardness Test specified in this section on third sample weld from each type of rail.
 - e. Perform Manual Ultrasonic Test specified in this section on all sample welds from each type of rail.

MATERIALS AND PERFORMANCE – SECTION 02857

THERMITE WELDS

3. Radiographic Testing
 - a. Inspect welds radiographically in accordance with American Society for Testing and Materials (ASTM) E142, ASTM E94, and these Specifications for the purposes of detecting flaws in field welds.
 - b. Radiographic tests shall detect flaws in welds with sufficient detail to establish weld's ability to meet the requirements specified herein.
 - c. Radiograph four areas of each weld, head, web, and each side of base.
 - d. Identify each radiographic film with Contract Number, sample number, rail identity, date, welder identity, inspection agency, and view. Submit a letter of certification with each film to _____, giving comment on any irregularities found in the weld, and whether weld passes or fails.
 - e. The acceptance criteria for this test shall indicate full penetration and complete fusion with no evidence of surface or internal fissures or cracks.
 - f. Non-destructive inspection of metal welds by radiographic use of nuclear by product materials shall be in accordance with United States Nuclear Regulatory Commission Rules and Regulations, Title 10, Atomic Energy, Part 20, Standard for Protection Against Radiation.
 - g. Transportation, handling, and storage of hazardous materials used in radiographic inspection of welds shall be performed only by, or under supervision of, a person of proven experience and ability operating under a proper license.

4. Rolling Load Test
 - a. Test one sample weld from each type of rail which has passed the Radiographic Test on a one 2-inch stroke rolling load machine.
 - b. Procedure mount test sample on a 2-inch stroke rolling load test machine. Apply a 57,300 pound wheel load on rail for 2,000,000 cycles. Measure and record to the nearest 0.001 inch deflection of the rail when the wheel load is over weld. Record for every 500,000 cycles.

MATERIALS AND PERFORMANCE – SECTION 02857

THERMITE WELDS

- c. Welds tested under this section shall sustain without failure not less than 2,000,000 cycles of repeated loadings of a 57,300 pound wheel load.
 - d. Alternate methods of testing joint dynamically may be submitted for approval.
5. Slow Bend Test
 - a. Subject a second sample weld from each type of rail which has passed Radiographic Test to the Slow Bend Test described in the Proceedings of the AREA, Volume 68.
 - b. Acceptance criteria for this test shall be minimum deflection of 3/4 inch and 100,000 pounds per square inch modulus of rupture.
6. Hardness Test
 - a. A third sample weld of each type of rail passing the Radiographic Test shall be longitudinally sectioned for a distance of one foot either side of weld, microetched, and tested by the Rockwell Hardness test using a 150 kg diamond sphero conical penetrator. Test results shall be converted to Brinell Hardness Numbers.
 - b. Rail shall be tested for hardness on sectioned face on both sides of weld, at 1/2-inch increments on three lines until the hardness is that of parent metal. One test line will be at center of head, second at center of web and third at center of base. Parent metal hardness shall be reached not more than 6 inches from weld center line or weld shall fail this test. The minimum Brinell Hardness number of parent metal is published as 300 for standard rail and 341 for high strength rail.
 - c. Inspect micro-etched section for compliance with field weld requirements of full penetration, complete fusion, and internal defects specified herein.
7. Manual Ultrasonic Testing
 - a. Inspect sample welds ultrasonically in accordance with recommendations of the Nov. 29-30, 1983 Proceedings of Association of American Railroads entitled "Railroad Rail Welding," Pages 191-205.
 - b. Acceptance criteria for this test shall be as specified in 1.04F.2 of this section.

MATERIALS AND PERFORMANCE – SECTION 02857

THERMITE WELDS

8. Approval of weld kit, welding process, and welding crews will depend upon all sample welds satisfying the specified requirements. Should any sample weld fail to satisfy the specified requirements, the welding process, the welding crew, or both, will not be qualified for the work.
9. Employ a supervisor for each welding crew, who has been trained and certified for performing thermite field welding by manufacturer supplying weld kits. Should supervisor of welding crew be replaced during the work, welding crew shall be re-qualified under the new supervisor.
10. Prior to performing welds in specified work, satisfactorily qualify welds and welding crew as specified herein.
11. If the _____ Contractor changes supplier of welding kits or welders during the job, repeat all of above sample weld testing.

D. Preparation and Training for Field Welding

1. Prior to making sample welds and prior to field welding, the _____ Contractor shall coordinate with the welding kit manufacturer the following at no additional cost to the Project.
 - a. Provide a detailed list of tools, equipment, and supplies required to make field welds. Copies shall be delivered to the _____ Contractor and the _____ and shall be kept on the job site with welders at all times.
 - b. Provide a detailed procedure for making field welds, consistent with _____ requirements. Field welds shall be made with approved kits. If there are different types of welds in the Contract, for example, different sizes or types of rail, compromise joints etc., a procedure shall be provided for each. Copies of procedures shall be delivered to the _____ Contractor and the _____ and shall be kept on job site with welders at all times.
 - c. Organize and conduct training course for welders. Representatives from the _____ may also participate in course. Course shall include “hands on” experience for all students. An outline or other material describing course shall be submitted to the _____ Contractor and the _____ for review and approval. Course work shall include the different type welds called for in Contract. All welders will participate in course, even if they have taken it for a previous job. Qualified welders will receive a dated Certification Card, signed by a

MATERIALS AND PERFORMANCE – SECTION 02857

THERMITE WELDS

Supplier Representative, approved by the _____, which must be available for inspection at any time.

- d. Organize and conduct refresher training courses for welders every six months. The _____ may participate in these courses as well. Records shall be kept by the _____ Contractor and the _____ indicating that their personnel have taken part in refresher courses. Welder's Certification Card shall be updated to reflect same.
 - e. Make random inspections of the welding work in progress, at least every three months, to insure that proper tools, equipment, and supplies are being used, and that their procedures are being followed.
 - f. Be on call to assist the _____ Contractor and the _____ in case any unusual problems arise in the field. Supplier should be prepared to provide for laboratory testing needed to solve a problem, and should have the capability of tracking their kit materials backward through the chain of production.
2. Responsibilities of the _____ Contractor
 - a. Coordinate welder training program described above, including provision of documentation required by the _____ to describe course, and verify that the _____ Contractor's personnel have successfully completed course work.

E. Field Weld Record

1. The _____ Contractor shall provide the _____ with a complete and up to date record of all welds, welders, and welding kits. This record shall be submitted on the approved Project standard form which includes, but is not limited to, the following information for each weld.
 - a. Weld number, location by track designation and station, date, and time weld made.
 - b. Rail identification including section, heat number, date rolled.
 - c. Kit manufacturer and identity of each mold and portion.
 - d. Weather conditions, air and rail temperature.
 - e. Rail gap.
 - f. Name of welder, _____ Contractor's foreman, and _____ representative on the job.

MATERIALS AND PERFORMANCE – SECTION 02857

THERMITE WELDS

- F. Field Weld In Track Testing
1. During field welding, hand test and inspect all field welds as specified herein to ensure compliance of welds to requirements of these Specifications.
 - a. Thermite welds shall be visually and dimensionally inspected as soon as weld has been completed regardless of whether track has been designated as “in revenue service” or “out of revenue service.”
 - b. Manual ultrasonic testing of thermite welds in track designated as “in revenue service” shall be completed within 24 hours of weld completion.
 - c. Manual ultrasonic testing of thermite welds in track designated as “out of revenue service” shall be completed within 30 days from date of welding but in all cases prior to the resumption of train operations.
 - d. It shall be the responsibility of the _____ Contractor to follow above criteria and ensure that all welds are properly inspected and tested at the _____ Contractor’s expense.
 2. Manual Ultrasonic Testing
 - a. Inspect all field welds ultrasonically in accordance with recommendations of the Nov. 29-30, 1983 Proceedings of Association of American Railroads entitled “Railroad Rail Welding,” pages 191-205. Weld quality shall meet requirements of this section.
 3. Test Procedures - Ultrasonic
 - a. Testing organization shall submit to the _____ detailed test procedure and description of test equipment including calibration blocks that will be utilized in testing process. Calibration process shall be able to permit detection of defects of size, type, and location described under acceptance criteria. Test procedure and equipment shall include, but not be limited to the following:
 - a.1 Calibration:
 - Calibrate when starting work and at least every hour.
 - Recalibrate if there is a change in probes or cables.

MATERIALS AND PERFORMANCE – SECTION 02857

THERMITE WELDS

- Use I.I.W. Type 1 and Type B 1 steel test blocks for calibration. A rail with drilled holes may be used in addition. If a rail is used, a duplicate shall be provided to the _____.

a.2 Web Test:

- Use two 45 degree probes placed on top of rail in pitch catch configuration.
- Scan from top to bottom of weld with both probes.
- Scan top and bottom edges of weld with a single probe.
- Scan from both sides of weld.

a.3 Head Test:

- Use two 45 degree probes placed on sides of the rail head in pitch catch configuration.
- Scan across weld with both probes angling them up and down to cover entire cross section of weld.
- Scan each vertical edge of weld with a single probe.
- Scan from both sides of weld.

a.4 Base Test:

- Use a 70 degree probe.
- Place probe on top of base far enough back from center of weld so that beam is following the "3/4 W" path.
- Move toward and away from weld, angling probe from side to side.
- Scan both sides of base and from both sides of weld.

- b. Test crew shall fully document their findings, on an approved Project standard form. This form shall include, but is not limited to, identification of: test equipment used, calibration, weld number and location, members of test crew, date and time of test, description of defects, and recommendation to accept or reject weld.

4. Acceptance Criteria - Ultrasonic

- a. No defect in the weld of any size will be accepted in the head, web or base of rail.
- b. The _____ Materials Testing Lab may perform random manual ultrasonic tests of field welds. The _____ is

MATERIALS AND PERFORMANCE – SECTION 02857

THERMITE WELDS

currently using equipment supplied by Krautkramer, and personnel who have been trained with this equipment.

5. Physical Inspection
 - a. The _____ Contractor shall visually and dimensionally inspect each field weld to determine conformance with alignment and finishing tolerances specified herein.
 - b. When weld is made and molds and risers removed weld shall be checked for obvious failures such as an incomplete weld.
 - c. Once weld has been ground and weld temperature is less than 200 degrees F physical inspections shall be made to verify acceptance criteria.

6. Acceptance Criteria - Physical
 - a. There should be no visible voids, ratholes, nicks, or gouges in surfaces which have been ground.
 - b. Weld collar in web zone and base of rail should not be ground except to remove notches created by upset conditions. Sharp protrusions and gouges should be blended into rail and weld collar contour to eliminate possible stress risers.
 - c. Combined vertical offset and crown camber at top of rail, at rail temperature of 200 degrees F or less, shall not exceed 0.060 inch, measured as shown on Figure 02857 1. NO DIP CAMBER shall be allowed.
 - d. Combined horizontal offset and horizontal kink camber at side of rail head, at rail temperature of 200 degree F or less, shall not exceed 0.060 inch, as shown on Figure 02857 1.
 - e. A finished deviation of not more than plus 0.010 inch or minus 0.00 inch from parent section of rail head surface shall be allowed.
 - f. If field weld, because of certain field conditions, is located within 4½ inches of a rail support, the sides and bottom of the rail base shall be within plus 0.012 inch or minus 0.00 inch of parent section.
 - g. Weld straightness tolerances shall be as shown on Figure 02857 1.

MATERIALS AND PERFORMANCE – SECTION 02857

THERMITE WELDS

7. Defective Welds

Defective welds shall be cut out and replaced with a 19-foot, 6-inch section of new rail, welded in place, at no additional cost to the _____.

8. Final Ultrasonic Testing

Final ultrasonic testing shall be performed by an on-track detector car.

1.05 REFERENCES

- A. ASTM.
- B. United States Nuclear Regulatory Commission and Regulations, Title 10, Atomic Energy, Part 20, Standard for Protection Against Radiation.
- C. American Railway Engineering Association (AREA).
- D. Proceedings of Association of American Railroads entitled "Railroad Rail Welding," Pages 191-205, November 29-30, 1983.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Furnish complete thermite weld kits conforming to MS No. 9266 and these Specifications.

PART 3 - EXECUTION

3.01 THERMITE WELDING

- A. General
 - 1. Thermite field welds shall be made to join rail sticks.
 - 2. Ends of rails to be welded shall be saw cut. Torch-cutting of rails will not be allowed.
 - 3. Do not locate field welds within the following locations in standard track work:
 - a. Within 8 feet of the center of any bolted, bonded, or insulated joint.

MATERIALS AND PERFORMANCE – SECTION 02857

THERMITE WELDS

- b. Within 2 feet of a thermite weld in the opposite rail.
 - c. Within 6 inches of any hole drilled in rail.
 - d. Within 9 inches of a weld which has been cut out.
 - e. Over a tie plate.
4. In the case of special trackwork (turnouts, Conley joints, and rail crossings) some exceptions to above will be allowed, with approval of the _____.
 5. If plug rails are required to meet requirements shown above, or to replace a defective weld, minimum length of plug rail is 19 feet, 6 inches.
 6. Thermite welding process generates extremely high temperature (up to 5,000 degrees F) accompanied by flames, sparks, hot molten metal, and slag. Extreme caution shall be observed by welders and others in the vicinity. The following precautions must be observed.
 - a. During welding process, prevent hot molten metal and slag from contacting water, snow, or ice as an explosion could occur.
 - b. Properly dispose of hot slag, slag pans, top and side risers, or other hot scrap. Be sure that this material is not left where it could be stepped on, causing serious injury.
 - c. Wear welding goggles or safety glasses and other safety equipment as appropriate.
 - d. During and after welding, avoid burning or damaging rail pads, insulators, ties and timbers, or setting fire to wayside areas. A fire extinguisher shall be required at weld site (2½-gallon water-type extinguisher).
 - e. Keep welding tanks, hoses, and other flammables a safe distance from the weld site.
 - f. Do not make field welds on open deck bridges or timber structures.
 - g. Unused thermite material must be kept in an approved secure, dry, weathertight location, consistent with applicable fire regulations, so that it will not be accessible to unauthorized persons.

MATERIALS AND PERFORMANCE – SECTION 02857

THERMITE WELDS

- b. It is important that weld is not subjected to a sudden strain by releasing hydraulic pressure too quickly. The rail puller/expander shall be left in place until rail has cooled to below 500 degrees F. Any movement of rail before weld has cooled to at least 500 degrees F may result in failure of weld.
 - c. Hydraulic rail puller/expander shall not be used to establish proper rail end gap.
 - d. When welding rail in track on lines in service, allow sufficient time to complete weld so that surface finish, and temperature of welded joint will permit safe operation of scheduled trains without delay to service. Temperature of welded joint should be 200 degrees F or less before rail traffic is allowed to pass over weld.
 - e. Thermite field welds shall be made in accordance with and shall not deviate from manufacturer's recommendations and AREA Chapter 4. Short cuts in recommended pre-heating process are prohibited.
5. Trim and grind weld to meet the following requirements and as otherwise specified by manufacturer:
- a. Finish weld to the tolerances specified in 1.04 of this section.
 - b. A rail shear, specifically designed for the purpose, shall be utilized to remove weld upset. Use of a saw, cutting torch or other hand held devices is prohibited.
 - c. Rail profile grinder specifically designed for the purpose, shall be utilized to finish grind top and sides of weld. Use of hand held grinder is prohibited.
 - d. As specified in 1.04E.6.b. of this section weld collar in the web zone and base of rail should not be ground except to remove notches created by upset conditions, sharp protrusions, and gouges. These should be blended into the rail and weld collar contour to eliminate possible stress risers. Remove, by grinding, defects visible to the unaided eye. If removal by grinding cannot be accomplished without damaging rail, remove the weld. Take precautions to avoid excessive pressure during grinding of weld in order to prevent overheating of rail surface.
 - e. Finish grinding shall be done only when weld temperature is less than 200 degrees F.

MATERIALS AND PERFORMANCE – SECTION 02857

THERMITE WELDS

- f. Overheating rail when grinding must be avoided. Since weld has cooled to below 200 degrees F prior to grinding, the temperature rise due to grinding should not exceed this level.
- g. Finish rail grinding on top and sides of weld shall be completed prior to operation of trains over weld.

D. Weld Identification

- 1. Mark weld identification on field side of rail using a Nissen permanent metal marker as manufactured by J.P. Nissen, Jr. Co., or approved equivalent and record required information in conformance with 1.04E of this section.

E. Weld Cleanup

- 1. Clean up, remove, and properly dispose of waste material such as paper and plastic containers, scraps of metal, slag, and molds.

- END OF SECTION -

MATERIALS AND PERFORMANCE – SECTION 02858

OTHER TRACK MATERIALS

PART 1 - GENERAL

1.01 WORK SPECIFIED

- A. This section specifies the requirements for miscellaneous _____ Contractor-furnished Other Track Materials (OTM) including, but not limited to: track spikes; track bolts, nuts, and spring washers; tie plates; rail clips, screw spikes, and spacer blocks (restraining rails).

1.02 RELATED WORK SPECIFIED UNDER OTHER SECTIONS

Documents affecting work of this section include, but are not necessarily limited to the following:

TBD

1.03 SUBMITTALS

- A. TBD
- B. Certificates of Compliance shall be provided for all materials furnished by the _____ Contractor.
- C. The _____ Contractor shall submit samples of acceptable materials proposed for use prior to any construction. Any _____ Contractor-furnished materials which are installed in track and subsequently found to be defective shall be replaced by the _____ Contractor at no additional cost to the _____.
- D. Submit shop drawings of all major track material components for review by the _____.

1.04 QUALITY ASSURANCE

- A. The dimensions and general arrangement of all other track materials shall conform to:
 - 1. American Railway Engineering Association (AREA), Manual for Railway Engineering (current to July 31, 1997), Chapter 5 (Published Annually).

1.05 REFERENCES

- A. AREA.
- B. American Society for Testing and Materials (ASTM).

MATERIALS AND PERFORMANCE – SECTION 02858

OTHER TRACK MATERIALS

1.06 HANDLING

- A. Load, unload, and stack OTM in a manner to prevent loss or damage to the materials. Any OTM damaged or lost will be replaced and paid for by the _____ Contractor at no expense to the _____.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Track Lock Spikes, Screw Spikes, and Spikes
1. Shall be new and conform to the requirements of the AREA Manual Chapter 5, Part 2 “Specifications for High Carbon Steel Track Spikes” with the dimensions specified in “Design of Cut Track Spike.”
 2. Spikes for use with 6-inch Grade ties shall be 5½ inch by 9/16 inch.
 3. Spikes for use with 7-inch Grade ties and all switch timber shall be 6 inch by 5/8 inch.
 4. Lock spikes shall be 5/8 inch x 7 inch and be manufactured of alloy spring steel with a minimum tensile strength of 160,000 psi, with an elongation of 2.5%.
 5. Screw spikes shall be forged from medium carbon steel as per ASTM A66, 7/8-inch in diameter, and 7 inches long.
- B. Nuts, Bolts, and Spring Washers
1. Track nuts and bolts shall be new and shall conform to the dimensions and specifications given in: “Design for Track Bolts and Nuts,” “Rail Drilling, Bar Punching and Track Bolts,” and “Specifications for Heat Treated Carbon Steel Track Bolts and Carbon Steel Nuts,” all as specified in Chapter 4, Part 2 of the AREA Manual.
 2. Spring washers shall be new and conform to “Specifications for Spring Washers” in Chapter 4, Part 2 of the AREA Manual and Section M12 “Spring Washers” of the “Specifications for Special Trackwork” in the AREA “Portfolio of Trackwork Plans.”
 3. Track bolt assemblies shall be new and sized by the _____ Contractor to fit joint bar assemblies and rail drillings on the out-of-service line.

MATERIALS AND PERFORMANCE – SECTION 02858

OTHER TRACK MATERIALS

C. Tie Plates

1. Tie plates shall be new and made from low carbon steel. Tie plates shall conform to the following:
 - a. Tie plates shall be of the proper size to fit the base of the 115 lb. rail. 115 pounds per yard (5½-inch rail base), a rolled, double-shoulder canted tie plate conforming to _____ Standard Plan, Drawing No. _____ shall be used. Six square 11/16-inch holes of four round 15/16-inch holes and two 11/16-inch square holes. The plate with round holes is used with a screw spike. The square holes are filled with lock spikes.

D. Resilient Fasteners

1. All resilient fasteners required shall be new and suitable for the various sizes of rail and joint conditions existing on the project and shall conform to “Specifications for Rail Anchors” in Chapter 5, Part 7 of the AREA Manual. Resilient fasteners shall be of the drive-on type “e” as approved by the _____.

E. Twin Tie Plates

1. Twin tie plates used to support the running rail and restraining rails in conventional or special trackwork shall conform to the dimensions shown on _____ Drawing No. _____.

F. Restraining Block Assemblies

1. Block assemblies used to connect the 132 lb. restraining rail to the 115 lb. running rail shall conform to the dimensions as shown on the contract drawings. The _____ Contractor shall furnish a shop drawing showing the block assembly; joint bars, bolts, washers, and twin tie plates showing all pertinent dimensions.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. The _____ may examine any materials furnished by the _____ Contractor for defects, damage, or non-conformance prior to installation. Materials not meeting the requirements of Part 2 of the Specifications or that are determined to be damaged or defective shall be removed from the project site and replaced by acceptable materials at the _____ Contractor’s expense.

MATERIALS AND PERFORMANCE – SECTION 02858

OTHER TRACK MATERIALS

3.02 INSTALLATION

- A. All OTM shall be new and delivered in approved containers (kegs) or on pallets. Installation of all OTM shall be as indicated in Section 02850 - Ballasted Track Construction and Section 02851 - Ballasted Turnouts.
- B. OTM shall be installed in accordance with Section 02850 - Ballasted Track Construction.
- C. OTM shall be handled by methods that will not result in damage or loss.

PART 4 - MEASUREMENT AND PAYMENT (TBD IN FDR)

4.01 MEASUREMENT

- A. No separate measurement or payment shall be made for other track materials.

4.02 PAYMENT

- A. Purchase and installation of other track materials and incorporation of said materials into the work shall be considered incidental to and included in the payment for Section 02850 - Ballasted Track Construction and Section 02851 - Ballasted Turnouts.

- END OF SECTION -

Section 03000s

Concrete

MATERIALS AND PERFORMANCE – SECTION 03001

CONCRETE

PART 1 - GENERAL

1.01 WORK SPECIFIED

- A. All labor, materials, services, and equipment necessary for furnishing and installing all cast-in-place concrete required for the completion of the work.

1.02 RELATED WORK SPECIFIED UNDER OTHER SECTIONS

Documents affecting work of this section include, but are not necessarily limited to the following:

TBD

1.03 SUBMITTALS

- A. TBD
- B. Test results for aggregates, water, and field tests.
- C. Mill test certificates and test reports for cement indicating compliance with these Specifications.
- D. Concrete mix designs for all classes and types of concrete to be used in the work.
- E. Proposed methods of concrete curing.
- F. Manufacturers' literature for admixtures, curing compounds, sealers, surface hardeners, etc.
- G. Name and location of concrete supplier.

1.04 QUALITY ASSURANCE

- A. Perform work in accordance with ACI 301, Structural Concrete for Buildings.
- B. American Association of State Highway and Transportation Officials (AASHTO).
- C. Standard Specifications, New York State Department of Transportation (NYSDOT).
- D. In each case, the latest revision shall apply.

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1.05 REFERENCES

A. American Concrete Institute (ACI). The following ACI codes, standards, and recommendations are intended to specify minimum standards of performance:

1. 211.1 Selecting Proportions for Concrete
2. 301 Structural Concrete for Buildings
3. 302 Guide for Concrete Floor and Slab Construction
4. 304 Measuring, Mixing, Transporting, and Placing Concrete
5. 305R Hot Weather Concreting
6. 306R Cold Weather Concreting
7. 309 Practice for Consolidation of Concrete
8. 318 Building Code Requirements for Concrete
9. 350R Concrete Sanitary Engineering Structures

B. American Society for Testing and Materials (ASTM). The following ASTM specifications are referred to in these Specifications and are to be considered a part of these Specifications:

1. C31 Making and Curing Concrete Test Specimens
2. C33 Concrete Aggregates
3. C39 Compressive Strength of Concrete Specimens
4. C42 Obtaining and Testing Drilled Cores
5. C94 Ready-Mixed Concrete
6. C138 Unit Weight, Yield, and Air Content of Concrete
7. C143 Test Method for Slump of Concrete
8. C150 Portland Cement (Rev. B)
9. C171 Sheet Materials for Curing Concrete
10. C172 Sampling Freshly Mixed Concrete

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|-----|-------|--|
| 11. | C231 | Air Content of Freshly Mixed Concrete |
| 12. | C260 | Air-Entraining Admixtures for Concrete |
| 13. | C311 | Sampling and Testing Fly Ash or Natural Pozzolans for Use in Concrete |
| 14. | C457 | Determination of Air Voids in Concrete |
| 15. | C494 | Chemical Admixtures for Concrete |
| 16. | C618 | Fly Ash and Pozzolan for Use in Concrete |
| 17. | D2628 | Preformed Polychloroprene Elastomeric Joint Seals for Concrete Pavements |

1.06 SOURCE QUALITY CONTROL

- A. Portland Cement - Mill test certificates identifying chemical and physical analysis.
- B. Aggregates - Perform tests by an approved independent testing laboratory prior to use to show compliance with these Specifications:
 - 1. Such tests which have been made within six months prior to the use of the aggregates will be acceptable.
 - 2. Gradation tests shall be performed at the point of use.
 - 3. The source of the material shall not be changed without retesting.
 - 4. All aggregates shall be tested for compliance with the specifications at a minimum of one-year intervals during the course of the work.
 - 5. Coarse aggregates shall be obtained from a NYSDOT-approved operating source.

1.07 TESTS AND INSPECTIONS

- A. All required field and laboratory tests shall be at the _____ Contractor's expense. Should any additional tests be necessary due to inadequate test results (i.e., core testing, load testing, etc.), the _____ Contractor shall also be responsible for the cost. The _____ Contractor shall use only an approved commercial testing laboratory.

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- B. The _____ Contractor shall provide facilities necessary to obtain and handle representative samples of materials to be tested and shall furnish all necessary cooperation and assistance as requested by the _____. The _____ Contractor shall provide sufficient notification to the testing laboratory and shall plan and schedule his operations to allow adequate time for all required testing and inspection.
- C. The testing laboratory shall be responsible to the _____ for the field control of all concrete and may reject batches for high slump, uncontrolled air-entrainment, or delays. Written reports shall be issued immediately after the testing is complete. However, if at any time the results are questionable, the _____ shall be notified immediately so that corrective steps may be taken. All tests and reports submitted for review shall be only for those specific items used in the work. One copy of the test reports shall be submitted directly to the _____ by the testing laboratory for review.
- D. The criteria for the acceptance of concrete shall be as detailed in ACI 318, Chapter 4, and include the following tests:
1. Concrete Test Cylinders
 - a. During the progress of the work, a set of six 6' x 12" cylinders shall be made for each 50 cubic yards of concrete placed, or fraction thereof, of each class of concrete placed each day. These cylinders shall be made up and cured in accordance with ASTM C31 and shall be tested in accordance with ASTM C39. The following schedule shall be used in the testing procedure:
 - 1) Two shall be tested at seven days.
 - 2) Two shall be tested at twenty-eight days.
 - 3) The remaining two shall be tested at forty days or as directed by the _____.
 - b. The making, pick-up, and curing of the cylinders shall be the responsibility of the testing laboratory, but the _____ Contractor shall cooperate in protecting the cylinders and notifying the testing lab of scheduled pours.
 - c. The report shall indicate the mix proportions, air content, water content, slump, batching time, placing time, and a detailed description where the tested concrete was placed in the structure. All items shall be completely filled in on each test report.

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2. Slump Tests
 - a. Slump tests shall be made of each batch and/or as frequently as directed. Tests shall be made in accordance with the requirements of ASTM C143.
3. Air Content Tests
 - a. Air content tests shall be made each time slump tests are taken of concrete required to be air-entrained. Tests shall be made in accordance with ASTM C172 or C231.
4. Portland Cement
 - a. Cement stored at the job site or in storage at the concrete supplier's plant for over 60 days shall be subjected to complete tests to determine compliance with ASTM C150.
5. Fine Aggregate
 - a. Tests shall be performed as outlined in ASTM C33. Soundness of the aggregate shall conform to the following:
 - 1) Sodium Sulfate: Maximum 7 percent loss.
 - 2) Magnesium Sulfate: Maximum 15 percent loss.
 - b. Organic impurities shall not be allowed. Sand exhibiting a color darker than the referenced color shall be rejected.
6. Coarse Aggregate
 - a. Tests shall be in accordance with ASTM C33 and as required by NYSDOT Specification 703.02.
7. Water
 - a. Questionable sources of water, as determined by the _____, shall be tested in accordance with AASHTO T26 and ACI 301.

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PART 2 - PRODUCTS

2.01 CONCRETE MATERIALS

A. Cement

1. Conform to ASTM C150, Type II.
2. Tricalcium aluminate (C3A) shall be limited to a maximum of 7 percent. Use only approved brands without change for the entire project.
3. Cement used throughout the entire project shall be uniform in color so as not to detract from the appearance of the exposed concrete.

B. Fine Aggregate

1. Natural sand in conformance with ASTM C33.

C. Coarse Aggregate

1. Crushed gravel or crushed stone meeting the requirements of ASTM C33 and NYSDOT Specification 703.02. Gradation shall conform to Table 703-4 of the NYSDOT specification, with the maximum size aggregate for various types of work as follows:
 - a. Floor Toppings
 - 1) For bond beam fill, use No. 1A size with not more than 10 percent passing a #4 sieve.
 - b. Use No. 1 size for:
 - 1) Slabs less than 7 inches in depth;
 - 2) Beams, girders, and columns less than 12 inches in width; and
 - 3) Concrete piles and other structural concrete where restrictions within concrete are 2 inches or less.
 - c. General work having a cross-sectional dimension of 12 inches or greater, use a mixture of No. 1 size and No. 2 size conforming to the following gradation:

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Primary Size (inches)	Percent Passing
1½	100
1	90-100
¾	60-90
½	22-50
¼	0-6

D. Water

1. Mixing water shall be clear and free from deleterious amounts of oil, acid, alkali, organic matter, and other substances. Water from an unpotable water source must be approved by the _____ prior to use.

2.02 ADMIXTURES

- A. Calcium chloride or admixtures containing more than 0.1 percent chloride ions are not permitted. Written conformance of the chloride ion content will be required from the admixture manufacturer prior to mix design review.

1. Water-Reducing Admixture

- a. The admixture shall conform to ASTM C494, Type A, and shall not contain more chloride ions than are present in municipal drinking water. The following are approved:
 - 1) “EUCON WR-75” by the Euclid Chemical Company.
 - 2) “Pozzolith 200N” by Master Builders.
 - 3) “Plastocrete 160” by the Sika Chemical Company.

2. High Range Water-Reducing Admixture (Superplasticizer)

- a. The admixture shall conform to ASTM C494, Type F or G, and shall not contain more chloride ions than are present in municipal drinking water. The following are approved:
 - 1) “EUCON 37” by the Euclid Chemical Company.
 - 2) “Sikament” by the Sika Chemical Company.

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3. Retarding Water-Reducing Admixture
 - a. The admixture shall conform to ASTM C494, Type D, and shall not contain more chloride ions than are present in municipal drinking water. The following are approved:
 - 1) “EUCON Retarder 75” by the Euclid Chemical Company.
 - 2) “Datatard HC” by W.R. Grace.
 - 3) “Plastiment” by the Sika Chemical Company.

4. Non-Chloride Accelerator
 - a. The admixture shall conform to ASTM C494, Type C or E, and shall not contain more chloride ions than are present in municipal drinking water. The following are approved:
 - 1) “Accelguard 80” by the Euclid Chemical Company.
 - 2) “Darex Set Accelerator” by W.R. Grace.

5. Air-Entraining Admixture
 - a. The admixture shall conform to ASTM C260. The following are approved:
 - 1) “Air Mix” by the Euclid Chemical Company.
 - 2) “Darex-AEA” by W.R. Grace.
 - 3) “MBVR” by Master Builders.

6. Bonding Admixture
 - a. The admixture shall be for use with the bonding grout or patching mortar. The following are approved:
 - 1) “SBR LATEX” by the Euclid Chemical Company.
 - 2) “ACRYL-60” by Standard Drywall Products, Inc.

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2.03 CURING AND SEALING MATERIALS

A. Curing and Sealing Compounds

1. The compounds shall conform to Federal Specification TT-C-800A and shall have a 30 percent minimum solids content.
2. The compound shall be of the styrene butadiene type.
3. Test data from an independent laboratory shall be submitted indicating a maximum moisture loss of 0.03 grams per square centimeter when applied at a coverage rate of 300 square feet per gallon.
4. Manufacturer's certification is required for approval.
5. The following are approved:
 - a. "Super Floor Coat" or "Super Plicoure" by the Euclid Chemical Company.
 - b. "Master Seal" or "Master Seal 66" by Master Builders.

B. Waterproofing Paper

1. The curing paper shall conform to ASTM C171.

2.04 ACCESSORIES

A. Bonding Compound

1. The compound shall be of the polyvinyl acetate, rewettable type. The following are approved:
 - a. "Euco Weld" by the Euclid Chemical Company.
 - b. "Sikadur Hi-Mod" by the Sika Chemical Company.

B. Embedded Items

1. Dovetail Anchor Slots shall be 24-gauge galvanized with removable filler. The following are approved:
 - a. #305 by Hohmann & Barnard.
 - b. #100 by Cleveland Steel Specialty Company.

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- c. “Bee-Hive” by Gateway Erectors, Inc.
 - d. Or Equal.
 - 2. Flashing Reglets - the following are approved:
 - a. PVC “84” by Superior Concrete Products.
 - b. “Watertite” Type “P” by O’Keefe’s, Inc.
 - c. Or Equal.
- C. Miscellaneous Items
 - 1. Mastic Material
 - a. For use in leveling concrete slabs. Mastic material shall be of the latex type. The following are approved:
 - 1) “S-180 Underlayment Cement” by Armstrong Cork Company.
 - 2) “Levelite-Latex” by Selby-Battersby & Company.
 - 3) Or Equal.
 - b. Depressions between high spots of the concrete slab shall not be greater than 3/16-inch under a 10-foot straight edge nor more than 1/16-inch within any 1-foot distance.
 - c. All variations above this tolerance shall not receive leveling cement, but shall be ground level.
 - 2. Compression Seals
 - a. Compression seals shall be of neoprene conforming to ASTM D2628.
 - b. The seals shall be furnished in continuous lengths and installed according to manufacturer’s recommendations.
 - c. At the time of installation, the seal shall be compressed to 65 percent of its original width.

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3. Neoprene Bearing Pads
 - a. Pads shall conform to the provisions of AASHTO standard specifications for highway bridges. The following elastomeric bearing pad manufacturers are approved:
 - 1) W.R. Grace & Company.
 - 2) Kirkhill Rubber Company.
 - 3) Or Equal.

2.05 CONCRETE MIX DESIGN

- A. All mix designs shall be proportioned in accordance with Section 4.3 (Field Experience) or Section 4.4 (Trial Batches) of ACI 318-83. If trial batches are used, they shall be established by an approved commercial testing laboratory employed by the _____ Contractor.
- B. The proposed mix design shall be designed to achieve an average strength 1,200 psi higher than the specified strength listed in the concrete class table below.
- C. Mix design submittals shall indicate the amounts of all ingredients including cement, admixtures, and the weight of the aggregates stated in a saturated surface dry condition.
- D. The various classes of concrete shall be designated as follows:

Maximum Water to Cement Ratio By Weight

<u>Class</u>	<u>28-Day Compressive Strength (psi)</u>	<u>Non-Air Entrained</u>	<u>Air-Entrained</u>
A	5,000	.45	.35
B	4,000	.55	.45
C	3,000	.68	.58
D	2,500	.74	.64
E	2,000	----	----

- E. In addition to the requirements above, these specific requirements shall be considered in the mix design:
 1. Concrete required to be watertight or concrete exposed to de-icers shall have a maximum water to cement ratio of 0.45.

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2. All concrete slabs less than 8 inches in thickness, when placed in temperatures below 50°F, shall contain the specified non-chloride accelerator.
3. All concrete shall contain an approved water-reducing admixture or an approved high range water-reducing admixture (superplasticizer).
4. All pumped concrete, watertight concrete, and concrete with a water to cement ratio below 0.50 shall contain the high range water-reducing admixture.
5. Cement contents shall be chosen to provide the minimum strengths for each class as shown in the concrete class table above. The amount of cement content, however, shall not be less than the following:
 - a. Class “B” - 550 pounds per cubic yard.
 - b. Class “C” - 470 pounds per cubic yard.
 - c. Class “B” Toppings - 600 pounds per cubic yard.
6. Unless otherwise specified, all concrete shall be Class “B” watertight.
7. All concrete exposed to weather or water, or subject to freezing, shall be air-entrained with an approved entraining admixture.

F. Slump

1. All concrete containing the high range water-reducing admixture (superplasticizer) shall have a maximum slump of 6 inches unless otherwise directed by the _____. Prior to the addition of the superplasticizer, the concrete shall be tested at the job site and a slump of 2 inches to 3 inches shall be verified. The plasticizer may then be added to increase the slump to the approved level.
2. All concrete not containing a high range water-reducing admixture (superplasticizer) shall conform to these maximum slump values:

Reinforced concrete-general	4”
Non-reinforced concrete	3”
Pavements, sidewalks	3”
Heavy mass concrete	3”
Slabs on grade	3”
Floor toppings	2”

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These values listed are specified as the “working limit.” The average slump values shall be less than the “working limit.”

3. Tolerances shall be as per ASTM C94, except that the plus tolerance shall be limited to the “working limit.” A deviation of 1 inch shall be allowed for such occasional batches of concrete that may inadvertently exceed the “working limit.” Batches of concrete with slumps exceeding the “working limit” will be rejected if the _____ Contractor fails to comply promptly with the _____ instructions to reduce the slump of the concrete within the “working limit.” The _____ Contractor shall not increase mixing time, add dry materials, or otherwise modify a rejected batch for the purpose of conforming to slump limits.
4. Concrete that has been rejected for failure to meet the slump limits shall not be salvaged for use in the work.
5. Concrete containing the high range water-reducing admixture (superplasticizer) may be given additional superplasticizer only when approved by the _____. If a time delay has occurred wherein the slump has decreased to a level that is significantly below the maximum approved level, additional admixture may be added to increase the slump to the maximum level.

G. Air Content

1. Air content for air-entrained concrete shall be controlled within the following limits:

General work	4% to 7%
Concrete exposed to frost	4.5% to 7.5%
Concrete exposed to salt	4.5% to 7.5%
Concrete with maximum 3/4-inch aggregate	4.5% to 7.5%
Finished trowel surfaces	3%
Mats	3%
Footings	3%
Substructure slab	3%

H. Rate of Hardening

1. Concrete mixes shall be designed to produce the following rates of hardening:
 - a. General concrete with the following ambient temperatures:

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50° - 85°F - normal rate of hardening
80°F - retarded rate of hardening
50°F - accelerated rate of hardening

b. Mass concreting with the following ambient temperature:

40°F - retarded rate of hardening

2. Should the _____ Contractor feel it advantageous to use modified rates of hardening to improve workmanship or facilitate his work, consideration will be given by the _____.

I. Mixing Water Control

1. The quantity of mixing water used in the concrete mix shall be determined by the _____ Contractor, with the amount used conforming to the various limits on specified slump. However, if the slump of the concrete should exceed the maximum specified slump, the _____ will direct the _____ Contractor to reduce the quantity of mixing water. Concrete consistency shall be uniform from batch to batch.

2. If deemed necessary by the _____ during the course of the work, moisture determinations of the aggregates shall be made and aggregate weights and water requirements adjusted accordingly.

3. When concrete is transported in units approved for mixing, the addition of not more than 10 percent of the total design water will be permitted at the job site to obtain the specified initial slump.

a. Any addition of water shall be followed by at least 30 revolutions in the mixing speed range.

b. Not more than two additions of water will be allowed at the point of deposition before discharge.

c. No re-tempering, defined as the addition of water after the mix has obtained its specified initial set, will be permitted.

J. Batching and Mixing

1. Batching

a. The _____ Contractor shall have at his disposal a modern and dependable batch plant within a reasonable distance from the work.

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- b. The batch plant shall conform to the requirements of the NYSDOT specifications for automatic proportioning equipment as specified herein, and shall be approved by the State of New York.
 - c. The batching and mixing shall conform to ACI 304 and NYSDOT Specification 501-3.03.
 - d. The batching shall be done only with materials previously approved by the _____.
2. Mixing Transporting and Discharging
- a. Conform to ASTM C94 and NYSDOT Specification 501-0.04.
 - b. Wastewater must be discharged and not used as mixing water for the next batch.
 - c. The maximum interval between successive truckloads of concrete discharged into the work shall not exceed 30 minutes when the portion of the work being placed requires more than one load of concrete.

2.06 MORTAR FILL

- A. Mortar fill to form fillets, channel bottom, and swept-in grout, where shown on the Contract Drawings, shall be made with the following proportions:

Sand	1 part
Cement	2½ parts
Water	minimum required for workability

PART 3 - EXECUTION

3.01 PLACING CONCRETE

- A. Concrete shall be placed in conformance with ACI 304 and these Specifications.
- B. Prior to placing concrete:
 - 1. All form work, embedded parts, reinforcements, foundation surfaces, and joints involved in the work must be inspected by the _____.

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2. All surfaces that will be in contact with the poured concrete shall be free from standing water, mud, debris, frost, snow, and ice.
3. Earth surfaces which are absorptive shall be moistened to a depth of 1 inch.
4. When the ambient temperature is above 40°F, all subgrade surfaces shall be wetted down with cool water just prior to placement.
5. All reinforcing bars and embedded parts shall be cleaned of any coating of oil, grease, ice, dried mortar, or any other foreign matter that will prevent bond with the concrete.
6. Preparation of joints shall be specified under Section 03251 - Joints for Concrete.
7. The _____ Contractor shall build into the concrete such items as reinforcing steel, inserts, sleeves, waterstops, etc., as shown on the Contract Drawings or as specified.
 - a. All embedded items shall be accurately located and securely fastened in place to prevent displacement during the placement of the concrete.
 - b. The _____ Contractor shall cooperate with all other trades in permitting ample time for the placement of all necessary sleeves, inserts, conduits, hangers, etc. required for their trades.
 - c. If in the judgment of the _____, the embedded items are placed in such a manner to reduce the structural adequacy of the structure, the _____ Contractor shall take the necessary corrective steps.
8. All anchor bolts for structural steel and mechanical equipment shall be carefully set as shown on the Contract Drawings and as shown on the fabricator's and manufacturer's reviewed anchor bolt setting plans.

C. Placement of Concrete

1. Concrete shall be conveyed by means that will prevent segregation and loss of mortar from the mix.
2. Adequate manpower and equipment in the form of buckets, buggies, chutes, conveyors, or other approved means shall be provided and

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properly maintained by the _____ Contractor to ensure continuous operations.

3. Care shall be taken that no equipment with aluminum parts comes in contact with the fresh concrete.
4. Deposit concrete vertically using chutes, elephant trunks, or other suitable devices to limit free fall to 5 feet.
5. Place formed concrete in continuous horizontal layers not more than 18 inches thick. When the time between successive layers exceeds one hour, the specified water-reducing, retarding admixture, Type “D,” will be required to delay initial set so that proper consolidation of lifts can occur and cold joints are avoided.
6. When a column-slab combination or a wall-slab combination pour is scheduled, the column or wall shall have taken its initial set before concreting is continued on the slab. Beams, girders, brackets, column capitals, and haunches shall be considered as part of the floor system and shall be placed integrally therewith.
7. Following a discontinuance or interruption in the placement of the concrete, all accumulations of mortar splashed upon the reinforcing steel and the surfaces of the forms shall be removed.
8. Dried mortar chips and dust shall not be puddled into the plastic concrete.
9. The forms or formwork shall not be jarred or the exposed reinforcement disturbed in any manner after the concrete has taken its initial set.

D. Pneumatic Placement

1. Pneumatic placement of concrete will be permitted only if authorized by the _____, in writing.
2. The equipment shall be suitable in kind and adequate in capacity for the work.
3. The equipment shall be operated and placed so that no vibrations result which may damage freshly placed concrete.
4. The machine shall be located as close as practicable to the place of deposit.

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5. The position of the discharge end of the line shall not be more than 8 feet from the point of deposit.
6. The discharge lines shall be horizontal or inclined upward from the machine.
7. At the conclusion of placement, the entire equipment shall be thoroughly cleaned.

E. Pumping

1. Pump placement of concrete will be permitted only if authorized by the _____, in writing.
2. The equipment shall be suitable in kind and adequate in capacity for the work.
3. The operation of the pump shall be such that a continuous stream of concrete, without air pockets, is produced.
4. When pumping is completed, the concrete remaining in the pipeline, if it is to be used, shall be ejected in such a manner that will not produce contamination of the concrete or separation of the concrete ingredients.
5. Prior to starting the pumping operations, the equipment and pipeline shall be thoroughly lubricated with a cement slurry in a manner approved by the _____.
6. After the pumping operation has been completed, the entire equipment shall be thoroughly cleaned.

F. Depositing Concrete Under Water or Flooding of Concrete

1. No concrete shall be deposited under water without the written permission of the _____, and then only in accordance with the _____'s directions. Proper tremie equipment and techniques must be used should the need for placement under water arise.
2. No water, except curing water, shall be allowed to come in contact with the concrete or masonry surface for a minimum of 24 hours.
 - a. Should unavoidable rising water put a stress on the concrete, adequate bracing must be provided.

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- b. Loading of flooded concrete shall not occur without the approval of the _____. Safety precautions shall be the responsibility of the _____ Contractor.

G. Interruption of Concreting

- 1. Should the placement of concrete be suspended or unavoidably interrupted, keyways and bulkheads shall be provided and steps taken to prevent feather-edging when work is eventually resumed. Horizontal surfaces shall be roughened for bond. Joint preparation and bonding shall be in compliance with Section 03251 - Joints for Concrete.

H. Consolidation of Concrete

- 1. Concrete shall be consolidated during and immediately after depositing. The consolidation shall be in conformance with ACI 309 in all respects and shall be accomplished by mechanical vibration subject to the following conditions:
 - a. The vibration shall be internal, unless special authorization is given by the _____ for external vibration.
 - b. Vibrators shall be capable of transmitting vibration to the concrete at frequencies recommended by ACI 309.
 - c. The intensity of the vibration shall be such as to visibly affect the mass of concrete by a slump of 1 inch over a radius of 18 inches.
 - d. The _____ Contractor shall supply a sufficient number of vibrators to properly consolidate each pour immediately after it is placed. Standby vibrators in good condition shall be readily available, if needed, during concrete placement.
 - e. Vibrators shall not be applied directly to the reinforcement or to the forms. They shall not be used to make the concrete flow in the forms over distances so great as to cause segregation.
- 2. Vibration shall be supplemented by spading as necessary to ensure smooth surfaces and well consolidated concrete. Form surfaces and corner locations that are difficult to consolidate with vibrators shall be consolidated by spading.

3.02 COLD WEATHER CONCRETING

- A. Adequate equipment shall be provided for heating the concrete materials and protecting the concrete during freezing or near freezing weather.

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- B. No frozen materials nor materials containing ice shall be used.
 - C. All concreting operations in cold weather, when temperatures are at, or expected to be below 40°F, shall conform to ACI 306R.
 - 1. Special attention is drawn to the minimum required placing and curing temperatures.
 - D. Only the specified non-chloride accelerator may be used. Calcium chloride or admixtures containing more than 0.1 percent chloride ions are not permitted.
 - E. Concrete damaged by freezing shall be removed and replaced at the _____ Contractor's expense.
- 3.03 HOT WEATHER CONCRETING
- A. Care shall be taken to protect the concrete or to schedule operations to avoid problems with flash set or conditions that produce excessively rapid drying.
 - B. All concrete operations during hot weather shall conform to the requirements of ACI 305R.
 - C. During hot weather, consideration shall be given to maintaining the temperature of the cement, aggregates, and mixing water such that the temperature of the concrete at the time of delivery to the job site in no case exceeds 90°F.
 - D. When the temperature of the concrete exceeds 80°F, the water-reducing, retarding admixture, Type “D,” may be required.
- 3.04 PLACING MORTAR FILL
- A. Prior to placing mortar fill, the concrete surface shall be thoroughly cleaned to remove all laitance, oil, grease, and other foreign matter that would prevent bonding.
 - B. Immediately following the placement of the mortar fill, a slurry coat shall be rubbed into the concrete surface.
 - C. The specified curing and sealing materials must be used for complete curing of the mortar fill.

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3.05 EQUIPMENT BASES

- A. Unless otherwise shown, equipment bases shall be constructed of Class “B” concrete. Size and location shall be coordinated with the manufacturer’s equipment drawings.
- B. All bases or pads shall be reinforced with a minimum of #4 rebars at 12 inches on center, or as detailed on the Contract Drawings. The reinforcing shall be dowelled into the base or slab with #4 rebars.
- C. The concrete slab or base shall be roughened and the specified bonding compound applied.
- D. The concrete shall be placed to the required profile and all exposed surfaces shall be finished as specified for the adjacent floor finishes. All edges shall be chamfered and tooled.

3.06 CONCRETE TOPPING

- A. Concrete topping shall be provided where shown on the Contract Drawings. The thickness of the toppings shall be as shown on the drawings, but in no case shall they be less than 2 inches.
- B. Unless otherwise noted, concrete for toppings shall be Class "B" concrete.
- C. Subsequent to float finishing the concrete substrate, the _____ Contractor shall prepare the surface to receive the topping by employing one of the following two alternate methods:
 - 1.a. Within six to twelve hours after the float finishing is completed, all loose mortar, scum, laitance, etc., shall be removed by wire brushes or other suitable means to expose the coarse aggregate.
 - 1.b. Care shall be exercised that the aggregate in the hardened concrete is not disturbed. Any aggregate that is disturbed shall be removed.
 - 1.c. The concrete substrate shall then be cured as specified herein and shall be protected until placement of the topping is completed.
 - 2.a. Any time after the concrete substrate has hardened, the entire surface shall be scarified to expose a clean surface of sound concrete.
 - 2.b. Leave the surface rough to a depth of 1/8-inch.

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- D. Prior to placing the concrete for the topping, the hardened concrete surface shall be thoroughly cleaned and moistened. However, the surface shall be free from excessive surface water.
- E. Apply bonding compound to the prepared and cleaned surface per the manufacturer's recommendations:
1. The _____ Contractor shall have the option of using a bonding grout composed of:

Cement	One Part
Sand	One Part (100% passing No. 30 sieve)
Bonding Admixture	per manufacturer's direction
Water	(Maximum Slump of 6 inches)

The bonding grout shall be brushed into the existing surface of the concrete. The topping must then be placed while the bonding grout is still tacky.
- F. Reinforcing for concrete toppings, when called for, shall be WWF 6x6 - W2.9 x W2.9 supplied in flat sheets, and shall be pressed into the wet concrete as the concrete is placed. The clear distance from the surface of the topping to the fabric shall be 1 inch.
- G. The concrete topping shall be cured by application of the specified curing and sealing materials. The curing must start immediately after the final finishing is complete.
- H. Joints shall be saw-cut in the topping and sealed as shown on the Contract Drawings.
- I. The concrete topping shall receive finish specified for floors and slabs.

3.07 FINISHING

- A. Floors and Slabs
1. Exposed Concrete Finish
 - a. Strike off to correct elevation immediately after placing concrete.
 - b. Bull float after screeding.
 - c. When the concrete will sustain foot pressure and all bleed water and surface sheen have evaporated from the surface, begin power

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float operation. The surface shall be floated at least twice, to uniform, sandy texture. Hand float inaccessible areas.

- d. Immediately following the power float operation, power trowel the surface at least twice, to a smooth, hard finish. Hand trowel inaccessible areas. Trowelled finish slabs shall be level so that depressions between high spots do not exceed 1/8-inch under a 10-foot straight edge.
 - e. Final trowelling shall be done so that a ringing sound is produced as the trowel is drawn over the surface. The finished surface shall be free of all trowel marks.
 - f. Apply the specified curing and sealing compounds to all exposed concrete finished floors and to the bottom of all concrete channels immediately following final finishing operations. Application of curing and sealing compounds shall be in two coats per manufacturer's recommendations. The sealing coat shall be applied just prior to the completion of construction.
2. Floors to receive quarry or ceramic tile:
- a. Strike off to correct elevation immediately after placing concrete.
 - b. Bull float after screeding to accurate and level lines as required to receive tile materials.
 - c. Floors to receive quarry tile shall be recessed and roughened with a stiff brush before final set.
 - d. Floors to receive ceramic tile by the thin set method shall be wood floated.
 - e. Floors to receive a concrete topping shall be finished with a magnesium float.
3. Tank Base Slabs
- a. Tank base slabs which do not receive subsequent toppings or swept-in grout are to have a power trowelled finish as outlined in 1. a., b., c., and d. above.
 - b. Commence curing immediately after power trowelling.

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4. Culvert inverts, manhole bottoms, catch basins, and other exterior concrete not intended for occupancy.
 - a. Magnesium Float Finish.
5. Sidewalks, Walkways, and Loading Docks
 - a. After float finishing as outlined in 1. a., b., and c., a broom finish shall be given perpendicular to traffic and sufficient to leave marks without appreciable disturbance of the surface.
 - b. Texture shall be as approved by the _____ from sample panels.

B. Formed Surfaces

1. Special care shall be taken during the forming for concrete and the concrete placement such that the amount of work required under this section is reduced to a minimum.
2. If, upon removal of the formwork, any voids or honeycombs are found, such faults shall be corrected immediately at the _____ Contractor's expense by implementing the following:
 - a. Cut away the unsound area to a minimum depth of 1 inch and refill with mortar mixed with the same brand of cement and same proportions as the original placement.
 - b. Edges of the patch shall be square with the face with feather-edging prohibited.
 - c. Dampen the area to be patched and then apply the specified bonding agent per manufacturer's recommendations.
 - d. Fill the hole with mortar with a ½-inch layer after the bonding compound has dried. Succeeding ½-inch layers will be placed after the first layer has taken initial setting.
 - e. If, in the opinion of the _____, improper consolidation is too extensive, or if the structure appears weakened by the voids, complete removal of the concrete in question may be required.
 - f. Patches must be kept moist for a minimum of three days.

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3. Rubbed Finishes

- a. The type of finish to be used shall be as scheduled or as noted on the Contract Drawings. Where the type of finish is not shown or scheduled, exposed faces shall be given a Type “B” finish and unexposed faces shall be given a Type “C” finish. Where concrete is to receive paint or a glazed wall finish, a Type “B” finish shall be used. The finishes are designated as follows:

Type “A” Surfaces shall be rubbed until all marks are obliterated and a uniformly smooth finish is obtained.

Type “B” Surfaces shall be rubbed until they are uniformly smooth, but complete obliteration of all marks is not required.

Type “C” All fins, burrs, and projections shall be removed. Any honeycomb or tie-holes shall be filled and patched.

- 1) Begin rubbing within four hours of the removal of the formwork and expedite to completion as rapidly as practicable.
- 2) Rub surfaces with carborundum and water until all fins, bubbles, hollows and other defects are removed.
- 3) Do not use grout or mortar in the rubbing process. Plastering of surfaces will not be allowed.
- 4) Use power tools with hand work limited to inaccessible corners or small areas.
- 5) After the rubbing is completed and the surface has dried, rub the surface with burlap to remove all loose powder.
- 6) All expansion joints in the completed work shall be left carefully tooled and free of all mortar and concrete.

3.05 CURING

- A. Maintain all concrete in a moist condition for the duration of the specified curing using the methods that will ensure complete and continuous saturation. Use of water sprays is acceptable provided care is exercised to ensure continuous moist

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curing. Alternate wetting and drying is prohibited. The curing schedule is as follows:

1. Interior floor slabs with resilient tile, carpet, or exposed surface:
 - a. Cure with specified curing and sealing compounds.
 2. Exterior slabs, sidewalks, curbs, etc.:
 - a. Cure with specified curing and sealing compounds.
 3. Remaining Floor Slabs and Tank Base Slabs
 - a. Cure with curing paper conforming to ASTM C171 with minimum 10-mil polyethylene sheets. Lap all edges a minimum of 6 inches. All joints shall be continuously taped. If any tearing or ripping of the sheets during subsequent operations on the slab occurs within the specified curing period, repair by taping or replacement will be required. Add water as required periodically or as ordered by the _____.
 4. Vertical Surfaces
 - a. Forms shall remain in place or the exposed concrete shall be covered with wet burlap during the curing period.
 - 1) The forms or burlap surfaces shall be kept continuously saturated throughout the curing period.
- B. Where specifically approved by the _____, in writing, the specified curing and sealing compounds may be used on other surfaces provided discoloration does not occur and the application is in accordance with the manufacturer's recommendations. Written certification of compatibility with subsequent finishes must be supplied by the finish manufacturer. In general, do not use curing and sealing compounds on the following surfaces:
1. Any surface against which additional concrete or other cementitious finishing materials are to be bonded.
 2. Any surface in which a waterproofing membrane is to be applied.
- C. During the curing period, exercise care to prevent excessive vibrations, mechanical disturbances, or heavy shocks which may damage concrete.

MATERIALS AND PERFORMANCE – SECTION 03001

CONCRETE

D. Duration of Curing

1. Continue curing until the cumulative number of days, not necessarily consecutive, during which the temperature of the air in contact with the concrete is above 45 degrees F has totaled seven days (three days for high early strength concrete).

- END OF SECTION -

MATERIALS AND PERFORMANCE – SECTION 03100

CONCRETE FORMWORK

PART 1 - GENERAL

1.01 WORK SPECIFIED

- A. All labor, materials, services and equipment necessary for furnishing, installing and removing all formwork for cast-in-place and precast concrete.

1.02 RELATED WORK SPECIFIED UNDER OTHER SECTIONS

Documents affecting work of this section include, but are not necessarily limited to the following:

TBD

1.03 SUBMITTALS

- A. TBD
- B. Shop drawings must be submitted that show in detail the items of the form system affecting the appearance of architectural concrete surfaces such as joints, tie holes, liners, patterns, and textures. Items must be shown in relation to the entire form system.
- C. Manufacturers' literature must be submitted with descriptions and recommended installation instructions for form ties, spreaders, corner formers, form liners, and form coatings.
- D. Submittals shall indicate pertinent dimensions, materials and arrangement of joints and ties.

1.04 QUALITY ASSURANCE

- A. The _____ Contractor shall be responsible for designing and constructing suitable and adequate falsework which shall be designed in accordance with ACI 347 "Recommended Practice for Concrete Formwork."
- B. The design of forms will take into account the effect of construction loads during and after placement of concrete.
- C. The forms shall be substantial, unyielding, and constructed mortar-tight and of sufficient rigidity to prevent distortion due to the pressures of concrete and other loads incidental to the construction operations.

MATERIALS AND PERFORMANCE – SECTION 03100

CONCRETE FORMWORK

1.05 REFERENCES

The publications listed below form a part of these Specifications to the extent referenced. The publications are referred to in text by the basic description only.

- A. ACI 301 - Specifications for Structural Concrete for Buildings.
- B. ACI 347 - Recommended Practice for Concrete Formwork.
- C. PS 1 - Construction and Industrial Plywood.

1.06 SYSTEM DESCRIPTION

- A. Design, engineer, and construct formwork, shoring, and bracing to meet design and code requirements so that the resultant concrete conforms to the required shapes, lines, and dimensions as shown on the Contract Drawings.

1.07 FIELD SAMPLES

- A. Field samples of formed concrete must be submitted when the surface of the concrete is to receive a special architectural treatment.
- B. Construct and erect sample formwork panel for architectural concrete surfaces receiving special treatment or finish as a result of formwork. Formwork shall include a vertical and a horizontal form joint.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and handle materials with care to prevent damage to or contamination of formwork.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Plywood: Exterior-type softwood plywood, PS 1-66.
- B. Glass Fiber Fabric-Reinforced Plastic Forms: Shall be matched, tight fitting, stiffened to support the weight of wet concrete without deflections that exceed the structural tolerances or that are detrimental to the appearance of the finished concrete.
- C. Lumber: Softwood framing lumber, PS 20-70. Grade markings shall be clearly visible and shall be marked by grading rules approved by the American Lumber Standards Committee.

MATERIALS AND PERFORMANCE – SECTION 03100

CONCRETE FORMWORK

- D. Steel: Minimum 16 gauge sheet, well matched, tight fitting, stiffened to support the weight of wet concrete without deflections that exceed the structural tolerances or that are detrimental to the appearances of the finished concrete. Metal forms may be used only for forming precast concrete.
 - E. Void Forms: Shall be moisture-resistant treated paper faces, seamless, laminated fiber material as approved by the _____. The forms shall be structurally sufficient to support the weight of a wet concrete mix and any construction or consolidation vibrations until the initial set.
- 2.02 FORMWORK ACCESSORIES
- A. Form ties shall be left in place and equipped with swaged (waterproofing) washers or other approved devices to prevent seepage of moisture along the tie.
 - 1. Minimum 1-inch depth of breakback.
 - B. Form release agent shall be a colorless material which will not stain concrete; absorb moisture; or impair finish, bonding, or color characteristics of coating intended for use on concrete.
 - C. Fillets shall be used for all exposed vertical and horizontal corners.

PART 3 - EXECUTION

3.01 INSPECTION

- A. Verify lines, levels, and measurements before proceeding with formwork.
- B. Notice shall be given 24 hours in advance of pour so that an inspection can be scheduled.
- C. Forms shall be inspected by the _____ prior to concreting.
- D. No concreting shall be done in the absence of the _____ without the written permission of the _____.

3.02 PREPARATION

- A. Conform to ACI 347, except as specified herein.
- B. Initially and before re-use, forms shall be cleaned and a coat of non-staining form release agent applied per the manufacturer's instructions.

MATERIALS AND PERFORMANCE – SECTION 03100

CONCRETE FORMWORK

1. Care shall be taken to avoid splashing oil on reinforcing steel or existing concrete.
2. Do not apply form release agent where concrete surfaces are scheduled to receive special finishes which may be affected by agent.

3.03 ERECTION

- A. Provide bracing to ensure stability of formwork. Strengthen all formwork liable to be overstressed by construction loads.
- B. Camber slabs and beams to achieve ACI 301 tolerances.
 1. 1/4 inch in 15 feet of span.
- C. Provide temporary ports in formwork to facilitate cleaning and inspection. Locate openings at bottom of forms to allow flushing water to drain. Close ports with tight fitting panels, flush with inside face of forms, neatly fitted so that joints will not be apparent in exposed concrete surfaces.
- D. All form joints shall be backed up to assure that the edges of abutting panels are in the same plane, straight and true, and forced tightly together to minimize fins. The quality of the form contact surfaces shall be subject to the approval of the _____.
- E. If installing void forms, protect them from moisture before concrete placement and protect from crushing during concrete placement.
- F. Do not displace or damage vapor barriers previously placed.
- G. Forms for exposed concrete shall be given special attention to provide a surface free from defects and form marks so that rubbing and finishing shall be kept to a minimum.
- H. Construct formwork to maintain tolerances in accordance with ACI 301.

3.04 INSERTS, EMBEDDED PARTS, AND OPENINGS

- A. Provide formed openings where required for work embedded in or passing through concrete.
- B. Coordinate work of other sections in forming and setting openings, slots, recesses, chases, sleeves, bolts, anchors, and other inserts.
- C. Install accessories in accordance with manufacturer's instructions, level and plumb. Ensure items are not disturbed during concrete placement.

MATERIALS AND PERFORMANCE – SECTION 03100

CONCRETE FORMWORK

3.05 FORM REMOVAL

- A. Do not remove forms and shoring or bracing until concrete has sufficient strength to support its own weight, and construction and design loads which may be imposed upon it.
- B. The following schedule shall be considered the minimum period before formwork can be removed under normal conditions with the use of Type II cement. Its use shall not relieve the _____ Contractor of responsibility for the safety and appearance of the structure.

Type of Form	Above		
	60°F	50 -60°F	40 -50°F
Columns 5' high	24 hours	36 hours	72 hours
Columns 5'-10' high	3 days	5 days	7 days
Columns 10' high	5 days	7 days	10 days
Walls 5'	24 hours	36 hours	72 hours
Walls 5-10'	3 days	5 days	7 days
Walls 10'	5 days	7 days	10 days
Beam Side Forms	24 hours	36 hours	72 hours
Beam Bottom Forms	14 days	18 days	21 days
Slabs 6' Span*	5 days	7 days	14 days
Construction Joint	24 hours	36 hours	72 hours
Bulk Heads	24 hours	36 hours	72 hours

* For slabs of more than 6-foot span, add twelve (12) hours for each additional foot over 5 feet.

- 1. When the temperature to which the forms or concrete surfaces are exposed to falls below 40°F, the forms shall remain in place an additional time equal to the time of the sub-40°F exposure. If form insulation is used, concrete surface temperature shall apply.

MATERIALS AND PERFORMANCE – SECTION 03100

CONCRETE FORMWORK

2. The _____ may modify the form removal schedule if compressive tests indicate that the in-place concrete is of sufficient strength. Methods of field curing the cylinders shall simulate that of the concrete and shall be approved by the _____. All such tests shall be at the option and expense of the _____ Contractor.
 3. When Type III cement or retarders are used, the form removal schedule above does not apply and may be modified by the _____.
- C. Immediately following the removal of the forms, the projecting ties shall be removed and all holes filled with grout flush with the wall. Care shall be taken to use the same brand of cement and same mix proportions used in the wall to prevent color differences.

3.06 CLEANING

- A. Clean forms to remove foreign matter as erection proceeds.
- B. Ensure that water and debris drain to exterior through clean-out ports.
- C. During cold weather, remove ice and snow from forms. Do not use deicing salts. Do not use water to clean out completed forms unless formwork and construction proceed within heated enclosure. Use compressed air to remove foreign matter.

- END OF SECTION -

MATERIALS AND PERFORMANCE – SECTION 03200

CONCRETE REINFORCEMENT

PART 1 - GENERAL

1.01 WORK SPECIFIED

- A. All labor, materials, equipment, and services necessary for furnishing and installing all steel reinforcement, welded steel wire fabric, and accessories for concrete required for the completion of the work.

1.02 RELATED WORK SPECIFIED UNDER OTHER SECTIONS

Documents affecting work of this section include, but are not necessarily limited to the following:

TBD

1.03 SUBMITTALS

- A. TBD
- B. Submit shop drawings.
- C. Indicate sizes, spacings, locations, and quantities of reinforcing steel, wire fabric, bending and cutting schedules, splicing, stirrup spacing, supporting, and spacing devices.

1.04 QUALITY ASSURANCE

- A. Perform concrete reinforcement work in accordance with CRSI Manual of Standard Practice, and Documents 63 and 65.
- B. Conform to ACI 301, 315, and 315R.

1.05 REFERENCES

- A. American Concrete Institute (ACI). The following codes, standards, and recommendations are intended to specify minimum standards of performance:
 - 1. ACI 301 Specifications for Structural Concrete for Buildings.
 - 2. ACI 315 Details and Detailing of Concrete Reinforcement.
 - 3. ACI 315R Manual of Engineering and Placing Drawings for Reinforced Concrete Structures.
 - 4. ACI 318 Building Code Requirements for Reinforced Concrete.

MATERIALS AND PERFORMANCE – SECTION 03200

CONCRETE REINFORCEMENT

- B. American Society for Testing and Materials (ASTM). The following codes, standards, and recommendations are referred to in these Specifications and are to be considered a part of these Specifications.
1. ANSI/ASTM A185 Welded Steel Wire Fabric for Concrete Reinforcement.
 2. ASTM A615 Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.
 3. ASTM E329 Recommended Practice for Inspection Testing Agencies for Concrete, Steel, and Bituminous Materials as Used in Construction.
- C. Concrete Reinforcing Steel Institute (CRSI). The following codes, standards, and recommendations are referred to in these Specifications and are to be considered a part of these Specifications.
1. CRSI Manual of Practice.
 2. CRSI 63 Recommended Practice for Placing Reinforcing Bars.
 3. CRSI 65 Recommended Practice for Placing Bar Supports, Specifications and Nomenclature.
- D. American Welding Society (AWS). The following codes, standards, and recommendations are referred to in these Specifications and are to be considered a part of these Specifications.
1. AWS D12.1 Reinforcing Steel Welding Code for Reinforcing Steel.

1.06 CERTIFICATES

- A. Submit mill test certificates of supplied concrete reinforcing, indicating physical and chemical analysis.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Reinforcing Steel: ASTM A615, 60 ksi yield grade billet-steel deformed bars, uncoated finish.
- B. Welded Steel Wire Fabric: ASTM A185 plain type; in flat sheets; coiled rolls; uncoated finish.

MATERIALS AND PERFORMANCE – SECTION 03200

CONCRETE REINFORCEMENT

- C. Stirrup Steel: ASTM A82.
- 2.02 ACCESSORY MATERIALS
- A. Tie Wire: Minimum 16 gage annealed type.
- B. Chairs, Bolsters, Bar Supports, Spacers: Sized and shaped for strength and support of reinforcement during installation and placement of concrete, including load bearing pad on bottom to prevent vapor barrier puncture.
- C. Chairs, Bolsters, Bar Supports, Spacers Adjacent to Architectural Concrete Surfaces: Plastic tipped-type; sized and shaped as required.
- 2.03 FABRICATION
- A. Unless otherwise shown or directed, the following minimum concrete cover shall be provided for reinforcement.
- | | <u>Minimum
Cover (inches)</u> |
|--|-----------------------------------|
| 1. Concrete cast against and permanently exposed to earth | 3 |
| 2. Concrete exposed to earth or weather: | |
| No. 6 through No. 18 bar | 2 |
| No. 5 bar and smaller | 1-1½ |
| 3. Concrete not exposed to weather or in contact with ground | |
| <u>Slabs, nails, joists:</u> | |
| No. 14 and No. 18 bars | 1½ |
| No. 11 and smaller | ¾ |
| <u>Beams, columns:</u> | |
| Primary reinforcement, ties, stirrups, spirals | 1½ |
| 4. Concrete exposed to water or sewerage slabs, walls | 2 |
- B. Locate reinforcing splices not indicated on Drawings at points of minimum stress. Indicate location of splices on Shop Drawings.

MATERIALS AND PERFORMANCE – SECTION 03200

CONCRETE REINFORCEMENT

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Before placing concrete, clean reinforcement of foreign particles or coatings.
- B. Place, support, and secure reinforcement against displacement. Do not deviate from alignment or measurement.
- C. Do not displace or damage vapor barrier, if required.

- END OF SECTION -

MATERIALS AND PERFORMANCE – SECTION 03251

JOINTS FOR CONCRETE

PART 1 - GENERAL

1.01 WORK SPECIFIED

- A. All labor, materials, services, and equipment necessary for furnishing and installing all expansion joints, construction joints, and control joints.

1.02 RELATED WORK SPECIFIED UNDER OTHER SECTIONS

Documents affecting work of this section include, but are not necessarily limited to the following:

TBD

1.03 SUBMITTALS

- A. TBD
- B. Furnish manufacturer's certification or test results identifying physical characteristics.
- C. Submit two (2) samples of each size and type of waterstop required.
 - 1. Minimum 4 inches in length.
- D. On the concrete reinforcement shop drawings clearly show in detail the locations of all joints in concrete.
- E. Test results from independent testing laboratories showing compliance with these Specifications.
- F. Sworn affidavits or statements from suppliers are not acceptable.

1.04 REFERENCES

- A. American Society for Testing and Materials (ASTM)
- B. Corps of Engineers (CRD)

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

TBD

MATERIALS AND PERFORMANCE – SECTION 03251

JOINTS FOR CONCRETE

2.02 INTEGRAL JOINT MATERIALS

A. Polyvinylchloride (PVC) Waterstops

1. PVC material shall be compounded from virgin PVC resins and shall contain no reclaimed, reground, or reworked materials. The material shall meet the following physical property requirements:

<u>Property</u>	<u>Method of Test</u>	<u>Requirement</u>
Tensile Strength (psi)	ASTM D412	1,400 min.
Ultimate Elongation (%)	ASTM D142	280 min.
Hardness, Type A Durometer	ASTM D2240	65-88
Stiffness in Flexure (psi)	ASTM D747	750 min.
Specific Gravity	ASTM D792	1.38 max.
Water Absorption in 48 hrs. (%)	ASTM D570	0.5 max.
Low Temperature Brittleness	ASTM D746	No sign of failure @ 35 F
Accelerated Aging	CRD-C-572	
Tensile Strength (psi)		1,500 min.
Elongation (%)		300 min.
Effect of Alkali in 7 Days	CRD-C-572	
Weight Change (%)		-0.10 to + 0.25
Hardness, Type A Durometer		± 5 max.
Tensile Strength Change (%)		-15 max.

2. Dimensions

- a. Expansion Joints: 9 inches long by 3/8-inch web with a 3/4-inch diameter center bulb.
- b. Construction and Control Joints: 6 inches long by 3/8-inch web with a 1/4-inch diameter center bulb.

B. Rubber Waterstops

1. Rubber waterstops shall be extruded from high quality styrene butadiene synthetic rubber or from natural rubber.
2. Rubber waterstops shall conform to CRD-C-513 and have the following physical properties:

MATERIALS AND PERFORMANCE – SECTION 03251

JOINTS FOR CONCRETE

<u>Property</u>	<u>Requirement</u>
Shore A Durometer Hardness	60 min.
Elongation (%)	450
3. Dimensions	
a. Expansion Joints: 9-inch center bulb type.	
b. Construction and Control Joints: 6-inch flat dumbbell type with a minimum of 3/8-inch web.	
C. Steel Plate Waterstops	
1. Steel waterstops shall be free of mill scale and other foreign matter.	
2. Dimensions	
a. 7-inch by 1/4-inch, with a minimum section length of 6 feet.	

PART 3 - EXECUTION

3.01 JOINT PREPARATION

- A. The joint surface of concrete previously placed shall be clean, moist, true to level and reasonably rough, with some coarse aggregate exposed. All laitance and loose mortar shall be removed.
- B. The surface of the joint shall be prepared prior to pouring. The joint shall be cleaned by wire brushing if necessary.
- C. Protect the joint until concreting is resumed.
- D. Hardened concrete shall be saturated for a period of six (6) hours and all excess moisture and all loose or foreign material shall be removed before new concrete is placed at joint.
- E. Precede new concrete by about 1/2 inch of soft mortar of the same proportions as that in the concrete. When accessible, this shall be rubbed into the surfaces of the joint.
- F. In column forms and other deep narrow forms, the concrete placement shall be started with an oversanded mix of 5/8-inch maximum aggregate with an extra sack of cement per cubic yard and with a 5-inch slump. This mix shall be placed several inches deep on the construction joint. Do not use a mortar layer.

MATERIALS AND PERFORMANCE – SECTION 03251

JOINTS FOR CONCRETE

- G. Waterstops shall be placed continuous around corners and intersections. Splices shall be made in accordance with the manufacturer’s recommendations.
- H. Splices of rubber waterstops shall be made with accessories supplied by the manufacturer and in accordance with instructions.
- I. Steel waterstops shall be made by lapping the two steel plates a minimum of 8 inches and tack welding each end.

3.02 **INSTALLATION**

A. **Expansion Joints**

- 1. Discontinue reinforcing steel, steel plate waterstops, corner protection angles, metal frames, and other fixed items embedded or bonded to concrete.
- 2. Place parallel concrete reinforcement 2 inches on each side of joint.
- 3. Provide slightly rounded or 3/4-inch chamfer, as shown on the Contract Drawings. Finish all edges neatly around the joint.

B. **Construction Joints**

- 1. Generally, the locations of construction joints are shown on the Contract Drawings. Where joints are not shown, it shall be the _____ Contractor’s responsibility to provide construction joints in locations suitable to operations and in locations that are in conformance with good concrete construction practice and as specified herein.
- 2. All horizontal construction joints shall have steel waterstops except as directed by the _____, in writing.
- 3. To minimize shrinkage effects, do not pour long, continuous walls or slabs at one time. The following tables give maximum pour lengths:

a. Rectangular slab* pours shall conform to this table:

<u>Short Side “S”</u>	<u>Long Side “L”</u>
20 ft.	L must be 4 x “S” ft.
20-30 ft.	L must be 80 ft.
30-40 ft.	L must be 70 ft.
40-60 ft.	L must be 60 ft.

MATERIALS AND PERFORMANCE – SECTION 03251

JOINTS FOR CONCRETE

- b. Circular slab* pours shall have a maximum surface area of less than 3,600 square feet.

* If pour exceeds the dimensions given in the tables, the slab shall be poured in alternating patterns conforming to the tables.

- c. Wall pours* shall be limited to 30 feet in horizontal dimension. Horizontal construction joints in walls are not permitted except as detailed on the Contract Drawings or as approved by the _____.

* If the walls exceed 30 feet, pour the wall in an alternating pattern.

- 4. Beam and girder construction joints shall conform to the following criteria:

- a. Locate construction joint at approximately the quarter-point of the span, but in no case shall the joint be located within twice the beam depth of an intersecting beam or girder. If a construction joint is desired within a beam, the shear reinforcement must be modified to meet the requirements of the American Concrete Institute by: 1) providing inclined stirrups, or by 2) the roughening of the joint surface or by providing a shear key in the joint surface and providing additional longitudinal reinforcement.

- 5. Column and pier construction joints shall be placed at the underside of the deepest beam or girder framing into the column.

- 6. Concrete reinforcement shall be continuous through all construction joints. Reinforcement shall be kept clean.

- 7. Provide additional reinforcing bars, No. 4 at 12 inches by 4-foot long centered in each vertical construction joint.

- 8. Provide keyways and waterstops as shown on the Contract Drawings.

C. Control Joints

- 1. Locate and construct control joints as shown on the Contract Drawings.

- a. Wall control joints shall be made at 15-foot intervals in long uninterrupted walls greater than 45 feet in length.

MATERIALS AND PERFORMANCE – SECTION 03251

JOINTS FOR CONCRETE

- b. Slab control joints shall be made using a pre-molded joint filler or by saw-cutting. Saw-cutting shall be done after the surface is firm enough not to be damaged by the cutting blade.

D. Joints Connecting Old and New Work

- 1. Construct as shown on the Contract Drawings.
- 2. Thoroughly clean and roughen existing surfaces before application of the bonding agent.
- 3. Make all joints watertight.

- END OF SECTION -