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**SECTION 03 38 00  
POST-TENSIONED CONCRETE**

**PART 1 - GENERAL**

**1.01 RELATED DOCUMENTS**

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections apply to this section.
- B. Related work in other Sections related to Post-tensioned Concrete include:
  - 1. Section 014529 Structural Testing Laboratory Services.
  - 2. Section 031000 Concrete Forming and Accessories.
  - 3. Section 032000 Concrete Reinforcing.
  - 4. Section 033000 Cast-In-Place Concrete.

**1.02 STANDARDS**

- A. The following Standards are listed in this specification.

ASTM A 416	Standard Specification for Steel Strand, Uncoated Seven-Wire for Prestressed Concrete
ASTM C 33	Standard Specification for Concrete Aggregate
ASTM C 150	Standard Specification for Portland Cement
ASTM E 328	Recommended Practice for Stress Relaxation Test for Materials and Structures

U.S. Corps of Engineers Method CRD-C611.

**1.03 SCOPE OF WORK**

- A. The post-tensioning supplier and installer shall furnish all labor, materials, services, and equipment required to produce a complete post-tensioned structural system. The work shall include the following items:
  - 1. Furnishing all post-tensioning materials including prestressing steel, anchorages, wedges, pocket formers, couplers, plates, support bars, chairs, tendon enclosures, and bursting reinforcement.
  - 2. Placing of all items listed above.
  - 3. Performing all post-tensioning operations including stressing, anchoring, trimming, encapsulating tendon anchors, and grouting pockets.
  - 4. Cooperating with the Owner's Testing Laboratory in their function of recording and reporting tendon elongation and tension applied to the prestressing steel.
  - 5. Performing all engineering required to fully design a post-tensioning system that complies with the final force and tendon profiles as shown on the structural drawings and to prepare complete shop drawings and field placing drawings.
- B. Tendons shall be unbonded as show on the drawings.

**1.04 REFERENCE STANDARDS AND CODES**

- A. American Concrete Institute (ACI):
  - 1. ACI 301.
  - 2. ACI 308.



3. ACI 318.
- B. American Society for Testing and Materials (ASTM):
  1. ASTM A 416.
  2. ASTM E 328.
- C. Concrete Reinforcing Steel Institute (CRSI): “Manual of Standard Practice”, CRSI MSP-2.
- D. Post-Tensioning Institute (PTI):
  1. “Specification for Unbonded Single Strand Tendons”.
  2. “Field Procedure Manual for Unbonded Single Strand Tendons”.
  3. “Post-Tensioning Manual”, Fifth Edition.
- E. Local Building Code.

#### **1.05 SYSTEM DESCRIPTION**

- A. Unbonded post-tensioning system described herein is intended to perform without long-term corrosion or other distress. Tendon sheathing and grease shall be as specified herein.

#### **1.06 SUBMITTALS**

- A. Due to the interdependent nature of Sections “031000 – Concrete Forming and Accessories”, “032000 – Concrete Reinforcing”, “033000 - Cast-In-Place Concrete” and “033800 - Post-Tensioned Concrete,” the Contractor shall review all supplier’s shop drawings/field-placing drawings against each other and inform Architect/Engineer of any potential interferences or conflicts.
- B. Shop Drawings/Field-Placing Drawings: Submit for review and approval. Drawings shall include but not be limited to the following:
  1. Tendon layout, including dimensions, which locates the tendons in the horizontal plane. Detail horizontal curvature of tendons at block-outs, openings, and anchorages, and show all openings in slabs and beams. Clearly designate each tendon.
  2. Tendon profiles showing support heights and locations, and any required support steel. Clearly show the location of each tendon and the method of support.
  3. Details of reinforcement around stressing pockets, closures, and openings, including bursting reinforcement, and any interference with tendons. Coordinate with mild reinforcing steel drawings as required.
  4. Details of anchorages, the positive connection between the anchorage and sheathing, pocket formers, couplers, and other related hardware.
  5. Details of the method for sealing the anchorage recesses after the tendon stressing tails have been removed.
  6. Clearance requirements for the hydraulic equipment and the dimensions of any stressing pockets required.
  7. Sequence of construction, including installation, pouring, and stressing sequences. Show all construction joints and related tendon details.
  8. Shop drawings shall be signed and sealed by a qualified professional engineer, licensed in the state where the project is located, who was in responsible charge of the drawing preparation.
- C. Manufacturer's Data: Submit for review and approval.
  1. Sample hardware, including but not limited to: Anchorage system, coated strand, wedges, pocket formers, and other sub-assemblies required for complete installation

- including all accessories required to complete the system. Submit evidence of approval by the International Conference of Buildings Officials (ICBO) or other agencies of equal stature.
2. Post-tensioning system brochures.
  3. Complete post-tensioning procedure, including but not limited to: Stressing system, method of determining anchor force, method of determining tendon slack, and method of cutting off excess strand after anchorage.
  4. Mill Certificates: Submit certified mill reports of post-tensioning steel immediately upon shipment indicating compliance with specified requirements for all material that is to be delivered to the project.
  5. Equipment Calibration: Submit certification of the calibration of all ram and gauge sets to the Architect/Engineer as specified herein.
  6. Certifications and other data as may be further required to demonstrate compliance with other items in this section.
- D. Calculations:
1. Submit calculations showing all engineering required to fully design the post-tensioning system, including friction loss calculations, bursting reinforcement calculations, number of prestressing tendons, anchorage and coupling systems, tendon supports, and tendon stressing procedures, as required to fully comply with the final force and tendon profiles as shown on the structural drawings. The design shall be in accordance with the requirements of ACI 318. Submit tendon manufacturer's data that documents the wobble and curvature friction coefficients used in the friction loss calculations. Clearly show on the shop drawings the values of wobble and curvature coefficients used in the design
  2. Post-Tensioning Supplier shall secure the services of a qualified professional engineer, licensed in the state where the project is located, to provide the design as specified above. Calculations shall be signed and sealed by the professional engineer and shall be submitted to Architect/Engineer for Owner's record only.
  3. Review of shop drawings and calculations by the Architect/Engineer will not relieve the Post-Tensioning Supplier of responsibility for final design as specified herein.
  4. By offering a proposal or entering into a contract for work of this Section, Post-Tensioning Supplier accepts the general design shown on the drawings as adequate for compliance with performance requirements at no additional cost to the Owner.
  5. Post-Tensioning Supplier shall be responsible for furnishing support and bursting steel quantities to the Contractor.
- E. Stressing Records: The contractor shall provide the appropriate cooperation and access to the Owner's Testing Laboratory to allow them to measure, record, and clearly report the following information. In the absence of a Testing Laboratory representative, the post-tensioning installer shall measure, record, report and submit the information described below. Submit records to the Architect/Engineer for approval within 24 hours after stressing.
1. Floor, pour, and tendon identification numbers.
  2. Calculated elongation and actual measured elongation for each jacking point, and totals for each tendon.
  3. Stressing ram number, initial and final gauge load reading during stressing for each tendon.
  4. Date of stressing operation and signature of the Contractor's stressing personnel and inspector witnessing the operation.

5. Range of allowable elongations for jacking force or a measure of the deviation of the measured elongations from the calculated elongations. Deviations that do not comply with the specified tolerances shall be noted for the Architect/Engineer to review.
  6. Obvious irregularities or stress loss during anchoring procedures.
  7. Required and actual concrete strength at time of jacking.
- F. Record Drawings: The Contractor shall provide record drawings to the Owner, in care of the Architect/Engineer, of any approved changes from the contract documents. Form of record drawings may be legible marked-up prints of contract drawings, or separate drawings of same scale.
- G. Review:
1. After review, shop drawings/field-placing drawings and data shall not be changed nor shall construction operations be deviated from, unless resubmitted under a cover letter delineating such change and reapproved.
  2. Review of details and construction operations will not relieve the Contractor of his responsibility for completing the work successfully in accordance with the contract drawings and specifications.

#### **1.07 QUALITY ASSURANCE**

- A. Qualifications: The supply and installation of post-tensioning shall be executed by organizations that have successfully performed major work of a nature similar to that involved in this project for a minimum of five (5) years and have successfully completed a minimum of five (5) similar projects in own name, unless this requirement is waived by the Architect/Engineer prior to Contract award. The Contractor shall submit supporting evidence acceptable to the Architect/Engineer that this qualification has been met. Post-tensioning shall be performed using methods and related equipment that are in conformance with generally accepted systems of post-tensioning. Experienced individuals shall control and supervise all operations.
- B. Material Quality Assurance: The post-tensioning material shall be produced by a plant that is fully PTI-certified at the time of bidding, and that shall maintain this certification throughout the duration of this project as described in the Post-Tensioning Institute's "Manual for Certification of Plants Producing Unbonded Single Strand Tendons."
- C. Installer Quality Assurance: All installers of unbonded post-tensioned tendons shall be certified under the Post-Tensioning Institute's "Post-tensioning Certification Program of Field Personnel for Unbonded Post-tensioning Installers".
- D. Inspection and Testing: Inspection and testing shall be provided in accordance with Testing Laboratory Services section of the Specification.
- E. Source Quality Control:
1. If requested by the Architect/Engineer, take two (2) strand samples from one end of each coil at the fabrication plant prior to greasing and sheathing. The Post-Tensioning Supplier shall notify the Architect/Engineer when the coils are ready to be sampled.
  2. Furnish all materials and handling which testing agency requires. Submit certification by the Post-Tensioning Supplier that any submitted samples are representative of the material to be furnished.
  3. Package the post-tensioning strands at the supplier's fabrication facility in a manner that prevents damage to strand and protects strand from moisture during transportation and storage.

- F. Field Quality Control:
1. The Contractor shall maintain a consistent and good standard of workmanship. Check bulkheads, position of anchorages, tendon chairing and tying, location, size and placement of reinforcement, and tendon quantity.
  2. Prior to pouring concrete, at a frequency as established for the project, an inspection of the tendons and mild reinforcing steel shall be made by the Architect/Engineer, or Independent Testing Agency.
  3. Inspection of stressing operations shall also be performed as directed by the Architect/Structural Engineer.
  4. The Contractor shall cooperate with the Owner's Testing Laboratory in their efforts to record tendon elongations. The Contractor shall keep a copy of the stressing records with the shop drawings.
  5. Submit certificates of all ram and gauge calibrations used on the project to the Architect/Engineer. Use of non-calibrated ram and gauge sets are not allowed on this project. If requested by the Architect/Engineer, Owner, or Field Inspector, the Contractor shall have the ram and gauge sets calibrated by an Independent Testing Agency, the cost of which shall be borne by the Contractor.
  6. Manufacture and deliver tendons in sequence and quantity to avoid lengthy job site storage.
  7. Satisfactorily protect all prestressing steel from all moisture and rust or other physical damage prior to placement and keep steel free from deleterious substances, such as chlorides, fluorides, sulfites and nitrates. Provide protection for exposed prestressing steel beyond ends of members to prevent deterioration by rust or corrosion.
  8. Do not store post-tensioning strand in such a manner that it is in direct contact with soil or fresh concrete or exposed to rain, snow, de-icing salts or other corrosive elements. Protect materials stored for more than one month from exposure to sunlight.
  9. Damage to tendon sheathing in excess of 2% of its length shall be grounds for rejection of sheathing.
  10. Contractor shall inspect tendon sheathing for damage and to verify watertight seal between sheathing and anchor. Repair all damaged sheathing.

## **PART 2 – PRODUCTS**

### **2.01 POST-TENSIONING STEEL**

- A. Strand: Prestressing steel shall use strand conforming to ASTM A416, Low-Relaxation Type, and shall have a minimum guaranteed ultimate tensile strength of 270,000 psi based on the nominal area of the strand. The strand shall additionally conform to the "Specification for Unbonded Single Strand Tendons", by PTI. The strand shall be free of dirt, corrosion or injurious marks, scratches, seams, and sharp kinks. Oil-tempered strand is prohibited. Certified mill reports giving name of drawing mill shall be submitted.
- B. Identification: All prestressing steel within every group or in the same member shall be of the same heat where practical. All tendons shall be assigned a proper heat and coil number and so identified on fabrication lists that are to be sent to the field with each shipment. Identify tendons in accordance with placing drawings. Unidentified steel shall not be allowed unless approved by the Architect/Engineer and tested.
- C. Sheathing: All post-tensioning tendons shall be coated and sheathed with an approved slippage sheathing designed to prevent the intrusion of cement paste and the loss of the

### **POST-TENSIONED CONCRETE**

#### **SECTION 03 38 00 - 5**

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Bid Addendum #1

- coating material and be watertight and impermeable to water vapor over the entire length. Such sheathing shall enclose the prestressing steel that shall then be placed in the forms prior to placement of concrete. The sheathing shall be continuously extruded medium or high-density polyethylene or polypropylene with a minimum thickness of 50 mils and an inside diameter at least .03 inches greater than the maximum diameter of the strand. The sheathing shall not rupture due to normal temperature changes, coiling and field handling. The sheathing material shall be chemically stable, without embrittlement or softening over the anticipated exposure temperature range and service life of the structure. It shall be non-reactive with concrete, prestressing steel, reinforcing steel, and P-T coating. Heat-sealed or plastic-wrapped sheathing is not acceptable.
- D. Coating: The P-T coating shall lubricate the tendon and permanently protect the prestressing steel against corrosion. It shall resist flow caused by gravity within the anticipated temperature range of exposure and provide non-brittle coating at the lowest anticipated temperature of exposure. It shall be chemically stable and non-reactive with prestressing steel, reinforcing steel, sheathing material, and concrete. The P-T coating shall be applied under pressure to ensure the filling of the interstices between the individual wires of the strand. There shall be no voids or pockets between the sheathing and the coated strand for water or air to collect. The minimum amount of coating on the prestressing strand shall be 2.5 pounds of material per 100 feet of strand for a 0.5-inch diameter strand and 3.0 pounds per 100 feet for a 0.6 inch diameter strand. The P-T coating shall satisfy the requirements of table 1 of ACI 423.6," Specification for Unbonded Single-Strand Tendons and Commentary".
- E. Repair tape: The tape used to repair damaged sections of sheathing or to wrap exposed strand shall be a minimum of 2 inches wide and shall be of a color that contrasts with the sheathing. The tape shall be self-adhesive and moisture-proof and shall be non-reactive with the sheathing, coating, prestressing steel, or concrete.

## 2.02 ANCHORAGES AND COUPLERS

- A. Anchor:
1. Anchoring hardware shall be steel and shall meet the minimum requirements set forth in ACI 318, except as modified herein. The anchorage shall be capable of developing at least 95% of the minimum specified ultimate strength of the prestressing steel without exceeding anticipated set, and shall be capable of passing the static and dynamic tests as outlined in Chapter 3 of the PTI Post-Tensioning Manual, Fifth Edition. All anchorages, couplers, and miscellaneous hardware shall be the standard products as manufactured by the Post-Tensioning Supplier, unless shown otherwise, and shall be approved by the International Conference of Buildings Officials, or other agencies of equal stature, and the Architect/Engineer.
- B. Size: Anchorages and distribution (bearing) plates shall be sized according to ACI 318 unless certified test reports are submitted proving acceptable deviation. Bursting steel shall be designed by the Post-Tensioning Supplier consistent with the anchorage to be provided.
- C. Embedment: Anchorages at slab edges or beam ends shall be recessed a minimum of 1 ½ inches. At construction joints, all anchorages or tendon force distribution plates (bearing plates) shall be embedded in the first of the consecutive pours. Flat back castings, plates, etc. which are placed against previously cast concrete and then stressed shall not be allowed. Washer type grommets shall be used at construction joints if grout exclusion is necessary for the embedded item. Normal depth pockets at intermediate construction joints shall not be

used unless adequate measures are taken to ensure that the pocket is completely filled with concrete during subsequent pours.

- D. Seating loss: Maximum allowable anchor slip or seating loss shall be 1/4 inch.

### **2.03 CONCRETE**

- A. The concrete shall have a minimum 28-day strength as specified on the drawings with minimum strength at transfer of prestress force equal to 75% of the 28-day compressive strength but not less than 3750 psi unless otherwise specified on the Contract Drawings. Components or admixtures with chloride, fluoride, sulphite or nitrate ions or any other substance deleterious to prestressing steel shall not be used.

### **2.04 TENDON SUPPORT SYSTEM**

- A. Slab Tendons: Support points shall consist of a bar support and continuous orthogonal steel as shown on the Contract Drawings. Bar supports shall be plastic, plastic tipped, epoxy coated or stainless steel.
- B. Beam Tendons: Supports shall consist of reinforcing steel tied between stirrup legs as shown on the Contract Drawings.

### **2.05 PRE-CONSTRUCTION CONFERENCE**

- A. At least 30 days prior to post-tensioned concrete construction, the Contractor shall hold a meeting to review the detailed requirements for preparing the concrete design mixes and to determine the procedures for producing proper post-tensioned concrete construction. Also review requirements for submittals, status of coordinating work and availability of materials. Establish work progress schedule and procedures for materials inspection, testing and certifications
- B. The contractor shall require responsible representatives of every party who is concerned with the post-tensioned concrete work to attend the conference, including but not limited to the following:
1. Contractor's Superintendent
  2. Laboratory responsible for the concrete design mix
  3. Laboratory responsible for field quality control
  4. Concrete Subcontractor
  5. Post-Tensioning Supplier
  6. Post-Tensioning and Mild-Reinforcement Installer
  7. Ready-Mix Concrete Producer
  8. Admixture Manufacturer(s)
  9. Concrete Pumping Equipment Manufacturer
  10. MEP Subcontractor
  11. Owner's and Architect's/Engineer's Representative
  12. Engineer-of-Record
- C. Minutes of the meeting shall be recorded, typed, and printed by the Contractor and distributed to all parties concerned within 5 days of the meeting. One copy of the minutes shall be transmitted to the following for information purposes.
1. Owner's Representative
  2. Architect
  3. Engineer-of-Record

- D. The Contractor shall coordinate the scheduled date of the conference with the Architect/Engineer

### **PART 3 - EXECUTION**

#### **3.01 POST-TENSIONING STEEL PLACEMENT**

- A. Profile: Post-tensioning tendons shall conform to the control points shown on the Contract Drawings and approved shop drawings and shall have a parabolic drape between supports unless noted otherwise. Harped tendons shall be straight between control points as shown on the drawings. Dimensions locating this profile apply to the center of gravity of the tendons. Low points of the tendons are at mid-span unless noted otherwise. Place the tendons normal to anchorage plates.
- B. Interference: Slight deviation in spacing of the slab tendons is permitted where required to avoid openings and inserts that are specifically located. Where interference occurs, contact the Architect/Engineer before moving any tendons. Coordinate the placement of mild steel reinforcement with placement of post-tensioning tendons. Proper tendon location has priority.
- C. Tolerances: Firmly support tendons and anchorages to prevent displacement during subsequent operations. Place them with a tolerance of plus or minus 1/8 inch in concrete dimensions of 8 inches or less, plus or minus 1/4 inch in concrete dimensions over 8 inches but not over 2 feet, and plus or minus 1/2 inch in concrete dimensions over 2 feet. These tolerances apply separately to both vertical and horizontal dimensions and might be different for both directions. In no case shall tendons violate the absolute minimum cover stated in ACI 117. Horizontal sweeps to miss openings, inserts, etc. shall have minimum radius of 25 feet and shall not exceed a maximum slope of 1:6. Maintain a minimum clearance of 6 inches at all openings. Twisting or entwining of individual tendons within a bundle is not permitted.
- D. Tendon Spacing: Maximum spacing of slab tendons shall be eight (8) times the thickness of the slab, but not greater than 60 inches, unless otherwise noted on the Contract Drawings. Bundle tendons in such a manner to allow proper concreting and the maintenance of the center of gravity of steel (C.G.S.).
- E. Supports: Provide a sufficient number of horizontal and vertical positioning supports to firmly support tendons to prevent displacement due to construction operations. Spacing of supports shall not exceed 3'-6" on center. Show all support devices on the shop drawings.
- F. Welding: Welding of cross bars or any welding in the vicinity of the tendons is not allowed. Do not use post-tensioning tendons as an electrical ground for welding operations.
- G. Sheathing:
1. The sheathing shall be continuous from end to end of all stressing anchorages and all embedded dead ends including intermediate anchorages, unless shown otherwise on the Contract Drawings, or otherwise approved by the Architect/Engineer.
  2. Exposed strand shall be spirally wrapped with polyethylene adhesive tape in a double layer from the end of the sheathing to the back of the anchor.
  3. After installing the tendons and prior to concrete placement, inspect the sheathing on each tendon for its entire length to detect possible damage. Repair any detected tears or abrasions by procedures conforming to the "Field Procedures Manual for Unbonded

Single Strand Tendons” by PTI. The repair of sheathing shall prevent intrusion of cement paste or loss of coating.

- H. Couplers: Do not use tendon couplers without prior approval of the Architect and Structural Engineer.

### **3.02 ANCHORAGES AND BLOCK-OUTS**

- A. Bursting Reinforcement:

1. Provide bursting reinforcement behind anchorages as required by calculations subject to the following minimums:
  - a. Slab: Provide two-#4 bars, one above and one below the tendon, continuous along concrete edges behind slab anchorages. Provide a #3 hairpin with 9” long legs around continuous #4’s between each anchorage. Provide two-#4 corner bars with 3’-6” legs, one each above and below the tendon C.G.S.
  - b. Beam: Provide two-#4 bars, horizontal or vertical, with appropriate development length, behind all beam anchorages.

- B. Block-outs:

1. Adequately reinforce all block-outs or pockets required for anchorages so as to not decrease the strength of the structure.
2. Do not coat block-out forms or pocket formers with grease, form oil, or any other substance that will decrease the bonding capacity of the patching grout to the surrounding concrete.

### **3.03 CONCRETE PLACEMENT**

- A. Formwork: Design of the formwork shall take into account the possibility of the slab or girder lifting off the formwork during tensioning, thereby transferring the entire load to the support areas. Construct the formwork to permit movement of the member without damage during application of the post-tensioning force. Supporting forms in post-tensioned areas are not to be removed until concrete is fully stressed. The Contractor shall submit his proposed shoring and reshoring schemes prior to commencement of forming work.
- B. Construction Joints: Locate construction joints at or near where the C.G.S. coincides with the center-of-gravity of the concrete section unless otherwise approved by the Architect/Engineer. The contractor shall submit construction joint locations in post-tensioned members to the Architect/Engineer for approval.
- C. Inserts, Anchors, and Coring: All inserts and anchors for suspended mechanical and architectural work shall be cast-in-place wherever feasible. Additional fasteners will be permitted only when it can be shown that the inserts will not spall concrete and are located so as to avoid hitting tendons or anchorages. The Contractor shall identify tendon locations on the surface of the slab if drilling or coring is to be done after concrete is placed.
- D. Placement: Place the concrete in conformance with the requirements of the Specifications. Do not place the concrete until the Architect/Engineer, or Independent Testing Laboratory has inspected the placement of the mild steel reinforcement and tendons at the frequency established for the project. Place the concrete in such a manner as to ensure that alignment of post-tensioning tendons remains unchanged. Make special provisions to ensure proper vibration of the concrete around the anchorage plates. Monitor the tendon positioning during the concrete placement. All floors below the level that is to have concrete placement shall



have been stressed before this concrete is placed, unless the shoring has been designed for the ensuing loads.

- E. Openings: Openings shall not be cut into cast concrete without the approval of the Architect/Engineer.

### **3.04 STRESSING**

- A. Methods: Perform post-tensioning by methods and related equipment that are in conformance with generally accepted systems of post-tensioning. Variations of such generally accepted methods and equipment will be permitted with Architect/Engineer approval, provided equal results can be obtained.
- B. Concrete Strength: Do not begin the post-tensioning operations until tests or readings have indicated that the concrete in the members has attained a compressive strength that is adequate for the requirements of the anchorages but not less than 75% of the 28 day compressive strength nor 3750 psi unless otherwise specified on the Contract Drawings. See Concrete Formwork section for acceptable methods for determining in situ concrete strengths.
- C. Equipment: Stress all tendons by means of hydraulic rams, equipped with accurate reading hydraulic pressure gauges that have been individually calibrated with a particular ram to permit the stress in the prestressing steel to be computed at any time. A certified calibration curve shall accompany each ram and gauge set. Immediately recalibrate the ram and gauge set if inconsistencies between the measured elongation and the gauge reading occur.
- D. Forces: Anchor the prestressing steel at an initial or anchor force that will result in the ultimate retention of the working or effective force shown on the plans. Jacking forces shall be those indicated on the shop drawings. The length of a tendon pull more than that shown by the required friction calculations or more than 125 feet for a one-way pull or 250 feet for a two-way pull is not permitted unless it is justified by calculations and specifically approved by the Architect/Engineer. The Field Inspector shall verify the wobble and curvature friction coefficients during the stressing operation and shall report to the Post-Tensioning Engineer deviations greater than 10% from the values assumed in the design. Required adjustments to the stressing operation shall be recommended by the Post-Tensioning Engineer and approved by the Architect/Engineer.
- E. Elongations: Keep records of all tendon elongations as previously described in this Section. Agreement within 7% between the gauge reading and the measured elongation and between the measured and the calculated elongation after stressing will be considered satisfactory. Deviations greater than 7% will be reported to the Architect/Engineer prior to completing stressing operation. No tensioning will be permitted until it is demonstrated that the prestressing steel is reasonably free and unbonded in the enclosure. Evidence that the steel is unbonded will be considered satisfactory if inward movement of steel is observed at one end of the tendon when a nominal pull is applied to the steel at the other end. The Architect/Engineer may order a force/elongation check at any time. Do not cut off tendons until elongation records have been reviewed and approved in writing by the Architect/Engineer.
- F. Stressing Sequence: The stressing sequence shall be as shown on the approved shop drawings. Use the following general stressing sequence except as otherwise noted or approved by the Architect/Engineer.
- G. Banded Slab:

1. Beam and Slab:
  - Step #1. Stress temperature tendons, if applicable.
  - Step #2. Stress continuous longitudinal slab tendons.
  - Step #3. Stress added longitudinal slab tendons.
  - Step #4. Stress continuous beam tendons.
  - Step #5. Stress added beam tendons.
  - Step #6. Stress girder tendons, if applicable.

H. Safety: Precautions shall be taken to prevent workers from standing directly behind, above or in front of the stressing rams.

### **3.05 GROUTING ANCHORAGE RECESSES**

- A. Cut the tendon tails within 24 hours after the stressing records have been approved. Cut off the excess strand at least 1/2 inch inside the face of the finished concrete surface, and not more than 3/4 inch from the face of the anchorage. Cutting may be done by means of oxyacetylene cutting, abrasive wheel, or hydraulic shears. Do not allow the wedges to become heated.
  1. Coat the anchorage recesses with an approved bonding agent and fill flush with a non-shrink, non-stain, chloride free grout compatible for use with prestressing steel or approved equal. Do not allow contamination of the anchorage recess surface that reduces the bonding capacity of the non-shrink grout.

### **3.06 INSTALLATION SUPERVISION**

- A. The duties of the post-tensioning installer's supervisor shall include:
  1. Check tendon placement before and during pouring of concrete. Be present during pours and check for tendons being moved out of position.
  2. Mark tendons prior to stressing and verify with the Owner's Testing Laboratory that all initial marks are accurate.
  3. Observe that tendon elongation measurements are made and recorded by Testing Laboratory or, in the absence of a Testing Laboratory representative, measure, record and report tendon elongations after stressing and submit copy of original to Architect/Engineer.
  4. Compare results of actual tendon elongations with hydraulic ram gage reading and with calculated elongation.
  5. Require checking of tendon force and/or elongation if requested by the Architect/Engineer.
  6. Do not allow cutting of tendons without the Architect/Engineer's written approval.

END OF SECTION

## SECTION 06 15 16 WOOD ROOF DECKING

### PART 1 - GENERAL

#### 1.01 SUMMARY

- A. Section includes solid-sawn wood roof decking
- B. Related Sections include Division 06 Section "Miscellaneous Rough Carpentry" for dimension lumber items associated with wood roof decking.

#### 1.02 ACTION SUBMITTALS

- A. Product Data: For each type of product.
  - 1. ~~For glued laminated wood roof decking, include installation instructions and data on lumber, adhesives, and fabrication.~~
  - 2. ~~For preservative treated wood products, include chemical treatment manufacturer's written instructions for handling, storing, installing, and finishing treated material.~~
- B. Samples: 24 inches long, showing the range of variation to be expected in appearance of wood roof decking.

#### 1.03 DELIVERY, STORAGE, AND HANDLING

- A. Schedule delivery of wood roof decking to avoid extended on-site storage and to avoid delaying the Work.
- B. Store materials under cover and protected from weather and contact with damp or wet surfaces. Provide for air circulation within and around stacks and under temporary coverings. Stack wood roof decking with surfaces that are to be exposed in the final Work protected from exposure to sunlight.

### PART 2 - PRODUCTS

#### 2.01 WOOD ROOF DECKING, GENERAL

- A. General: Comply with DOC PS 20 and with applicable grading rules of inspection agencies certified by ALSC's Board of Review.

#### 2.02 SOLID-SAWN WOOD ROOF DECKING

- A. Standard for Solid-Sawn Wood Roof Decking: Comply with AITC 112.
- B. Roof Decking Species: Douglas fir.
- C. Roof Decking Nominal Size: As indicated on Drawings.
- D. Roof Decking Grade: Western woods; Select(ed) Decking or Select Dex.
- E. Grade Stamps: Factory mark each item with grade stamp of grading agency. Apply grade stamp to surfaces that are not exposed to view.
- F. Moisture Content: Provide wood roof decking with 15 percent maximum moisture content at time of dressing.

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- G. Face Surface: Sandblast exposed surfaces.
- H. Edge Pattern: Vee grooved.

### **2.03 PRESERVATIVE TREATMENT**

- ~~A. Pressure treat wood roof decking according to AWWPA U1; Use Category UC2.~~
- ~~B. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium.
  - 1. For exposed items indicated to receive a stained or natural finish, use products that do not contain colorants, bleed through, or otherwise adversely affect finishes.~~
- ~~C. Use process that does not include water repellents or other substances that might interfere with application of indicated finishes.~~
- ~~D. After treatment, redry materials to 15 percent maximum moisture content.~~

### **2.042.03 ACCESSORY MATERIALS**

- A. Fasteners for Solid-Sawn Roof Decking: Provide fastener size and type complying with AITC 112 for thickness of deck used.
- B. Fasteners for Glued-Laminated Roof Decking: Provide fastener size and type complying with requirements in "Installation" Article for installing laminated roof decking.
- C. Nails: Common; complying with ASTM F 1667, Type I, Style 10.
- D. Fastener Material: Hot-dip galvanized steel.
- E. Bolts for Anchoring Roof Decking to Walls: Carbon steel; complying with ASTM A 307 with ASTM A 563 hex nuts and, where indicated, flat washers, all hot-dip zinc coated.
- F. Installation Adhesive: For glued-laminated wood roof decking indicated to be of diaphragm design and construction, provide adhesive that complies with research/evaluation report.
- G. Sealants: Latex, complying with applicable requirements in Division 07 Section "Joint Sealants" and recommended by sealant manufacturer and manufacturer of substrates for intended application.
- H. Penetrating Sealer: Clear sanding sealer complying with Division 09 Section "Staining and Transparent Finishing" and compatible with topcoats specified for use over it.

### **2.052.04 FABRICATION**

- A. Shop Fabrication: Where preservative-treated roof decking is indicated, complete cutting, trimming, surfacing, and sanding before treating.
- B. Predrill roof decking for lateral spiking to adjacent units to comply with AITC 112.
- C. Seal Coat: After fabricating and surfacing roof decking, apply a saturation coat of penetrating sealer in fabrication shop.

## **PART 3 - EXECUTION**

### **3.01 EXAMINATION**

- A. Examine walls and support framing in areas to receive wood roof decking for compliance with installation tolerances and other conditions affecting performance of wood roof decking.

- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.02 INSTALLATION

- A. Install solid-sawn wood roof decking to comply with AITC 112.

1. Locate end joints for combination simple and two-span continuous lay-up.

- ~~B. Install laminated wood roof decking to comply with manufacturer's written instructions.~~

- ~~1. Locate end joints for combination simple and two-span continuous lay-up.~~
- ~~2. Nail each course of glued laminated wood roof decking at each support with one nail slant nailed above the tongue and one nail straight nailed through the face.
  - ~~a. Use 12d nails for 2 by 6 and 2 by 8 roof decking.~~~~
- ~~3. Glue adjoining roof decking courses together by applying a 3/8 inch bead of adhesive to the top of tongues, according to research/evaluation report.~~

- ~~C.B. Anchor wood roof decking, where supported on walls, with bolts as indicated.~~

- ~~D. Where preservative treated roof decking must be cut during erection, apply a field treatment preservative to comply with AWPA M4.~~

- ~~1. For solid-sawn roof decking, use inorganic boron (SBX).~~

- ~~E.C. Apply joint sealant to seal roof decking at exterior walls at the following locations:~~

- ~~1. Between roof decking and supports located at exterior walls.~~
- ~~2. Between roof decking and exterior walls that butt against underside of roof decking.~~
- ~~3. Between tongues and grooves of roof decking over exterior walls and supports at exterior walls.~~

### 3.03 ADJUSTING

- A. Repair damaged surfaces and finishes after completing erection. Replace damaged roof decking if repairs are not approved by Architect.

### 3.04 PROTECTION

- A. Provide water-resistive barrier over roof decking as the Work progresses to protect roof decking until roofing is applied.
- B. If, despite protection, roof decking becomes wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.

**END OF SECTION**

## SECTION 06 18 00 GLUED-LAMINATED CONSTRUCTION

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section Includes:
1. Framing using structural glued-laminated timber.

#### 1.2 ACTION SUBMITTALS

- A. Product Data: Submit manufacturer's product information, certification, and installation instructions for each type of engineered framing member and accessory indicated. Include test reports and published allowable loads for all fasteners used.
- B. Shop Drawings: Submit shop drawings for all engineered lumber framing used to support exterior cladding, floor or roof framing, ceiling or soffit framing and load-bearing support framing for any floor or roof areas. Shop drawings shall indicate placing of all framing members showing type, size, member thickness, number, location and spacing. They shall also indicate supplemental strapping, bracing, splices, bridging, accessories and details required for proper installation. Shop drawings must indicate type of fastening system used along with size and number of fasteners.
1. Screwed and bolted connections shall show type, size, and number of fasteners for all connections. Submit manufacturer's data giving strength values for screws used.
  2. Connections using anchors shall show product name, embedment, edge distance and spacing.
  3. Shop drawings submitted must be prepared under the supervision of and sealed by a professional engineer licensed in the state where the project is located.
- C. Calculations: Submit calculations for all engineered wood framing members and connections that are prepared and sealed by a professional engineer licensed in the state where the project is located. Calculations shall indicate sizing of members supporting the loads as indicated on the drawings and the design of connections indicating method of connection and
1. Size and length of all welds for welded connections.
  2. Type, size, number and capacity of all screwed or bolted connections.
- D. Deflection Limits: Design framing to withstand loads without deflections greater than the following:
1. Brick back-up: L/600
  2. Stucco back-up: L/600
  3. EIFS back-up: L/360

4. Back-up for glass – L/175 for length less than 13  
L/240 + ¼” for lengths greater than 13’-6” and less than 40’-0”
5. Back-up for metal panel – L/175 – Use 16 gage minimum or as required by the metal panel supplier.
6. *Roof deflection – Reference local IBC.*

~~E. Qualification date for professional engineer~~

### 1.3 INFORMATIONAL SUBMITTALS

- A. Certificates of Conformance: Issued by a qualified testing and inspecting agency indicating that structural glued-laminated timber complies with requirements in AITC A190.1.

### 1.4 QUALITY ASSURANCE

- A. Manufacturer Qualifications: An AITC- or APA-EWS-licensed firm.
- B. Professional Engineer Qualification: A professional engineer who is legally qualified to practice in jurisdiction where project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of engineered wood framing that are similar to those indicated for this project in material, design and extent.
- C. Product Certification: Manufacturer’s material certification or data from a independent testing agency that is qualified according to ASTM E 329 indicating engineered lumber complies with requirements.

### 1.5 DELIVERY, STORAGE, AND HANDLING

- A. General: Comply with provisions in AITC 111.
- B. Individually wrap members using plastic-coated paper covering with water-resistant seams.

## PART 2 - PRODUCTS

### 2.1 STRUCTURAL GLUED-LAMINATED TIMBER

- A. General: Provide structural glued-laminated timber that complies with AITC A190.1 and AITC 117 or research/evaluation reports acceptable to authorities having jurisdiction.
  1. Factory mark each piece of structural glued-laminated timber with AITC Quality Mark or APA-EWS trademark. Place mark on surfaces that are not exposed in the completed Work.

2. Provide structural glued-laminated timber made with wet-use adhesive complying with AITC A190.1.
- B. Unless otherwise indicated, Structural Glued-Laminated Timber shall meet following requirements:
1. Species and Beam Stress Classification: Southern pine, 24F-1.8E.
  2. Lay-up: Either balanced or unbalanced.
- C. Appearance Grade: Premium , complying with AITC 110.

## **2.2 TIMBER CONNECTORS**

- A. Materials: Unless otherwise indicated, fabricate from the following materials:
1. Structural-steel shapes, plates, and flat bars complying with ASTM A36/A36M.
  2. Round steel bars complying with ASTM A575, Grade M 1020.
  3. Hot-rolled steel sheet complying with ASTM A1011/A1011M, Structural Steel, Type SS, Grade 33.
- B. Finish steel assemblies and fasteners with rust-inhibitive primer, 2-mil dry film thickness.
- C. Hot-dip galvanize steel assemblies and fasteners after fabrication to comply with ASTM A123/A123M or ASTM A153/A153M.

## **2.3 MISCELLANEOUS MATERIALS**

- A. End Sealer: Manufacturer's standard, transparent, colorless wood sealer that is effective in retarding the transmission of moisture at cross-grain cuts and is compatible with indicated finish.
- B. Penetrating Sealer: Manufacturer's standard, transparent, penetrating wood sealer that is compatible with indicated finish.

## **2.4 FABRICATION**

- A. Shop fabricate for connections to greatest extent possible, including cutting to length and drilling bolt holes.
- B. Camber: Fabricate horizontal and inclined members of less than 1:1 slope with either circular or parabolic camber equal to 1/500 of span.
- C. End-Cut Sealing: Immediately after end cutting each member to final length, apply a saturation coat of end sealer to ends and other cross-cut surfaces, keeping surfaces flood coated for not less than 10 minutes.



1. Provide mitered inlay at all exposed exterior beam end conditions. Shop fabricate inlay for face grain exposure to match sides of beam, refer to drawing 2/A08.22
- D. Seal Coat: After fabricating, sanding, and end-coat sealing, apply a heavy saturation coat of penetrating sealer on surfaces of each unit.

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION**

- A. General: Erect structural glued-laminated timber true and plumb and with uniform, close-fitting joints. Provide temporary bracing to maintain lines and levels until permanent supporting members are in place.
  1. Handle and temporarily support glued-laminated timber to prevent surface damage, compression, and other effects that might interfere with indicated finish.
- B. Cutting: Avoid extra cutting after fabrication. Where field fitting is unavoidable, comply with requirements for shop fabrication.
- C. Fit structural glued-laminated timber by cutting and restoring exposed surfaces to match specified surfacing.
  1. Predrill for fasteners using timber connectors as templates.
  2. Finish exposed surfaces to remove planing or surfacing marks.
  3. Coat cross cuts with end sealer.

### **3.2 ADJUSTING**

- A. Repair damaged surfaces after completing erection. Replace damaged structural glued-laminated timber if repairs are not approved by Architect.

### **3.3 PROTECTION**

- A. Do not remove wrappings on individually wrapped members until they no longer serve a useful purpose, including protection from weather, sunlight, soiling, and damage from work of other trades.
  1. Slit underside of wrapping to prevent accumulation of moisture inside the wrapping.

**END OF SECTION**

## SECTION 07 19 00 WATER REPELLENTS

### PART 1 - GENERAL

#### 1.01 SUMMARY

- A. Section includes:
  - 1. Film-forming water-repellent treatments for cast-in-place concrete vertical and horizontal surfaces that meets requirements for graffiti removal.
  - ~~A-2.~~ Penetrating water-repellent treatments for horizontal concrete walk surfaces.

#### 1.02 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

#### 1.03 ACTION SUBMITTALS

- A. Product Data: For each type of product.
  - 1. Include manufacturer's printed statement of VOC content.
  - 2. Include manufacturer's recommended number of coats for each type of substrate and spreading rate for each separate coat.
- B. Samples: For each type of water repellent and substrate indicated, 12 by 12 inches in size, with specified water-repellent treatment applied to half of each Sample.

#### 1.04 INFORMATIONAL SUBMITTALS

- A. Product Certificates: For each type of water repellent.
- B. Field quality-control reports.
- C. Sample Warranty: For special warranty.

#### 1.05 QUALITY ASSURANCE

- A. Applicator Qualifications: An employer of workers trained and approved by manufacturer.
- B. Mockups: Prepare mockups of each required water repellent on each type of substrate required to demonstrate aesthetic effects, and to set quality standards for materials and execution.
  - 1. Locate mockups on existing surfaces where directed by Architect in locations that enable viewing under same conditions as the completed Work Insert requirement.
    - a. Size: 25 sq. ft. each.
  - 2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
  - 3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.
- C. Mockups: Provide water repellent products and accessories required to construct integrated exterior mockup specified in Division 01 Section "Mockups."

### **1.06 FIELD CONDITIONS**

- A. Limitations: Proceed with application only when the following existing and forecasted weather and substrate conditions permit water repellents to be applied according to manufacturers' written instructions and warranty requirements:
1. Concrete surfaces and mortar have cured for not less than 28 days.
  2. Building has been closed in for not less than 30 days before treating wall assemblies.
  3. Ambient temperature is above 40 deg F and below 100 deg F and will remain so for 24 hours.
  4. Substrate is not frozen and substrate-surface temperature is above 40 deg F and below 100 deg F.
  5. Rain or snow is not predicted within 24 hours.
  6. Not less than 48 hours have passed since surfaces were last wet.
  7. Windy conditions do not exist that might cause water repellent to be blown onto vegetation or surfaces not intended to be treated.

### **1.07 WARRANTY**

- A. Special Warranty: Manufacturer's standard form in which manufacturer agree(s) to repair or replace materials that fail to maintain water repellency specified in "Performance Requirements" Article within specified warranty period.
1. Warranty Period: Five years from date of Substantial Completion.

## **PART 2 - PRODUCTS**

### **2.01 PERFORMANCE REQUIREMENTS**

- A. Performance: Water repellents shall meet the following performance requirements as determined by testing on manufacturer's standard substrates representing those indicated for this Project.
- B. Water Absorption: Minimum 80 percent reduction of water absorption after 24 hours for treated compared to untreated specimens when tested according to the following:
1. Cast-in-Place Concrete: ASTM C 642.
  2. Precast Concrete: ASTM C 642.
- C. Water-Vapor Transmission: Comply with one or both of the following:
1. Maximum 10 percent reduction water-vapor transmission of treated compared to untreated specimens, according to ASTM E 96/E 96M.
- D. Durability: Maximum 5 percent loss of water-repellent performance after 2500 hours of weathering according to ASTM G 154 compared to water-repellent-treated specimens before weathering.

## 2.02 FILM-FORMING WATER REPELLENTS

- A. Silicone-Resin Sealer, Film-Forming Water Repellent: Clear, polymerized, silicone-resin water repellent for dense substrates; in a solvent- or waterborne solution containing not less than 3 and up to 7 percent solids by weight; and with 100 g/L or less of VOCs.
  - 1. Basis of Design: Design is based on PROSOCO Sure Klean Weather Seal Blok-Guard & Graffiti Control Ultra. Subject to compliance with requirements, provide named product or comparable product approved by Architect.
- B. Provide product that offers graffiti removal with use of manufacturer's graffiti removal agent.

## 2.03 PENETRATING WATER REPELLENTS

- A. Silane, Penetrating Water Repellent: Clear, containing 50 percent or more solids of alkyltrialkoxysilanes; with alcohol, mineral spirits, water, or other proprietary solvent carrier; and with 350 g/L or less of VOCs.
  - 1. Basis of Design: Design is based on PROSOCO, Inc. SLX100 Water & Oil Repellent. Subject to compliance with requirements, provide named product or comparable product approved by Architect.
  - 2. Provide product with the following characteristics:
    - a. Treated surfaces "breathe" (do not trap moisture).
    - b. Resists oil and food stains.
    - c. Does not form a surface film or gloss.
    - d. Excellent surface beading when compared with conventional "neat" silanes.
    - e. Safe for use on surfaces subjected to vehicular traffic.

## PART 3 - EXECUTION

### 3.01 EXAMINATION

- A. Examine substrates, areas, and conditions, with Applicator present, for compliance with requirements and conditions affecting performance of the Work.
  - 1. Verify that surfaces are clean and dry according to water-repellent manufacturer's requirements. Check moisture content in three representative locations by method recommended by manufacturer.
  - 2. Verify that there is no efflorescence or other removable residues that would be trapped beneath the application of water repellent.
  - 3. Verify that required repairs are complete, cured, and dry before applying water repellent.
- B. Test pH level according to water-repellent manufacturer's written instructions to ensure chemical bond to silica-containing or siliceous minerals.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.02 PREPARATION

- A. New Construction and Repairs: Allow concrete and other cementitious materials to age before application of water repellent, according to repellent manufacturer's written instructions.

- B. Cleaning: Before application of water repellent, clean substrate of substances that could impair penetration or performance of product according to water-repellent manufacturer's written instructions.
- C. Protect adjoining work, including mortar and sealant bond surfaces, from spillage or blow-over of water repellent. Cover adjoining and nearby surfaces of aluminum and glass if there is the possibility of water repellent being deposited on surfaces. Cover live vegetation.
- D. Coordination with Sealant Joints: Do not apply water repellent until sealants for joints adjacent to surfaces receiving water-repellent treatment have been installed and cured.
  - 1. Water-repellent work may precede sealant application only if sealant adhesion and compatibility have been tested and verified using substrate, water repellent, and sealant materials identical to those required.

### 3.03 APPLICATION

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect the substrate before application of water repellent and to instruct Applicator on the product and application method to be used.
- B. **Film-Forming Water Repelellants:**
  - ~~B~~.1. Apply coating of water repellent on surfaces to be treated using high-volume, low-ressure (less than 50 psi) spray to the point of saturation. Apply coating in dual passes of uniform, overlapping strokes. Remove excess material; do not allow material to puddle beyond saturation. Comply with manufacturer's written instructions for application procedure unless otherwise indicated.
    - ~~1~~.a. Precast Concrete: At Contractor's option, first application of water repellent may be completed before installing units. Mask mortar and sealant bond surfaces to prevent water repellent from migrating onto joint surfaces. Remove masking after repellent has cured.
  - ~~C~~.2. Apply a second saturation coating, repeating first application. Comply with manufacturer's written instructions for limitations on drying time between coats and after rainstorm wetting of surfaces between coats. Consult manufacturer's technical representative if written instructions are not applicable to Project conditions.
- C. **Penetrating Water Repellants: Apply single coating of water repellent on surfaces to be treated using high-volume, low-ressure (less than 50 psi) spray to the point of saturation. Apply coating in dual passes of uniform, overlapping strokes. Broom out puddles until they completely penetrated surface. Wipe down excess with clean absorbent towel. Comply with manufacturer's written instructions for application procedure unless otherwise indicated.**

### 3.04 FIELD QUALITY CONTROL

- A. Testing of Water-Repellent Material: Owner reserves the right to invoke the following procedure at any time and as often as Owner deems necessary during the period when water repellent is being applied:
  - 1. Owner will engage the services of a qualified testing agency to sample water-repellent material being used. Samples of material delivered to Project site will be taken, identified, sealed, and certified in presence of Contractor.

2. Testing agency will perform tests for compliance of water-repellent material with product requirements.
  3. Owner may direct Contractor to stop applying water repellents if test results show material being used does not comply with product requirements. Contractor shall remove noncomplying material from Project site, pay for testing, and correct deficiency of surfaces treated with rejected materials, as approved by Architect..
- B. Coverage Test: In the presence of Architect, hose down a dry, repellent-treated surface to verify complete and uniform product application. A change in surface color will indicate incomplete application.
1. Notify Architect seven days in advance of the dates and times when surfaces will be tested.
  2. Reapply water repellent until coverage test indicates complete coverage.

### **3.05 CLEANING**

- A. Immediately clean water repellent from adjoining surfaces and surfaces soiled or damaged by water-repellent application as work progresses. Correct damage to work of other trades caused by water-repellent application, as approved by Architect.
- B. Comply with manufacturer's written cleaning instructions.

**END OF SECTION**

## SECTION 32 91 14 PLANTING MEDIA

### PART 1 - GENERAL

#### 1.01 WORK INCLUDED

- A. Provide materials, testing, equipment and labor required to prepare amended plant mediums for:
1. Stockpiled Topsoil (if applicable)
  2. Planting Mix and Mulch, per use as listed in Section 2.02, below.

#### 1.02 RELATED SECTION

- A. Planting: Section 329300

#### 1.03 QUALITY ASSURANCE

- A. If requested by owner, all soil components shall be tested by local or state testing laboratory for conformity to the specifications:
1. Contractor shall submit proposed laboratory name, address, and telephone numbers for approval.
- B. For delivered material, test one grab sample for each 100 c.y. of bulk material delivered to the site.
- C. Excavated material from tree pits and shrub beds shall not be used for preparation of backfill mix.

#### 1.04 SUBMITTALS

- A. Contractor shall submit a quart size bags of soil and mulch sample, along with macro and micro nutrient analysis, to landscape architect for approval prior to delivery to the job site.
- B. Planting media mix data from manufacturer.
- C. Manufacturer's product data information.

#### 1.05 INSPECTIONS

- A. Testing will be at the expense of the contractor on owner's request.

#### 1.06 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Deliver material to site when permitted by the owner and only when project is ready for related work.

### PART 2 - PRODUCTS

#### 2.01 ON SITE TOPSOIL MATERIALS

- A. Stockpiled topsoil from site shall consist of like material to that used for landscape grading.
1. Quantity: Approximate quantity of stockpiled native topsoil will not be known until demolition and rough grading have been completed under Civil Work.
  2. Stockpiling: Stockpile stripped topsoil onsite.
  3. Composition: Fertile, friable, well-drained soil, of uniform quality, free of stones over one inch diameter, sticks, oils, chemicals, plaster, concrete and other deleterious materials.

4. Analysis: Obtain an agricultural suitability analysis of the proposed topsoil from an accepted, accredited Testing Agency at Contractor's cost.
5. Test Results: Request Testing Agency to send one (1) copy of test results directly to
6. Landscape Architect and one (1) copy to the Owner. Imported topsoil shall be amended per soils analysis report.

## **2.02 PLANTING MIX**

- A. Planting mix for planters and bed areas along Texas Avenue shall be by Nature's Way Resources 'Garden and Flower Bed Mix', Conroe Texas, (936-321-6990), or approved equal.
- B. Lightweight Planting Soil mix for all lawn and planting areas on structure shall be as supplied by *Hydrotech* - ~~Nature's Way Resources 'Green Roof Mix', Conroe Texas, (936-321-6990),~~ or approved equal.
  - ~~Soil mix shall include leaf mold compost (coarse screened), enriched loam topsoil (composted to kill weed seeds and increase humus content, screened to 5/8 inch minus to remove any root fragments), expanded shale, and a small amount of Re-Mineralizer (trace minerals and micro-nutrients)~~
  - ~~Wet (saturated) weights per cubic foot shall not exceed 57.5 lbs.~~





AMERICAN HYDROTECH, INC.

**AMERICAN HYDROTECH LiteTop®  
GROWING MEDIA SPECIFICATIONS**

- X. Growing Media
1. Provide a custom growing media mix that will support vigorous growth of the specified planting materials, complying with the following performance specifications that meet or exceed the German FLL Standards: Research Association for Landscape Development and Construction; Guidelines for Planning, Performance, and Maintenance of Vegetated Rooftops.
    - A. American Hydrotech Inc., Houston Ultra-Light LiteTop® Intensive Media Blend

Property	LiteTop® Intensive Growing Media*
<b>Grain Size Distribution (ASTM F1632 Method B)</b>	
clay fraction (<0.002mm)	< 3%
silt fraction (0.075-0.002mm)	< 12%
passing #200 sieve (0.075mm)	< 15%
passing #60 sieve (0.25mm)	5 - 25 %
passing #18 sieve (1.0mm)	15 - 45 %
passing #10 sieve (2.0mm)	20 - 60%
passing 1/8-inch sieve	40 - 80 %
passing 1/4-inch sieve	65 - 95%
passing 3/8-inch sieve	95 - 100 %
<b>Density (ASTM E2399)</b>	
Initial Media Density	(40 lbs – 50 lbs/cf)
Maximum Media Density	(55 lbs – 65 lbs/cf)
<b>Water/Air Management (ASTM E2399)</b>	
saturated water capacity	> 35%
saturated air content	> 10%
total pore space	> 45%
<b>Water Permeability</b>	
Hydraulic Conductivity	> 10 in/hr
<b>pH, Lime, and Salt Content</b>	
pH (saturated paste)	6.0 – 8.0
EC salts content (water extract)	<3.0 mmhos/cm
<b>Organics (LOI 550°C) (ASTM F1647)</b>	
Organic Matter content	5 – 15 %
<b>Compost Fraction</b>	
1) Meet or exceed USEPA Class A standard, 40 CFR 503.13, Tables 1 & 3 (chemical contaminants) and 40 CFR 503.32(a) (pathogens) and/or be permitted in the state of origin to produce Class A material.	
2) Meet or exceed US Compost Council STA/TMECC criteria or equal for Class I or II stable, mature product.	
* Values shall be adjusted due to availability of local materials or special project conditions related to plant selection and/or environmental conditions.	

Revised: January, 2021

AMERICAN HYDROTECH, INC., 303 E. OHIO ST., CHICAGO, ILLINOIS 60611-3387  
 TELEPHONE 312/337-4998 • FAX 312/661-0731 • [www.hydrotechusa.com](http://www.hydrotechusa.com)  
 CANADA • FAR EAST • MIDDLE EAST • UNITED KINGDOM • UNITED STATES

- ~~C. Restaurant Green Roof soil shall be Hydrotech Lite Top growing media, as provided by Hydrotech or approved equal.~~
- D. Mulch shall be locally sourced “Hardwood Mulch” as supplied Nature’s Way ‘Native Aged Double Grind’, Conroe Texas, (936-321-6990, or approved equal.
- E. All shrubs beds shall receive one application of post planting fertilization with Microlife Ultimate (8-4-6) as supplied by San Jacinto Environmental Supplies, 2221 W 34th St., Houston, Texas 77018, 713.957.0909, or approved equal.
- F. If root stimulator is required after planting, apply one application of “Super Seaweed” as supplied by San Jacinto Environmental Supplies, 2221 W 34th St., Houston, Texas 77018, 713.57.9090, or approved equal.

### **PART 3 - EXECUTION**

#### **3.01 MIXING**

- A. Mix soil base, amendments and chemical additives by mechanical means. Do not mix additives with excavated material at the plant pit site.
- B. Thoroughly mix all amendments in specified proportions prior to installation. Mix may be pre-blended or blended on site. Mix shall be approved by landscape architect prior to installation.
- C. Soil and sand bases shall be completely pulverized and free of lumps or aggregated material. Moisture content of base materials shall not be such that chemical, granular or pelletized additives become dissolved during the mixing process.
- D. Mix media in quantities of not less than 50 cubic yards or mix total quantity required, if less than 100 cubic yards. The Contractor shall be responsible for continuity between batches.
- E. For soil media mixes, do not incorporate soil from mixing area with mix.

**END OF SECTION**

## SECTION 32 93 00 PLANTS

### PART 1 - GENERAL

#### 1.01 WORK INCLUDED

- A. This Section includes specifications for furnishing and installing planting materials including:
  - 1. Organic and chemical fertilizer
  - 2. Mulch
  - 3. Planting media and accessories

#### 1.02 RELATED SECTIONS

- A. Planting Irrigation: Section 328400
- B. Planting Media: Section 329114
- C. Turf And Grasses: Section 329200

#### 1.03 STANDARDS

- A. American National Standards Institute (ANSI)/American Association of Nurserymen (AAN): ANSI Z60.1 1-069 "Nursery Stock".
- B. "Grades and Standards", latest edition of Texas Association of Nurserymen Specifications, Austin, Texas 78704.
- C. Perform work in accordance with all applicable laws, codes, and regulations required by authorities having jurisdiction over such work and provide for all inspections and permits required by federal, state, and local authorities in furnishing, transporting, and installing materials.

#### 1.04 QUALITY ASSURANCE

- A. Installer: Installation of planting work shall be performed by a single firm specializing in landscape and planting work. Contractor shall be licensed by the Texas Association of Nurserymen, shall possess an agricultural certificate, shall be a licensed pest applicator, and shall have not less than 5 years of experience in this type of work.
- B. Installer's field supervision: Require Installer to maintain an experienced full-time supervisor on project site when work is in progress.
  - 1. Pesticide Applicator: State licensed for commercial work is required.
- C. Compliance: Ship planting materials with Certificates of Inspection as required by governing authorities. Comply with all applicable local, state, and federal requirements regarding materials, methods of work, and disposal of excess and waste materials.
- D. Provide quality, size, genus, species, and variety of plants indicated, complying with applicable requirements in ANSI Z60.1. Provide healthy, vigorous stock, grown in recognized nursery in accordance with good horticultural practice and free of disease, insects, eggs, larvae and defects such as knots, sun-scald, injuries, abrasions or disfigurement.

- E. Analysis and Standards: All packaged products shall be delivered in original manufacturer's sealed containers. For unpackaged materials, submit analysis by recognized laboratory made in accordance with methods established by the Association of Official Agriculture Chemists, wherever applicable.

#### **1.05 MATERIAL INSPECTIONS**

- A. Plants shall be subject to inspection and approval by landscape architect upon delivery for conformity to specifications. Landscape architect may reject plant material that in his opinion does not conform to specifications. Submit a written or verbal request for inspection of plant material to landscape architect at least five (5) days prior to preferred date. The landscape architect reserves the right to refuse inspection at this time if, in his judgment, a sufficient quantity of plants is not available for inspection. The contractor shall submit alternate source for material if primary source of material deem unsatisfactory to meet specifications.
- B. Substitutions of plant materials will not be permitted unless authorized in writing by landscape architect. If proof is submitted that any plant specified is not obtainable, a proposal will be considered for use of the nearest equivalent size or variety with corresponding adjustment of contract price. Such proof shall be substantiated and submitted in writing to landscape architect at least thirty (30) days prior to start of work under this Section. These provisions shall not relieve contractor of the responsibility of obtaining specified materials in advance if special growing conditions or other arrangements must be made in order to supply specified materials.
- C. Contact landscape architect for inspection after planting operation has been completed. Such inspection is for the purpose of establishing the maintenance period.
- D. Request for inspections to the landscape architect 5 working days prior to anticipate inspection date.

#### **1.06 SUBMITTALS**

- A. Furnish required copies of photos of plant materials from their sources, manufacturers literature, samples, certifications, or laboratory analytical data for the following items:
1. Tree, shrubs and groundcovers (Samples and / or photographs)
  2. Planting backfill mix (sample bag)
  3. Mulch (manufacturer's literature and samples)
  4. Tree and shrub planting fertilizer (certification or laboratory analytical data)
  5. Tree paint (manufacturer's, literature)
  6. Subdrainage materials (pipes, gravel, soil separator) *if applicable*
  7. **Geotextile** Fabric *if applicable*.

#### **1.07 PLANT MATERIAL DELIVERY, STORAGE AND HANDLING**

- A. The following considerations for product handling shall be evaluated:
1. During hot weather and when practical, the contractor may be required to transport plant materials between sunset and sunrise if transported in an open trailer or unrefrigerated van.
  2. Dug material should be maintained and watered as required at the nursery to guarantee their vitality and health until shipping.

3. Protect from all damage trunks, stems, branches and root balls during tree tying, wrapping and loading operations.
  4. Load containers onto transport vehicle and secure in a manner that protects the structural integrity of the root balls and branches.
  5. The contractor shall be solely responsible for the safe transportation of plants to the site and their condition upon arrival. Trees damaged, dehydrated or abused during transit and storage will be rejected.
  6. Plant materials should not be stored on concrete or left exposed to examples of climate without adequate protection.
  7. Protect the root balls and water regularly until planting. If trees are left in storage over the weekend or holiday provide a means of periodical watering and inspection of container moisture.
  8. B & B material shall be stored and maintained in a manner which affords protection from dehydration and damage of root ball. Root balls shall be wrapped and stored in mulch or approved containers.
- B. The landscape architect may inspect any phase of this operation and may reject any plant material improperly handled during any point of this operation.
- C. Nothing in this section shall be interpreted as relieving the contractor of his responsibility to provide healthy, viable plants, nor shall it have any affect upon the terms of the warranty specified herein.

#### **1.08 INCIDENTAL REPAIRS**

- A. The landscape contractor shall coordinate repairs of damage to irrigation system incidental to the planting operation by either own forces or by irrigation subcontractor. Above repairs shall be made immediately so as to not interfere with the automatic cycling of the irrigation system. All repairs shall be permanent and include all flushing required to clean the lines of debris deposited by such damage.
- B. Incidental damage to work by other subcontractors during landscape installation shall be made immediately and at no extra cost to the owner.

#### **1.09 JOB CONDITIONS**

- A. Work Scheduling: Proceed with and complete planting work in a timely manner, working within seasonal limitations for each kind of planting work required.
- B. Planting Time
1. Correlate planting with specified maintenance periods to provide maintenance from date of substantial completion.
  2. Plant trees, shrubs and groundcover after final grades are established and prior to planting of lawns, unless otherwise directed by landscape architect or owner's representative in writing. If planting occurs after lawn work, protect lawn areas and promptly repair damage to lawns resulting from planting operations.
- C. Utilities: Refer to drawings and coordinate with utility contractor for location of utilities. Contractor shall be responsible for damage to existing utilities and structures.
- D. Security: The owner will not assume any responsibility for security of any materials, equipment, etc. during construction of the project until project acceptance.

- E. Excavation: When conditions detrimental to plant growth are encountered, such as rubble fill, adverse drainage conditions beyond the scope of this contract, or obstructions, notify owner's representative of such conditions, immediately and before planting.
- F. Pollution Control: Control dust caused by planting operations. Dampen surfaces as necessary. Comply with pollution control regulations of governing authorities.

## **PART 2 – PRODUCTS**

### **2.01 PLANTS**

- A. Plants shall be nursery grown in accordance with good horticultural practices under climatic conditions similar to those of project for at least 12 (twelve) months unless specifically otherwise authorized by landscape architect in writing. Unless specifically noted otherwise, all plants shall be heavy, symmetrical, tightly knit, so trained or favored in development and appearance as to be superior in form, number of branches, compactness and symmetry.
- B. Plants shall be sound, healthy and vigorous, well branched and densely foliated when in leaf. They shall be free of disease, insect pests, eggs, or larvae, and shall have healthy, well developed root systems. They shall be free from physical damage or adverse conditions that would prevent thriving growth.
- C. Plants shall be true to species and variety and shall conform to measurements specified except that plants larger than specified may be used if approved by landscape architect. Use of such plants shall not increase contract price. If larger plants are approved, the ball of earth or container size shall be increased as specified under “Applicable Standards” and subject to the approval of the landscape architect.
- D. Plants shall be measured when branches are in their normal position. Height and spread dimensions specified refer to main body of plant and not branch tip to tip. Caliper measurement shall be taken at a point on the trunk six inches (6") above natural ground four inches (4") in caliper and at a point twelve inches (12") above the natural ground line for trees over four inches (4") in caliper. If a range of size is given, no plant shall be less than the minimum size and not less than 40% of the plants shall be as large as the maximum size specified. The measurements specified are the minimum size acceptable and are the measurements after pruning, where pruning is required. Plants that meet the measurements specified, but do not possess a normal balance between height and spread shall be rejected.
- E. Container stock shall have grown in the containers in which delivered for at least six months, but not over two years. Samples must prove no root bound conditions exists. No container plants that have cracked or broken balls or earth when taken from container shall be planned. Container stock shall not be pruned before delivery. Field grown plants recently transplanted into containers will not be accepted.
- F. Balled and burlap trees, when accepted, shall have a root ball size of ten (10X) times the caliper minimum.
  - 1. Nursery grown B&B material shall be first pruned and thinned at the place of growth immediately prior to digging as required for packaging and safe moving. Method or pruning shall be as approved in the field by the landscape architect. Do not remove self-locking tags during this pruning prior to delivery to site. Final pruning shall take place at the site.

- G. Trees which have damaged or crooked leaders, or multiple leaders, unless specified, will be rejected. Trees with abrasions of the bark, sun scalds, disfiguring knots, or fresh cuts of limbs over 3/4 "which have not completely callused, will be rejected.
- H. Method of pruning shall be as approved in the field by the landscape architect. Do not remove self-locking tags during this pruning prior to delivery to site. Final pruning shall take place at the site.
- I. Plant Materials
  - 1. Refer to landscape plans and plant schedule.

## **2.02 WATER**

- A. Furnished by owner. Transport as required.

## **2.03 PRE-EMERGENCE WEED CONTROL**

- A. All landscape and grass areas shall be treated with organic pre-emergent herbicide whenever possible. Application rate and timing shall be based on manufacturer's recommendation.
- B. If applying organic pre-emergent herbicide is not feasible, commercial chemical herbicide may be used with prior approval from landscape architect or owner's representative. Application rate and timing shall be based on manufacturer's recommendation. Treatment should be only applied by state licensed commercial applicator.
- C. If necessary, contact herbicide may be use such as Roundup or approved equal. Do not exceed manufacturer's recommended rate of application. Treatment should be only applied by state licensed commercial applicator.

## **2.04 MULCH**

- A. Mulch for top dressing: Shall be organic mulch free from deleterious materials, debris and suitable for top dressing of trees, shrubs or ground covers. Mulch shall be the product of standard stripping of bark from pine, oak, or hardwood for fiber or pulp manufacturing with dark brown in color. Bark shall be shredded in a manner where large pieces are at a minimum.
- B. Compost Mulch: Enriched bark mulch for bed prep shall be as above with additional organic of peat and/or manure.

## **2.05 PIPE FOR WATERING TUBE**

- A. Shall be perforated Polyvinyl Chloride pipe, Type (SDR 35), gray in color.

## **2.06 PLANTING MIX**

- A. Refer to planting media section for specifications.

## **2.07 FERTILIZER**

- A. Post planting fertilization shall be 100% organic.
  - 1. Microlife or approved equal and apply at manufacturer's recommendation rate.

## **2.08 STEEL EDGING**

- A. Typical steel edging shall be 3/16" thickness by 4" height with 2.6 lbs/ft. unless indicated in the drawings.
- B. Contract shall submit product data for approval prior to installation.

**2.09 WEED BARRIER / GEOTEXTILE FABRIC**

- A. Typar #3401 thermally spunbonded polypropylene, non woven, weed control fabric, 4.0 oz / lineal yard weight by American Excelsior or approved equal.
- B. Contractor is required to submit samples and product data for approval prior to installation.

**2.10 HYDROTECH GARDMAT LT or approved equal**

- A. To be installed in locations over Hydrotech Lightweight Planting Soil mix that exceed 20% slope. Refer to civil grading plan.

PRODUCT DATA SHEET

**GardMat® LT**



**GENERAL DESCRIPTION**

GardMat LT is a 100% coconut fiber matrix stitched together with biodegradable thread between biodegradable natural fiber top and bottom netting.

**BASIC USE**

GardMat LT is designed to provide heavy duty wind and water surface erosion protection and assist with vegetation establishment for 18-24 months when installed over Hydrotech's LiteTop® growing media as part of Hydrotech's Garden Roof® Assembly. GardMat LT is typically used for plugs and/or potted plant vegetation plantings. Disk Anchors are used to fasten GardMat to LiteTop Growing Media surface.



**INSTALLATION**

- Refer to Hydrotech's Garden Roof Installation Guidelines for specific installation instructions
- GardMat LT shall be installed as indicated in Hydrotech's Garden Roof Installation Guide
- Used with plugs and/or potted vegetation
- Can be used for slopes up to 1:1 (45°; 100%) maximum
- Good for up to 24 months where excellent vegetation coverage is needed before mat degradation

**TECHNICAL DATA**

PROPERTY	TEST METHOD	RESULTS
WIDTH (feet)		6.67 ± 5%
LENGTH (feet)		108.0 ± 5%
THICKNESS (inches)	ASTM D5199 / ECTC <sup>1</sup>	0.26
WEIGHT (oz/sqyd)	ASTM D5261	8.83
TENSILE STRENGTH (MD <sup>2</sup> - lb/ft)	ASTM D5035	342
TENSILE STRENGTH (TD <sup>3</sup> - lb/ft)	ASTM D5035	211
ELONGATION (MD - %)	ASTM D5035	7.6
ELONGATION (TD - %)	ASTM D5035	11.1
WATER ABSORPTION (%)	ASTM D1117 / ECTC	155
RESILIENCY (%)	ECTC	85
STIFFNESS / FLEXIBILITY (oz-in)	ASTM D1388 / ECTC	0.11
SMOLDER RESISTANCE ECTC		YES <sup>4</sup>

(values published are min. req)

1. (ECTC) Erosion Control Technology Council

2. MD = Machine Direction

3. TD = Transverse Direction

4. Material is smolder resistant according to ECTC Guidelines



**PART 2 - PART 3 - EXECUTION**

**3.01 LAYOUT AND EXCAVATION OF PLANTING AREAS**

- A. Layout plants in locations shown on drawings. Use wire stakes color-coded for each species of plant material or spray paint with non toxic paint to delineate each plant species and outline bed locations. Each tree shall be staked for approval prior to planting.
- B. The landscape architect will check location of plants in the field and shall adjust to exact position before planting begins.
- C. If underground obstructions are encountered notify the landscape architect as to whether an adjustment or change of location is possible within the design intent. If the contractor is allowed to adjust or change location, rather than remove the obstruction, he shall make the change at no expense to the owner. Backfill and tamp abandoned pits have obstructions which cannot be removed.

**3.02 EXCAVATION TO SUBGRADE FOR PLANTING AREA AND VERIFICATION OF FINISHED GRADE**

- A. Excavate all planting areas (pit and beds) to required depth as hereinafter specified and stockpile enough material to prepare planting mix for all plants. Remove excess material from site.
- B. Verify that required grades are within two (2") inches of required subgrade provided under a separate contract, and excavate further as may be required.
- C. Subsoil shall not be worked when moisture content is so great that excessive compaction will not occur, nor when it is so dry that clods will not break readily. Water shall be applied, if necessary, to bring soil to an optimum moisture content before tilling and planting.
- D. Do not excavate tree pits more than 24 hours in advance of planting operation. Excavate container grown tree pits to the following dimensions:

<u>Excavation for</u>	<u>Width</u>	<u>Depth</u>
Boxed trees	Box + 24 in.	Ball + 6 in.
Container grown trees	Cont. + 18 in.	Ball + 6 in.
B&B trees	Ball + 12 in.	Ball + 6 in.
Container grown shrubs	Cont. + 12 in.	Ball + 4 in.

- 1. Excavation for trees pits in areas of select fill (crushed and compacted limestone or similar) shall be twice as wide and twice as deep as given root ball. Fill bottom four inches of tree pit with gravel and cover with soil separator before backfilling pit.

- E. Excavate shrub and ground cover beds to the following depths:

<u>Excavation for</u>	<u>Width</u>	<u>Depth</u>
Shrubs &	Entire Bed	Cont. + 4 in., not to be less than
Groundcover	Entire Bed	Cont. +4 in., not less than 8 in

- F. Rip or cultivates subgrade in pits and beds to a depth of three (3") inches minimum.

**3.03 DRAINAGE, DETRIMENTAL SOILS AND OBSTRUCTIONS**

- A. Test drainage of plant beds and pits by filling with water twice in succession. Conditions permitting the retention of water in planting beds for more than twenty-four (24) hours or

percolation of less than one (1") inch per hour shall be brought to the attention of the Landscape Architect.

- B. Notify the landscape architect of all soil or drainage conditions contractor considers detrimental to growth of plant material. (State condition and submit proposal and cost estimate for correcting condition.) If rock, hardpan, underground construction work, tree roots or other obstructions are encountered in the excavation of plant pits and beds, alternate locations may be selected by landscape architect. Where locations cannot be changed, submit cost required to remove the obstructions to a depth of not less than six (6") inches below the required pit or bed depth. Proceed with work after approval.

### **3.04 PREPARING PLANT MATERIALS FOR PLANTING**

- A. Container grown stock shall be removed carefully and handled only by the root ball. Do not lift or handle container plants by tops, stems, or trunks at any time.
- B. Do not bind or handle any plant with wire or rope at any time so as to damage bark or break branches. Lift and handle plants only from bottom of ball.
- C. Balled and burlap (B&B) plants shall have firm balls of earth. Plants moved with a ball will not be accepted if the ball is cracked or broken before or during planting operations. B&B material shall be dug only when dormant. Pre-dug stored B&B material shall be inspected and approved at the storage site.

### **3.05 INSTALLATION OF PIT PLANTED MATERIALS**

- A. Do not commence any planting until the irrigation system is completely automated or can be operated manually.
- B. Fill plant pits with soil mix to compact depth to receive plant root ball, so top of root ball is two (2") inches above finished grade.
- C. Install PVC watering tubes in tree pits, vertically, at edge of pit as shown.
- D. Scarify the walls and bottom of all plant pits immediately prior to the placement of plant and backfill mix. The Contractor shall remove all glazing caused by an auger or mechanical hole digger.
- E. For boxed & container grown material, break vertical bands and remove top and bottom of container. Carefully lower plant into pit with backhoe or approved method and adjust elevation. Cut horizontal banks and remove sides. Prune away girdled roots and tease root hair masses. Carefully fill pit and compact by watering in to support root ball.
- F. Place B&B plants carefully in the prepared planting pit. Do not disturb root ball or untie twine or roping until backfill settlement is complete and tree is staked, if applicable. Fill planting pit by flooding each eight (8") inches of backfill for balls greater than 24" diameter. Wrap trunks with double layer of tree wrap.
- G. Smooth planted areas to conform to specified grades after full settlement has occurred. Contractor shall bear final responsibility for proper surface drainage of planted areas. Any discrepancy in the drawings or specifications, obstructions on the site, or prior work done by another party, which contractor feels precludes establishing proper drainage, shall be brought to the attention of the landscape architect in writing.
- H. Mulch circles shall not exceed width of root mass by more than 4". Mulch circles shall meet lawn or bed grades evenly and smoothly.

- I. Water all plants immediately again after planting.
- J. Apply pre-emergent weed control material in areas to receive mulch.
- K. Spread mulch in required areas to the compacted depth of two (3") inches.

**3.06 INSTALLATION OF BED PLANTED MATERIALS**

- A. Install steel edging where shown. Anchor with steel stakes spaced not more than three (3') feet O.C. or as per often as necessary to have smooth radius or straight tangent. Drive stake to one (1") inch below top of edging.
- B. Fill all shrub and groundcover beds with plant bed mix to finished grade (compacted) plus two (2") inches minimum.
- C. Excavate in planting mix for individual plant and install as required. Set plant plumb and brace rigidly in position until planting soil mix has been tamped solidly around the ball and roots.
- D. When plant pits have been backfilled approximately two-thirds (2/3) full, fertilizer per manufacturer's recommendations at the maximum rate.
- E. Water plant thoroughly, saturating root ball, before installing remainder of the planting soil to top of pit, eliminating all air pockets. Top of root ball shall be two (2") inches above finished grade.
- F. Smooth planting areas to conform to specified grade after full settlement has occurred. Contractor shall bear final responsibility for proper surface drainage of planting areas.
- G. Water all plants immediately again after planting.
- H. Apply pre-emergent weed control material over entire area to receive mulch.
- I. Mulch all shrub and groundcover beds to three (3") thick.

**3.07 SURFACE DRAINAGE OF PLANTING AREAS**

- A. Contractor shall bear final responsibility for proper surface drainage of planted areas. Any discrepancy in the drawings or specifications, obstructions on the site, or prior work done by another party, which contractor feels precludes establishing proper drainage, shall be brought to the attention of the landscape architect in writing.

**3.08 POST PLANTING FERTILIZATION**

- A. Tree Planting
  - 1. Apply fertilizer 30 - 45 days after installation.
  - 2. Inject material specified in Section 2 with a high-pressure injector into soil at depth and diameter shown below.

Tree Caliper	Application Points	Radius	Depth	Application Rate Per Tree
Under 2"	3	4" - 6"	16" - 18"	1-1/2
2" - 4"	3	4" - 6"	18" - 24"	2
4" - 5"	4	4" - 6"	2' - 3'	2-1/2

5" - 6"	5	4" - 6"	3' - 4'	3
Above 6"	3' O.C.	4" - 6"		5 gal./100 sf Root Area (Drip Line)

### 3.01 PRUNING

- A. Prune containerized plants only at time of planting and according to standard horticultural practice to preserve the natural character of the plant. Prune by removing entangled branching and by removing crotches. Avoid removing branch tips wherever possible. Pruning shall be done under supervision of the landscape architect.
- B. Remove all dead wood, suckers, and broken or badly bruised branches. Use only clean, sharp tools.
- C. Prune lower branching from trees to a height of 18" above ground per 1 1/4" caliper.
- D. Prune B&B material in addition to place of growth as may be directed by landscape architect by removing a percentage of interior branching proportional to the root loss during digging (up to 1/3).

### 3.02 STAKING

- A. The Contractor, will be responsible for material remaining plumb and straight for all given conditions through the guarantee period. Tree support shall be done as outlined on the following tables and as illustrated on the details.
- B. Trees should be staked during the same day as planting. Plants shall stand plumb after staking.
- C. Staking shall be Platipus Deadman System - Plati-Mat®.

### 3.03 MAINTENANCE BY THE CONTRACTOR

- A. The contractor shall begin maintenance after each plant is installed and continue until final acceptance.
- B. The contractor's maintenance period shall begin upon inspection and approval at Substantial Completion and shall be for 180 days or to be determined by owner. *Contractor to provide monitoring of transplant trees by a certified arborist for 3 years after issuance of Notice of Substantial Completion. Contractor shall perform 6 visits per year (18 visits total) with a written report after each visit that is provided to the owner. Contractor Shall provide maintenance of transplant trees in the first year after planting: feeding, Pruning, spraying, and moisture/irrigation adjustment.*
- C. The contractor's maintenance of new planting shall consist of watering, cultivating, weeding, mulching, re-staking, tightening and repair of guys, resetting plants to proper grades or upright position, and furnishing and applying such pesticide sprays and invigorates as are necessary to keep the plantings free of insects and disease and in thriving condition.
- D. Protect planting areas and plants at all times against damage of all kinds for duration of maintenance period. Maintenance includes temporary protection barriers and signs as required for protection. If any plants become damaged or injured, because sufficient protection was not provided, treat or replace as directed by landscape architect at no additional cost to the owner.

### **3.04 FINAL ACCEPTANCE**

- A. Work under this section will be accepted by landscape architect upon satisfactory completion of all work, including maintenance, but exclusive of replacement of plant materials under the warranty period. Upon termination of maintenance period, the owner will assume responsibility for maintenance of the work.

### **3.05 WARRANTY**

- A. Planting shall be warranted by the contractor to remain alive and healthy for a period of 12 months after the date of Substantial Completion. Plants in an impaired, dead or dying condition after initial acceptance or within 12 months shall be removed and replaced. New planting and method of placing shall comply with the requirements of the specifications. Plants replacing those removed during the guarantee period shall also be guaranteed to remain alive and healthy for an additional 12 months after installation and acceptance.
- B. Contractor shall not be held responsible for failure due to neglect by owner or property manager, vandalism, acts of god, during warranty Period. Report such conditions to the landscape architect or owner's representative in writing when discovered.
- C. Contractor shall indicate during Pre-Bid regarding warranty status of plant material in the case of no irrigation system provided in the project.
- D. Submit a letter of warranty containing the following information:
1. "We hereby guarantee that the landscape planting we have furnished and installed is free from disease and in good condition, and the work has been completed in accordance with the drawings and specifications, ordinary wear and tear and unusual abuse, or neglect excepted.  
We agree to repair or replace any defects in material or workmanship which may develop during the period of one (1) year from acceptance, and also to repair or replace any damage resulting from the repairing or replacing of such defects, at no additional cost to the owner. We shall make such repairs or replacements within a reasonable time, as determined by the owner, after receipt of written notice.  
In the event of our failure to make such repairs or replacements within a reasonable time after receipt of written notice from the owner by certified mail, we authorize the owner to proceed to have said repairs or replacements made at our expense, and we will pay the costs and charges therefore, upon demand."

### **3.06 CLEAN UP**

- A. Clean up all areas as required for complete and acceptable inspection.
- B. It is Contractor's responsibilities to replace or restore any damaged or disturbed areas during planting operation back to its original condition.

### **3.07 INSPECTIONS**

- A. Submit requests for inspections to the landscape architect at least five (5) days prior to anticipated inspection date.

**END OF SECTION**