



STATE OF CONNECTICUT
DEPARTMENT OF TRANSPORTATION



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Subject: Project No. 300-139
New Haven: Independent Wheel True Facility – New
Haven Rail Yard.

April 4, 2011

NOTICE TO CONTRACTORS:

This is to notify all concerned and especially the prospective bidders that the bid opening for the subject project is still scheduled for April 6, 2011 at 2:00 P.M. in the Conference Room of the Department of Transportation Administration Building, 2800 Berlin Turnpike, Newington, Connecticut.

The Department has established a general mailbox to receive contractor questions. Please send all future questions to DOTContracts@ct.gov. Please refer to the instructions below on how to obtain the addendums and share with anyone having a need to know.

Addendum No. 4 is available online via the Contracting Portal & FTP Site

This addendum is necessary to revise Special Provisions and to answer questions on the subject project.

The FTP site for Contractors to access Project Information:

Location: <https://sfile.ct.gov/>

Logon: CTDOTContract

Password: ctdotBid123

Folder 102 Addendums

Gregory D. Straka
Contracts Manager
Division of Contracts Administration

APRIL 1, 2011

NEW HAVEN RAIL YARD FACILITIES IMPROVEMENTS:

INDEPENDENT WHEEL TRUE FACILITY

STATE PROJECT NO. 300-139

TOWN OF NEW HAVEN

ADDENDUM NO. 4

SPECIAL PROVISIONS

REVISED SPECIAL PROVISION

The following Special Provision is hereby deleted in its entirety and replaced with the attached like-named Special Provision:

- **NOTICE TO CONTRACTOR – PROJECT COORDINATION**

REVISED CSI SPECIAL PROVISIONS

The following CSI Special Provisions are hereby deleted in their entirety and replaced with the attached like-named CSI Special Provisions:

- **SECTION 03 30 00 – CAST-IN-PLACE CONCRETE**
- **SECTION 07 42 63 – FABRICATED WALL PANEL SYSTEM**
- **SECTION 11 10 00 – EQUIPMENT SCHEDULE**
- **SECTION 11 24 00 – GENERAL SHOP EQUIPMENT**

QUESTIONS & ANSWERS

Q1. S&C requests clarification on the switch required for this project. Drawing E5-02 shows two incoming switch sections and two outgoing fuse sections. This would be a four compartment switch. The description indicates this is a three compartment switch. Drawing E5-706 shows a three section switch. Therefore S&C requires clarification as to what is required by the customer.

A1. Drawing E5-002 (sheet 299) notes that a three (3) compartment switch is proposed for this project. The switch will receive two (2) fused line side feeders with one (1) common

load connection as indicated on Drawing E5-002 (sheet 299). Further, Drawing E5-002 (sheet 299) does not identify any fused sections on the load side of the switch. Drawing E5-706 (sheet 313) identifies three (3) compartments as well. It is anticipated that only three (3) sections are required from any contractor chosen manufacturer. However, the shop drawing process will not mandate a quantity of sections as long as the contractor can meet the specification and mount the equipment on the pad size as per the contract documents.

- Q2.** Regarding Drawing S5-008 (Sheet 237) Note No. 5. This note indicates that the slab steel shall be “Weldable Steel”. Does this note pertain to the main slab reinforcing as noted in the “One Way Slab Schedule”? Or does this pertain to ALL reinforcing within the slab including wall dowels, dowel bar subs, curb dowels, haunch steel, grade beam steel, etc.?
- A2.** Grade A706 weldable steel is required only where the grounding and bonding for the structure occurs. At locations where the contractor installs a ground connection from a ground bar to the reinforcing steel as per Detail 5 on Drawing E5-701 (sheet 308) and Detail 9 on Drawing E5-703 (sheet 310) grade A706 weldable steel reinforcing is required. All other reinforcing in the slab and grade beams does not have to be weldable. Refer to Drawing E5-112 (sheet 301) for locations of ground bars. The contractor is required to submit shop drawings for approval indicating electrical grounding locations and details per Specification Section 26 05 26 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS, Part 1.3.
- Q3.** Drawing S5-028 (sheet 257) indicates three details for piping under slab. What is the criteria that determines between the use of pipe hangers and concrete encasement?
- A3.** The details for Under Slab Single Conduit/Pipe Support and Under Slab Multiple Conduit/Pipe Support shown on Drawing S5-028 (sheet 257) shall be used. Typical Slab Detail at Embedded Pipe on Drawing S5-028 (sheet 257) applies only when the utility being installed conflicts with the slab. Please refer to Specification Section 26 05 43 - UNDERGROUND DUCTS AND RACEWAYS FOR ELECTRICAL SYSTEMS, Part 3.1 for additional requirements of concrete encasement for under slab electrical, telephone and communications duct banks.
- Q4.** Regarding Drawing S5-031 (Sheet 260). There is a detail for “Concrete Column Encasement”. Are there any Column encasements?
- A4.** Concrete encasement shall be installed on all columns on Column Lines B and E and the columns at the intersections of Column Lines C-7 and C-12. Encasement shall extend 8’-0” above the finished floor elevation and shall be enlarged at the column base so that the entire structural steel base plate is encased. Specification Section 03 30 00 - CAST-IN-PLACE CONCRETE, Part 3.14 has been revised in Addendum No. 4.

- Q5.** The specifications include a Section entitled Applied Fireproofing 07 81 00. Drawing S5-031 show fireproofing details and indicates " For fireproofing locations, see architectural drawings". We have searched several times through the drawings and could not find any requirements on the architectural drawings for applied fireproofing. In addition, it appears from interpreting A5-002 that the building code would not require any applied fireproofing. Does this project have any applied fireproofing? If so, where? If not, then Section 07 81 00 should be deleted. Please clarify.
- A5.** Refer to Addendum No. 3, Question and Answer 22. Exposed cementitious sprayed fire-resistant materials shall be used to achieve required rating. Refer to Specification Section 07 81 00 -APPLIED FIREPROOFING, Part 2.2.
- Q6.** The project specifications and drawings lack sufficient information to properly estimate the contractor's scope of work and cost associated with Owner Furnished equipment. The drawings refer the reader in at least two places (A5-105 and A5-302) to see "Industrial Drawings". The Industrial drawings provided in the Bid Documents are general and do not provide enough details for the Contractor's installation and electrical work for this equipment. Please clarify.
- A6.** Specification Section 11 10 00 - EQUIPMENT SCHEDULE lists the equipment in the project and provides direction on who furnishes and installs this equipment. Three pieces of equipment are listed as Owner Furnished and Contractor installed. For the Hopper, Utility Vehicle and the Wheel Truing Machine, the Contractor installer is the Under Floor Wheel Lathe (UFWL) Vendor. The five pieces of equipment that are furnished by the Construction Contractor must also be installed by the Construction Contractor (CF/CI). Details of the equipment requirements are included in the specifications listed in the table on page 2 of Specification Section 11 10 00 - EQUIPMENT SCHEDULE. The required electrical connections are shown on Drawing E5-112 (sheet 301). Specification Section 11 10 00 - EQUIPMENT SCHEDULE has been revised in Addendum No. 4 for clarification.
- Q7.** The hopper and conveyor system is shown vaguely on some drawings but not listed in Section 11? Is it OF/OI ? Is it part of the Wheel Truing machine? Please clarify the Contractor's role in regards to this equipment.
- A7.** The hopper and conveyor system are supplied and installed by the Under Floor Wheel Lathe (UFWL) Vendor. Please see NTC – Project Coordination for details on the interface between the UFWL Vendor and the Construction Contractor. Specification Section 11 10 00 - EQUIPMENT SCHEDULE has been revised in Addendum No. 4 for clarification. Also, refer to Addendum No. 3, Question and Answer 45.
- Q8.** As noted in the contract for Project No. 300-139 it states that the Turnouts for this project will be supplied by Metro-North Railroad. Are these Turnouts pre-paneled?

- A8.** Please refer to NTC – Acceptance of Owner-Furnished Track Material which states “Two new turnouts will be delivered by Metro-North packaged in “kit” form prior to Notice to Proceed. The turnouts will be stored at a location within the New Haven Rail Yard. The Contractor shall retrieve the turnouts from this location and assemble them within the Project work limits.”
- Q9.** Reference Section 074263 Fabricated Wall Panel System., page 074263-6 Section 2.2 A. Item 3 A calls for a 36 inch wide panel, however the elevations tend to show a thirty inch wide panel which realistically lines up better with other wall components. Please clarify the width of the metal wall panel.
- A9.** Fabricated Wall Panels shall be 30” wide. Specification Section 07 42 63 - FABRICATED WALL PANEL SYSTEM, Part 2.2.A.3.A has been revised in Addendum No. 4
- Q10.** In regards to steel casing for the Independent Wheel True Facility (and any Connecticut DOT project in general), is spiral weld acceptable or does it have to be straight seam?
- A10.** The Specifications for Item No 0104057A - POLE FOUNDATION, TYPE A and Item No 1002150A - LIGHT STANDARD FOUNDATION - SPECIAL require steel shells to conform to ASTM A252. Per ASTM A252 each welded pile shall be made by seamless, electric resistance welding, flash welding or fusion welding with longitudinal, helical-butt, or helical-lap seams.
- Q11.** Could CONNDOT provide drawings which show TMH-11A, 11B, 11C, and CCO or provide sufficient information to quantify this work?
- A11.** Additional information has been added to clarify the physical distances between locations where work is to be performed under this project. Notes 5 and 7 have been added to Drawings C5-010 (sheet 337) and C5-011 (sheet 338) respectively in Addendum No. 3. Also, refer to Addendum No. 3, Question and Answer 49.
- Q12.** C5-111 shows running cable through an existing underground system from TMH- 11. SC-001 shows an existing overhead cable running from TMH-11. Which is correct?
- A12.** Drawing SC-001 (sheet 120) does not depict the work currently being installed under Project No. 301-0106, which is currently in construction. Under Project No. 301-0106, the existing overhead cable running from TMH-11 will be removed and new structures TMH-11A, 11B and 11C will be installed. Also, refer to Addendum No. 3, Question and Answer 49.
- Q13.** Specification 03 30 00 – 14. The chart on this page for “Recommended mix designs and concrete admixtures”, has a column labeled “Reinf. E.C.” Does this mean Epoxy Coated Reinforcing”? Also, Drawing S5-008 (sheet 237), note no. 5 indicates that all structural

slabs shall be reinforced with weldable rebar. Does this mean that the slabs are to be weldable as well as epoxy coated rebar?

- A13.** Epoxy-coated reinforcing is required for all structural slab top reinforcing, all foundation beam top reinforcing, and all foundation beam stirrups. Also, epoxy-coated reinforcing is required for all dowels that lap with structural slab top reinforcing. The chart in Specification Section 03 30 00 part 2.5.C has been revised in Addendum No. 4. Note 5 on Drawing S5-008 (sheet 237) only applies to locations where the grounding and bonding for the structure occurs. Also, refer to Addendum No. 4, Question and Answer 2.
- Q14.** Will this further mean that ANY reinforcing that falls within the structural slabs will have to be epoxy coated as well as weldable rebar (grade beams, pile dowels, wall dowels from pits, etc.)?
- A14.** Epoxy-coated reinforcing is required for all structural slab top reinforcing, all foundation beam top reinforcing, and all foundation beam stirrups. Also, epoxy-coated reinforcing is required for all dowels that lap with structural slab top reinforcing. The chart in Specification Section 03 30 00 - CAST-IN-PLACE CONCRETE, Part 2.5.C has been revised in Addendum No. 4. Only locations where the grounding and bonding for the structure occurs require weldable reinforcing steel. Also, refer to Addendum No. 4, Question and Answer 2 and 13.
- Q15.** In Specification Section 11 24 00, item 2.2 Drill Press specified is discontinued item by Delta Machinery and the other manufacturer's item do not meet the spec exactly, what would be acceptable alternate?
- A15.** Specification Section 11 24 00 - GENERAL SHOP EQUIPMENT, Part 2.2 has been revised in Addendum No. 4 to include updated product information.

The Bid Proposal Form is not affected by these changes.

There will be no change in the number of calendar days due to this Addendum.

The foregoing is hereby made a part of the contract.

NOTICE TO CONTRACTOR - PROJECT COORDINATION

1.01 DESCRIPTION

- A. This Section identifies project coordination requirements relative to performance of the Work.
- B. The Contractor shall coordinate construction activities with the Vendor engaged to engineer, design, fabricate, deliver, install and commission an Under Floor Wheel Lathe (UFWL) and ancillary support systems in the Independent Wheel True Facility (IWT). The Contractor shall coordinate its activities with the work of Others in such a way as to minimize conflicts and interferences, and shall cooperate fully with Metro-North, Connecticut DOT (CTDOT) and its agents, and the UFWL Vendor.
- C. Except as specifically allowed by the Contract, Metro-North operations, including yard operations of trains, track systems, power distribution, communications and other systems, will remain active without interruption for the duration of this Contract.

1.02 PROJECT SCHEDULE

- A. The Contractor shall include in its Project Schedule activities in support of a three (3) month activity when the UFWL Vendor will install and commission the UFWL machine and ancillary systems within the pit of the IWT. This activity must commence as soon as the IWT facility construction has advanced to a condition of “weather-tight.”, at which time the Contractor shall permit the UFWL Vendor to commence installation activities in accordance with the requirements of “NOTICE TO CONTRACTOR – ENGINEER OCCUPANCY”. “Weather-tight” is defined as having the foundation, floor slab, wheel true pit, inspection pit, structural steel, roof, walls, doors and windows installed for the Main Shop Area (from Column Line 12 to the east to Column Line 7 to the west, and from Column Line B to the north to Column Line E to the south). Furthermore, all building work activities in the Main Shop Area shall be substantially complete except for final testing and commissioning, including but not limited to the following:
 - 1. Full access by the UFWL Vendor to the Main Shop Area for transportation and rigging of machinery.
 - 2. In-slab shop rails shall be installed, aligned to UFWL Vendor requirements, secured and cut to length in front and behind pit so that final gap filler pieces of shop rails can be custom fit in by MNR after installation of machinery. Typically, this is 3’ to 6’ each rail.
 - 3. Building power, lighting and HVAC systems in the Main Shop Area shall be installed and operational.
 - 4. Main power supply cable for machinery shall be installed.
 - 5. Sump pumps inside the pits shall be installed and operational.
 - 6. Any penetrations through building walls for chip disposal systems etc. shall be

complete and ready for UFWL system installation. A penetration in the reinforced concrete wall at column line 10 of approximately 18" x 36" located approximately 3" above the inspection pit floor is required and shall also be complete and ready for chip disposal conveyor installation.

7. Provide temporary secure storage area or room for "valuable" items shipped with machine (printers, PC, tools, spare parts, etc).
 8. Main Shop Area shall be clear of any debris.
 9. Overhead crane shall be installed, tested and ready for operation.
 10. Shop floor coatings shall NOT be installed until after completion of work by the UFWL Vendor.
- B. The Contractor shall structure its project CPM schedule to clearly identify the activities needed to achieve the "weather-tight" milestone and to identify the UFWL Vendor activities, in accordance with the CPM schedule requirements of Item # 0969000A – Project Coordinator.

1.03 PROJECT ADMINISTRATION

- A. The activities of the UFWL Vendor will be directed by the Engineer.

1.04 COOPERATION AND COORDINATION OF WORK

- A. The work in this Section requires coordination with the work being performed by the UFWL Vendor that may have equipment and articles that may occupy areas in, around or adjacent to this Contract Work Site. Work shall be performed in cooperation with Other Contractors and so scheduled as to allow speedy and efficient completion of the work.
- B. The UFWL Vendor shall attend coordination meetings as required by Metro-North, CTDOT and with the Contractor to coordinate the work being performed under this contract with the work being performed under contracts and agreements.
- C. The Contractor shall provide Metro-North and CTDOT and the UFWL Vendor proper and safe access to the Site on a scheduled and orderly basis, and will afford them a reasonable opportunity for the delivery and storage of materials and equipment and the execution of their work. The Contractor shall not clutter the Site with equipment, materials and products which could interfere with the work of the UFWL Vendor. The Contractor shall protect the products, equipment and materials stored by the UFWL Vendor on the Site. Disputes arising with respect to delivery or storage of materials or equipment, or otherwise relating to coordination of the Work with the work of the UFWL Vendor or arising with respect to loss, damage or expense incurred or suffered by the Contractor as a result of the acts or omissions of the UFWL Vendor shall be resolved among the various Contractors without recourse to or against Metro-North or CTDOT.
- D. The Contractor shall cooperate and coordinate with the UFWL Vendor in scheduling and performing the work each is required to perform under its respective contract and to furnish

to the UFWL Vendor, upon request, copies of relevant portions of the Contractor's Work Plan Schedules. If the UFWL Vendor encounters a delay that can be avoided by the Contractor's rescheduling the order of the Work without adversely affecting the Contractor's ability to complete its performance by the completion dates specified herein or its overall costs of performance of the Work, the Contractor shall reschedule its performance to accommodate the delayed UFWL Vendor.

- E. The Contractor shall cooperate and coordinate with the UFWL Vendor with respect to all aspects of its performance of the Work which affects the performance of the UFWL Vendor. With respect to facilities which are to be shared by the UFWL Vendor, the Contractor shall mutually agree with the UFWL Vendor on lay down and storage space and the Contractor shall store and access its equipment and materials in a manner that will permit the UFWL Vendor to have sufficient access to their respective equipment and materials. The Contractor shall coordinate with the UFWL Vendor with respect to delivery schedules in order to avoid impeding the access to their respective equipment and materials. The Contractor shall cooperate with the UFWL Vendor in adequately securing common gates and access ways, and establishing agreed upon procedures to protect the security of the equipment and materials of the UFWL Vendor.
- F. With respect to access to the Site, the Contractor shall cooperate with the UFWL Vendor so that the moving of equipment, materials and work forces onto the Site through any limited access point shall occur in the most expeditious manner. The Contractor shall not obstruct any common access point without good reason and reasonable prior notice to the UFWL Vendor and reasonable attempts at accommodating the UFWL Vendor with alternative access, if such obstruction shall continue for more than a brief time.
- G. Contractor shall assure that its forces coordinate and cooperate with the forces of the UFWL Vendor working on the Project.
- H. The Contractor shall install two benchmarks within the Wheel True Pit for use by the UFWL Vendor in the installation of the UFWL and ancillary systems. The locations of the benchmarks shall be coordinated in advance with the UFWL Vendor to ensure that the benchmarks are in convenient and accessible locations.
- I. The Contractor shall utilize shop drawings of the UFWL Vendor indicating the location and nature of foundation elements for the UFWL machinery in the layout of the Wheel True pit slab.
- J. Mutual Responsibility
 - 1. The Contractor shall afford the UFWL Vendor reasonable opportunity for introduction and storage of their materials and equipment and performance of their activities and shall connect and coordinate the Contractor's construction and operations with theirs as required by the Contract Documents.

2. If part of the Work depends upon proper execution or results upon construction or operations by the UFWL Vendor, the Contractor shall, prior to proceeding with that portion of the Work, promptly report to CTDOT apparent discrepancies or defects in such other construction that would render it unsuitable for such proper execution and results. Failure of the Contractor so to report shall constitute an acknowledgment that the UFWL Vendor completed or partially completed construction is fit and proper to receive the Work, except as to defects not then reasonably discoverable.
3. Whenever the Work is dependent upon the work of the UFWL Vendor, the Contractor shall:
 - a. Coordinate its dependent Work with such other work;
 - b. Provide the UFWL Vendor with all necessary dependent data and requirements;
 - c. Examine the drawings and specifications of the work of the UFWL Vendor;
 - d. Notify the UFWL Vendor, with a copy of the notice delivered to CTDOT's Construction Project Manager, of all improperly installed work which would prevent satisfactory installation of the dependent Work; and
 - e. Take all other steps as are necessary to ensure that the dependent Work is properly constructed and installed.
4. At all locations where a portion of the Project to be installed or constructed by the Contractor abuts a portion of the Project to be installed or constructed by the UFWL Vendor, the Contractor shall take special care to ensure that such installation or construction is coordinated to result in a smooth junction between the two portions of the Project, without gaps or mismatches in connections, materials, equipment or grade. If the Contractor proposes to engage in activities which by their nature are disruptive to the activities of the UFWL Vendor, the Contractor shall give reasonable prior notice to the UFWL Vendor and shall coordinate with the UFWL Vendor to schedule such activity in the least disruptive time practicable under the circumstances. When practical, the Contractor shall coordinate similar disruptive activities with the UFWL Vendor so that they occur simultaneously or in sequence if that would benefit the Project as a whole.
5. The Contractor shall promptly remedy damage wrongfully caused by the Contractor to completed or partially completed construction or to property of the UFWL Vendor.

SECTION 03 30 00 - CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. The Contractor shall coordinate work with that of other trades affecting or affected by the work included under this Section and shall cooperate with such trades, the Inspecting Agency, the Designer and the Department to assure the steady and timely progress of the work.
- B. The Contractor agrees to accept the results of any tests secured by a qualified Testing Laboratory.
- C. Where referred to, Standard Specifications of technical societies, manufacturer's associations and federal agencies shall be the latest edition, unless noted otherwise by Connecticut Building Code, and include all amendments current as of the date of issue of these Specifications.

1.2 SUMMARY

- A. Provide all materials and labor necessary to complete all concrete, plain and reinforced as indicated on the Plans or called out for in these specifications and as required to complete the Project. Work included, without limiting the generality thereof, consists of:
 - 1. The installation of all elements including cast-in-place concrete walls, base slabs, foundations, footings, tie beams, and slabs.
 - 2. The installation of trenches, pits, electrical and telephone ductbanks, and other incidental concrete work.
 - 3. Work of architectural and other trades required to be built into the concrete, such as inserts, anchors, embedded plates, under slab conduit or utility supports and reinforcing dowels.
 - 4. Encasement of steel columns as indicated on Structural and Architectural plans to provide for fireproofing and protection from impact.
 - 5. All forms, staging, bracing and other materials and equipment necessary and required to produce the concrete in place and for removal of same.
 - 6. Installation of reinforcing steel, including accessories and supports, anchor bolts, leveling plates and other embedded items.
 - 7. Finishing of concrete as specified herein or as indicated on Plans.

1.3 RELATED WORK SPECIFIED ELSEWHERE

- A. Carefully examine all of the Contract Documents for requirements which affect the work of this section.
 - 1. Carefully review all of the Contract Documents for anchor bolts, inserts, conduits, sleeves, anchors, and all other items which must be cast into concrete construction.

2. Items needed to be embedded in concrete work may or may not be described in detail and must be determined through careful coordination of all subcontractors and building trades.

B. Other specifications sections which directly relate to the work of this section include, but are not limited to, the following:

1. Item #0702396A, "Driving Prestressed Concrete Piles"
2. Section 03 45 00 - Architectural Precast Concrete
3. Section 03 54 00 - Trowelable and Self-Leveling Concrete Underlayment
4. Section 05 50 00 - Metal Fabrications
5. Section 07 14 00 - Fluid Applied Waterproofing
6. Section 07 14 16 - Cold Fluid-Applied Waterproofing
7. Section 07 19 00 - Water Repellent Penetrating Sealer
8. Section 07 92 00 - Joint Sealants.

1.4 QUALITY ASSURANCE

A. Codes and Standards: Comply with provisions of following codes, specifications and standards, except where more stringent requirements are shown or specified:

Connecticut State Building Code

1. ACI 301 "Specifications for Structural Concrete for Buildings".
2. ACI 304 "Recommended Practice for Measuring, Mixing, Transporting and Placing Concrete".
3. ACI 305 "Recommended Practice for Hot Weather Concreting".
4. ACI 306 "Recommended Practice for Cold Weather Concreting".
5. ACI 311 "Recommended Practice for Concrete Inspection".
6. ACI 318 "Building Code Requirements for Reinforced Concrete".
7. ACI 347 "Recommended Practice for Concrete Formwork".
8. ACI 614 "Recommended Practice for Measuring, Mixing, and Placing Concrete".
9. ACI 211.1 "Recommended Practice for Selecting Proportions for Normal Weight - Concrete".
10. ASTM C31 "Making and Curing Concrete Compression and Flexural Strength Test-Specimens in the Field".
11. ASTM C39 "Test Method for Compressive Strength of Cylindrical Concrete Specimens".
12. ASTM C94 "Specifications for Ready Mixed Concrete".
13. ASTM C136 "Sieve Analysis of Fine and Coarse Aggregate".
14. ASTM C138 "Unit Weight, Yield, and Air Content of Concrete".
15. ASTM C143 "Test for Slump of Portland Cement Concrete".
16. ASTM C150 "Specification for Portland Cement".
17. ASTM C171 "Sheet Materials for Curing Concrete".
18. ASTM C172 "Sampling Fresh Concrete".
19. ASTM C231 "Test for Air Content of Freshly Mixed Concrete by the Pressure Method".
20. ASTM C260 "Specification for Air-Entraining Admixtures for Concrete".
21. ASTM C309 "Specification for Liquid Membrane Forming Compounds for Curing Concrete".
22. ASTM C494 "Specification for Chemical Admixtures for Concrete".
23. ASTM C827 "Test Method for Change in Height at Early Ages of Cylindrical Specimens from Cementitious Mixtures".
24. ASTM C989 "Specification for Ground Iron Blast-Furnace Slag for Use in Concrete and Mortars".

- 25. ASTM C1064 "Test Method for Temperature of Freshly Mixed Portland-Cement Concrete".
- 26. ASTM E154 "Test Methods for Water Vapor Retarders Used in Contact with Earth Under Concrete Slabs, on Walls, or as Ground Cover".
- 27. NRMCA "Concrete Plant Standards and Truck Mixer and Agitator Standards".
- 28. CRSI Concrete Reinforcing Steel Institute, "Manual of Standard Practice".
- 29. ACI 302 "Guide For Concrete Floor and Slab Construction".
- 30. ACI 308 "Standard Practice For Curing Concrete".
- 31. ACI 315 "Details and Detailing of Concrete Reinforcement".

- B. Concrete Testing Service: The Contractor shall employ and pay an independent testing laboratory, acceptable to the Department, to perform material evaluation tests and to design concrete mixes or, when acceptable to the Department, provide copies of recently made material tests and mix designs.
- C. Materials and installed work may require testing and retesting, as directed by Designer, at anytime during progress of work. Allow free access to material stockpiles and facilities. All tests, including retesting of rejected materials and installed work, shall be done at Contractor's expense.
- D. Workmanship: The Contractor is responsible for correction of concrete work which does not conform to the specified requirements, including strength, tolerances and finishes. Correct deficient concrete as directed by the Designer.

1.5 SUBMITTALS

- A. Submit the following in accordance with Form 816 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR - SUBMITTALS.
- B. Product Data: Submit manufacturer's product data with application and installation instructions for proprietary materials and items, including reinforcement and forming accessories, admixtures, patching compounds, waterstops, joint systems, curing compounds, dry-shake finish materials, and others as requested by Designer.
- C. Shop Drawings: Submit shop drawings and schedules of all work under this Section for approval prior to fabrication of any material. Shop drawings shall include sufficient plans, sections and detail drawings to suitable scale to permit the erection of the reinforcing steel. Reinforcement: Submit shop drawings for fabrication, bending, and placement of concrete reinforcement. Comply with ACI 315 "Manual of Standard Practice for Detailing Reinforced Concrete Structures". Shop Drawings shall include but not be limited to the following:
 - 1. Bar reinforcement shop drawings shall include setting plans, elevations, bending diagrams, cutting lists and other information so as to completely define and establish the location, spacing, size, length, bending, shape, splicing and keying at construction joints and all other pertinent information as required. Drawings shall show grades of reinforcing steel. Opposite hand reinforcing shall be detailed separately. Wall reinforcing shall be detailed on wall elevations and sections.
 - 2. Type, size and location of all accessories required for proper assembling, placing and support of the reinforcement.
 - 3. All openings, depressions, construction and control joints, trenches, sleeves, inserts and all other project requirements affecting reinforcing details and placing.

4. Sizes, thickness of material, methods of assembly, anchorage, galvanizing, shop paint and all other information necessary.
 5. Type, size and method of attachment of steel and fiberglass corner protection for encased steel columns.
- D. Samples: Submit samples of materials as specified and as otherwise requested by Designer, including names, sources and descriptions.
 - E. Laboratory Test Reports: Submit laboratory test reports for concrete, concrete materials, and mix design tests.
 - F. Material Certificates: Provide materials certificates in lieu of materials laboratory test reports when permitted by Designer. Material certificates shall be signed by manufacturer and Contractor, certifying that each material item complies with, or exceeds, specified requirements.
 - G. Submit written reports to Designer of each proposed mix for each class of concrete to be incorporated into the work at least 15 days prior to start of work. Do not begin concrete production until mixes have been reviewed and accepted by Designer in writing.
 - H. Adjustment to Concrete Mixes: Mix design adjustments may be requested by Contractor when characteristics of materials, job conditions, weather, test results, or other circumstances warrant; at no additional cost to the Department and as accepted by Designer. Laboratory test data for revised mix design and strength results must be submitted to and accepted by Designer in writing before using in work. Admixtures shall be from one source only.
 - I. Batch Ticket Information: Provide concrete delivery tickets showing job name and location, date and time of delivery, quantity of concrete, quality and type of concrete, admixtures, amount of water added, and all other relevant information as described in ASTM C-94. Submit at the end of each week.
 - J. Submit an as-built survey prepared by a Land Surveyor Licensed in the State of Connecticut showing horizontal and vertical locations of all anchorage devices used for building columns, including columns in pits, and a certification that all anchorage devices have been constructed in the correct locations. Fabrication of column base plates and mobilization of steel erection equipment shall not commence until the as-built survey and certification has been submitted and approved by the Designer.

1.6 PROJECT CONDITIONS

- A. Weather: Protect concrete from damage and reduced strength or performance due to weather extremes during mixing, placing and curing.
- B. Cold Weather: Unless specifically authorized by the Designer, concrete work shall not proceed when ambient temperature is below 40°F.
 1. Comply with ACI 306 in cold weather.
 2. Maintain concrete temperature of at least 60°F. Reinforcement, forms and ground in contact with concrete shall be free of frost.

3. Keep concrete and formwork at least 50°F for at least 96 hours after placing concrete.
 4. The use of calcium chloride in any form is not permitted. Non-chloride accelerator shall be used when ambient temperature is below 50°F.
 5. Admixture manufacturer shall provide technical assistance at no additional cost. A manufacturer's representative shall be available for consultation by phone or on site upon 72 hour notice.
- C. Hot Weather: Concrete, when deposited, shall be less than 85°F. Cool the mix in a manner acceptable to the Designer if the concrete temperature is higher.
1. Comply with ACI 305 in hot weather.
 2. Evaporation Retardant shall be used when ambient temperature exceeds 80°F.

1.7 PRE-INSTALLATION MEETING

- A. Conduct a Pre-Installation Meeting at the Project Site in compliance with the requirements of Form 816 Subarticle 1.20-1.05.24-2.
- B. Prior to submittal of the specified concrete design mixes, the Contractor shall schedule a meeting to review procedures for producing proper concrete construction.
- C. The Contractor shall require attendance by responsible representatives of every party who is involved with the concrete work including, but not limited to, the following:
 1. Contractor's superintendent.
 2. Testing Agency responsible for the concrete mix design.
 3. Testing Agency responsible for field quality control.
 4. Concrete Sub-contractor.
 5. Ready-mix concrete producer(s).
 6. Admixture manufacturer.
 7. Concrete pumping Contractor.
 8. Formwork Contractor.
 9. Concrete Finisher.
- D. The Designer will be present at the meeting and must be notified at least 10 days prior to the scheduled date of the meeting.
- E. Minutes of the meeting shall be recorded, published and distributed by the Contractor to all parties concerned within 5 working days of the meeting.

PART 2 - PRODUCTS

2.1 FORM MATERIALS

- A. Forms for Exposed Finish and Architectural Concrete: Unless otherwise indicated, construct formwork for exposed concrete surfaces with plywood, metal, metal-framed plywood faced or other acceptable panel-type materials, to provide continuous, straight, smooth, exposed surfaces. Furnish in largest practicable sizes to minimize number of joints and to conform to joint system shown on plans.
1. Use overlaid plywood complying with U.S. Product PS-1 "A-C or B-B High Density Overlaid Concrete Form", Class I.
 2. Use plywood complying with U.S. Product Standard PS-1 "B-B (Concrete Form) Plywood", Class I, Exterior Grade or better, mill-oiled and edge-sealed, with each piece bearing legible inspection trademark.
 3. Multipour HDO Plywood, Simpson Timber Company or approved equal.
 4. Construct formwork for Architectural concrete using high density overlay products listed above. Joints in formwork shall align with joints indicated on plans. Use appropriate length and width of HDO plywood so that joints in plywood formwork occur at locations shown on Drawings.
- B. Forms for Unexposed Finish Concrete: Plywood, lumber, metal, or other acceptable material. Provide lumber dressed on at least 2 edges and one side for tight fit.
- C. Form Coatings: Provide commercial formulation form-coating compounds that will not bond with, stain, nor adversely effect concrete surfaces, and will not impair subsequent treatments of concrete surfaces. Provide Nox-Crete Form Coating 250 as manufactured by Nox-Crete, Inc., Duogard II as manufactured by W.R. Meadows or Clean Strip Ultra (J-3 VOC) as manufactured by Dayton Superior or approved equal.
- D. Form Ties: For concrete structures which will not be in view or buried below finish grade, use carbon steel factory-fabricated, removable or stay in place snap off type form ties, designed to prevent form deflection and to prevent spalling concrete upon removal. Provide units which will leave no metal closer than 1-1/2" to surface. Provide ties which, when removed, will leave holes not larger than 1" diameter in concrete surface. Patch all holes with non-shrink grout.
1. Form ties and spreaders for walls in areas exposed to view shall be B1 Heavy Duty Stainless Steel Two Strut Coil Tie or B3 Screw on Coil Tie with B30 Screw on Plastic Cones for 1/2 inch bolt diameter, 1-1/2" setback and 1-1/4" diameter to 1" diameter taper by Dayton Richmond or approved equal. Plastic cone holes shall be filled with non-shrink grout. Strut coil ties shall be sized to satisfy loading requirements.
 2. In lieu of carbon steel formties specified in Paragraph D. above, fiberglass formties as manufactured by RJD Industries, Dayton Richmond or approved equal may be used. Fiberglass formties shall be standard gray color. The concrete structure shall be finished by grinding the fiberglass formtie flush with the finish surface of the concrete structure.

- a. If tapered architectural holes are required, dummy tapered cones having a 1" setback and a taper from 1" to 1-1/4 shall be fastened to the interior of the formwork to achieve the specified pattern on the finish structure.
- E. Chamfer Strips: Where chamfers are indicated, provide rubber or polyvinyl chloride type, or smooth clear, sealed softwood.

2.2 REINFORCING MATERIALS

- A. Reinforcing Bars: ASTM A 615 or A 706, Grade 60, deformed.
- B. Epoxy-Coated Reinforcing Bars: ASTM A 775.
- C. Steel Wire: ASTM A 82, plain, cold-drawn steel.
- D. Epoxy-Coated Wire and Welded Wire Fabric: ASTM A 885.
- E. Welded Deformed Steel Wire Fabric: ASTM A 497.
- F. Supports for Reinforcement: Provide supports for reinforcement including bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire fabric in place. Use wire bar type supports complying with CRSI specifications. Wire for tying shall be 18 gauge black annealed wire conforming to ASTM A 82.
 1. For structural slabs, use supports with sand plates or horizontal runners where base material will not support chair legs.
 2. For exposed to view concrete surfaces, where legs of supports are in contact with forms, provide supports with legs which are plastic protected (CRSI, Class 1) or stainless steel protected (CRSI, Class 2).
- G. Fabrication: Reinforcement shall be accurately formed to dimensions of the plans, details and schedules. Fabrication shall not commence until details and schedules have been approved by the Designer in writing.
 1. Reinforcement shall be bent cold, around a pin with a free revolving collar having a diameter ratio to the diameter of the bar not less than:
 - Two times for stirrups
 - Six times for bars up to and including 1 inch
 - Eight times for bars over 1 inch
 2. Reinforcement shall not be straightened or re-bent in a manner that will injure the material. Bars with kinks or bends not shown on the plans will not be used.
- H. Tapered Plate Basket Assembly:
 1. Acceptable product: PNA PD³ Basket[®] Assembly or approved equal.
 2. Material:
 - a. Tapered plate dowels: Plasma cut from hot rolled steel bar meeting ASTM A 36 to within 3/16" of 12" with a 4° taper from the widest end to the narrow end.

- b. Side frame supports: ¼ inch diameter cold drawn wire meeting ASTM A 108, Grade 1010-1020.
 - c. De-bonding agent: Tectyl® 506 or approved equal.
3. Fabrication:
- a. Weld plate dowels (on widest end only) into side frames, with welded ends alternating along length of assembly.
 - b. Weld eight gauge wires across side frames at 3 feet o. c. to keep assembly stable during shipping and installation.
 - c. Thinly and evenly coat plate dowels with de-bonding agent without excessive drips or thickness.
 - d. Finished assembly shall hold tapered plate dowels to within +/- 1/8 inch of ½ slab depth.
 - e. Bar dimensions: ½ inch by 12 inch; 2 ½ inch at the midpoint spaced at 27 inches on center.
- I. Diamond Shaped Load Plate For Construction Joints:
- 1. Acceptable product: PNA Diamond Dowel® System or approved equal.
 - 2. Material:
 - a. Diamond shaped load plate: 3/8" saw cut from hot rolled steel plate meeting ASTM A 36.
 - b. Pocket former: High density plastic with internal collapsible fins and spacer that hold diamond shaped load plate in correct position and creates a void to its vertical faces.
 - c. Dimensions of plate: 3/8" by 4-1/2" by 4-1/2".
- J. Synthetic Structural Fiber Reinforcement: Provide synthetic structural fibers complying with the following requirements:
- 1. Synthetic structural fibers shall meet the requirements of ASTM C 1116, Paragraph 4.1.3, Type III.
 - 2. Synthetic structural fibers shall be made of polypropylene and polyethylene.
 - 3. Synthetic structural fibers shall have a minimum length of 1.5" (38 mm).
 - 4. Synthetic structural fibers shall have an aspect ratio (length divided by the equivalent diameter of the fiber) between 80 and 100.
 - 5. Synthetic structural fibers shall be:
 - a. Grace STRUX 90/40 synthetic fiber reinforcement: or Engineer approved substitute from Fibermesh, Inc. or Euclid Chemical Co.
 - 1) Monofilament Fiber.
 - 2) Specific Gravity: 0.92.
 - 3) Fiber Length: 1.57 inches
 - 4) Aspect Ratio: 90.
 - 6. The minimum addition rate of the synthetic fiber reinforcement shall be:
 - a. Grace STRUX® 90/40 at [4] pounds per cubic yard.

2.3 CONCRETE MATERIALS

- A. Portland Cement: ASTM C 150, Type I or II. Use one brand of cement throughout project, unless otherwise approved in writing by the Designer. The characteristics of the cement and both the fine and coarse aggregate used in the production of all exposed concrete shall be such as to

produce concrete of a light color. These materials are subject to the approval of the Designer based on the inspection of sample panels prepared in accordance with Paragraph 1.05 I.

- B. Granulated Blast-furnace Slag:
1. Blast furnace slag shall comply with ASTM C 989, Grade 120. Blast furnace slag shall be mixed with Portland cement for the 5000 psi mixture as indicated on plans at minimum 25% - 50% ratio.
- C. Normal Weight Aggregates: ASTM C 33, and as herein specified. Use 3/4" maximum size for all concrete, except high early and lean concrete which requires 3/8" aggregate. Provide aggregates from a single source for exposed concrete.
1. Light Weight Course Aggregate: Expanded shale, clay or slate conforming to ASTM C330. Maximum size of aggregates shall be 3/8".
- D. Water: Clean, potable and free from foreign materials in amounts harmful to concrete and embedded steel.
- E. Air-Entraining Admixture: ASTM C 260, certified by manufacturer to be compatible with other required admixtures.
1. Products: Subject to compliance with requirements, products which may be incorporated in the work include, but are not limited to, the following or approved equal:
 - a. "Darex AEA" or "Daravair"; Grace Construction Products
 - b. "Air-Mix"; Euclid Chemical Co.
 - c. "Sika Aer"; Sika Corp.
 - d. "MB-VR or MB-AE"; Master Builders.
- F. Water Reducing Admixture: ASTM C 494, Type A, and containing not more than 0.1% chloride ions.
1. Products: Subject to compliance with requirements, products which may be incorporated in the work include, but are not limited to, the following or approved equal:
 - a. "Daratard-17"; Grace Construction Products.
 - b. "Eucon WR-75"; Euclid Chemical Co.
 - c. "Pozzolith 100XR", Master Builders.
 - d. "Plastiment", Sika Chemical Corp.
- G. High-Range Water Reducing Admixture (Super Plasticizer): ASTM C 494, Type F or Type G and containing not more than 0.05% chloride ions.
1. Products: Subject to compliance with requirements, products which may be incorporated in the work include, but are not limited to, the following or approved equal:
 - a. "ADVA" or "Daracem"; Grace Construction Products.
 - b. "PSP"; Protex Industries Inc.
 - c. "Super P"; Anit-Hydro.
 - d. "Sikament"; Sika Chemical Corp.
 - e. "Rheobuild"; Master Builders.

- H. Water Reducing, Non-Chloride Accelerator Admixture: ASTM C 494, Type E or C, and containing not more than 0.1% chloride ions.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. "Accelguard 80"; Euclid Chemical Co.
 - b. "Pozzutec 20"; Master Builders, Inc.
 - c. "PolarSet"; Grace Construction Products.
 - d. Or approved equal.
- I. Corrosion Inhibitor: At exterior slabs areas, drives and slabs in contact with soil. ASTM C494 Type C Calcium Nitrite, maximum water cement ratio of 0.40. Minimum dosage rate of three and one half (3.5) gallons per cubic yard. Manufacturer of materials shall have a minimum of five years experience in the production of corrosion inhibitors for concrete.
1. Test and Performance Data: The corrosion inhibitor shall have been tested in accordance with the following test procedures:
 - a. FHWA/RD-83/012.
 - b. ASTM G61
 - c. ASTM G109
- J. Water Reducing, Retarding Admixture: ASTM C 494 Type D, and containing not more than 0.1% chloride ions.
1. Products: Subject to compliance with requirements, products which may be incorporated in the work include, but are not limited to, the following or approved equal:
 - a. "Edoco 20006"; Edoco Technical Products.
 - b. "Pozzoloth Retarder"; Master Builders.
 - c. "Eucon Retarder 75"; Euclid Chemical Co.
 - d. "Daratard"; W. R. Grace.
 - e. "Plastiment"; Sika Chemical Co.
- K. Shrinkage Control Admixture shall be "Eclipse Plus" by Grace Construction Products or approved equivalent product.
- L. Prohibited Admixtures: Calcium chloride shall not be used.
- M. High Early Strength Cement: High early strength cement shall be required at manholes locations for riser sections and elsewhere as indicated on plans. High early strength material shall be a hydraulic cement, Five Star Highway Patch as manufactured by Five Star Products, Inc., Emaco T415 as manufactured by Master Builders Inc., HD50 as manufactured by Dayton Superior or approved equal meeting or exceeding the following physical properties:

<u>Property</u>	<u>Test</u>	<u>Result</u>
1. Compressive Strength	ASTM C-109	2 hours - 2,000 psi 1 day - 5,000 psi

		7 day -	7,000 psi
2. Bond Strength	ASTM C-882	1 day -	1,500 psi
		7 day -	2,000 psi
3. Length Change	ASTM C-157	28 day wet	+ 0.05%
		28 day dry	- 0.05%
4. Set Time	ASTM C-266	Initial -	15 min.
		Final -	30 min.
5. Freeze /Thaw Resistance Relative Durability Factor	ASTM C-666 (A)		90%

2.4 RELATED MATERIALS

- A. Reglets: Where resilient or elastomeric sheet flashing or bituminous membranes are terminated in reglets, provide reglets of not less than 26 gauge galvanized sheet steel. Fill reglet or cover face opening to prevent intrusion of concrete or debris.
- B. Expanding Waterstop Strip: Expanding waterstop shall be natural rubber product that has been chemically modified to incorporate hydrophilic agents. This process shall permit the waterstop materials to undergo controlled expansion in the presence of moisture. The expansion shall provide a double locking water-stop, one from the rubber's natural resiliency and one from expansion. Expansion shall occur in three dimensions: width, height, and length and will follow the direction of least resistance. The waterstop shall incorporate a stainless steel wire net within the material. The wire net shall eliminate unnecessary expansion in length and width and help prevent "winding" action when fastened to concrete. The water stop materials shall have excellent durability and resistance to chemicals and shall be capable of performing in salt water and cement water. The materials shall not contain any toxic substance or heavy metals and shall be environmentally safe. Physical properties shall include the following:

<u>Physical Properties</u>	<u>Test Method</u>	<u>Value</u>
Size		.78 in X .39 in (0.78" x 0.39")
Hardness	ASTM D2240	30±6
Tensile Strength	ASTM D412	100 psi
% Elongation at Ultimate Failure	ASTM D412	500%
Volume Exp. Coefficient		2
Vulcanization		No
Days to Max Vol Expansion		35
Specific Gravity	ASTM D792	1.18

1. Expanding Sealant: Provide a single component hydrophilic sealant to be used in conjunction with expanding waterstop for all new and repair applications where rough surfaces are encountered. Physical properties shall be as follows:

<u>Physical Properties</u>	<u>Test Method</u>	<u>Value</u>
Hardness	ASTM D2240	28
Tensile Strength	ASTM D412	350 psi
% Elongation at Ultimate Failure	ASTM D412	700%
Volume Exp. Coefficient		1.8
Polymerized		Yes
Tack Free		10 hours

- C. Non-Shrink Grout: Non-shrink, Non-metallic Grout: Provide non-metallic cement based grout requiring only addition of water, with minimum 28-day compressive strength of 8,000 psi, with shrinkage compensation characteristics in both the plastic and hardened states, conforming with ASTM C1107, "Grade C". Manufactured by: Five Star Grout 100 by Five Star Products Inc., SikaGrout 212 as manufactured by Sika Corporation, or Masterflow 928 by Master Builders, Inc. or approved equal.
- D. Moisture-Retaining Cover: Provide HydraCure reusable, reflective wet cure blankets as manufactured by PNA Construction Technologies, Transguard 4000 Reusable Wet Cure Covers by Reef Industries, Inc. or approved equal. Wet cure blankets shall be comprised of a non-woven polypropylene fabric coated with a white-pigmented polyethylene, total thickness 42 mils.
- E. Liquid Membrane-Forming Curing Compound:
 1. Curing and Sealing Compound: Clear styrene acrylate or acrylic polymer type, 30% solid content minimum. Compound shall be "Super Rez Seal" or "Super Floor Coat" by The Euclid Chemical Company or "Masterseal 66" by Master Builders or approved equal.
 2. Dissipating Resin Curing Compound: Dissipating resin type conforming to ASTM C309, Type I, "Kurez DR" by The Euclid Chemical Company, "Vulkem 2100" by Mameco International, Bro-Cure by Nox-Crete, Inc. or approved equivalent product. The film must chemically break down in a two to four week period.
 3. Compounds containing sodium silicate are prohibited.
- F. Underlayment Compound: Refer to Section 03 54 00 - TROWELABLE AND SELF-LEVELING CONCRETE UNDERLAYMENT.
- G. Bonding Compound: Polyvinyl acetate or acrylic base.
 1. Products: Subject to compliance with requirements, products which may be incorporated in the work include, but are not limited to, the following or approved equal:
 - a. Acrylic or Styrene Butadiene:
 - 1) "J-40 Bonding Agent"; Dayton Superior Corp.
 - 2) "Everbond"; L & M Construction Chemicals.
 - 3) "Hornweld"; A. C. Horn, Inc.

4) "Daraweld C"; W. R. Grace.

H. Evaporation Retarder shall be "Eucobar" by The Euclid Chemical Company or "Confilm" by Master Builders or approved equivalent product.

I. Compressible Filler Materials:

1. Compressible foam expansion joint filler material used at Joints between abutting concrete surfaces indicated to receive surface sealant materials shall be a flexible synthetic gray foam of isomeric polymers in a mini, closed cell structure. The foam shall be lightweight, flexible, highly resilient with a recovery of over 99%. The cell structure shall be virtually non-absorbent. The foam shall be non-extruding, non-gassing, non-staining and shall be capable of bonding to concrete surfaces with common cartridge adhesives. Provide Ceramar as manufactured by W. R. Meadows or approved equal.

J. Curing/Sealer/Hardening/Dustproofing Sealer:

1. Where concrete curing agent/sealer/hardener/dustproofing is called for on the plans or is specified herein for structural slabs, provide "Ashford Formula" manufactured by Curecrete Chemical Company, or approved equal from Tnemec, Chemprobe or Unitex with the following attributes:

a. A non-film forming chemical that penetrates into the concrete where it reacts with the alkali and lime, commonly called concrete salts. During this reaction it chemically combines with the salts melting them within the concrete into a gel which locks the pores of the concrete.

b. This process densifies the concrete into a solid mass that does not allow penetration into the concrete surface.

c. The performance criteria shall be established by tests conducted by recognized independent testing laboratories.

1) Curing: Reduce moisture loss by a minimum of 90% during initial 24 hours.

2) Abrasion: Taber C-17 wheel, min. 30% increase in abrasion resistance.

3) Bonding: ASTM-D3359, min. 17% increase in epoxy adhesion.

4) Hardening: ASTM-C-42, min. 38% increase in compressive strength at 28 days.

5) ASTM-C-805, min. 13% increase impact resistance, Schmidt Hammer Test Method.

6) Permeability: ASTM modified, 7 in. head, min. leakage 0.0005 cubic inches/hour.

7) Chemical Resistance: The manufacturer shall provide a chemical resistance guide listing test results by independent laboratories.

2.5 PROPORTIONING AND DESIGN OF MIXES

A. Prepare design mixes for each type and strength of concrete by either laboratory trial batch or field experience methods as specified in ACI 301. If trial batch method used, use an independent

testing facility acceptable to Department for preparing and reporting proposed mix designs. The testing facility shall not be the same as used for field quality control testing.

B. Submit written reports to Designer for review of design mix for specified strength of concrete within 15 days prior to start of work. Do not begin concrete production until mixes have been reviewed by Designer.

C. Mix design and concrete admixture requirements:

Location	f _c	w/c Ratio	Air Entr	DCI	HRWRA	Eclipse+	Blast Furnace Slag	Sealer	Reinf. E.C.	Macro Fibers
Foundation Beams and Pile Caps	4000 psi	0.4	4% ± 1.5%	No	Yes	No	No	No	Yes*	No

Structural Slabs and walls in Pits	5000 psi	0.4	4% ± 1.5%	3.5 gal/CY	Yes	Yes	100 lb/CY	Yes	Yes*	4 lbs. CY Strux 90/40
Structural Slabs on Ground	4000 psi	0.4	4% ± 1.5%	3.5 gal/CY	Yes	Yes	100 lb/CY	Yes	Yes*	4 lbs. CY Strux 90/40
Foundation. Mats and Light Weight Conc. Infill	4000 psi	0.5	4% ± 1.5%	No	No	No	No	No	No	No
Curbs, Toppings & Steel Column Encasement	4000 psi	0.4	6% ± 1.5%	No	No	yes	No	Yes	Yes	4 lbs. CY Strux 90/40
Mudmat	3000 psi	0.45	6% ± 1.5%	no	no	no	no	no	no	no

*Epoxy-coated reinforcing is required for all structural slab top reinforcing, all foundation beam top reinforcing, and all foundation beam stirrups. Also, epoxy-coated reinforcing is required for all dowels that lap with structural slab top reinforcing.

D. Mix Proportions for High Early Concrete: High early concrete shall be a preblended, prepackaged material requiring only the addition of water and stone aggregate.

E. Adjustment to Concrete Mixes: Mix design adjustments may be requested by Contractor when characteristics of materials, job conditions, weather, test results, or other circumstances warrant; at Contractor's expense and as accepted by Designer. Laboratory test data for revised mix design and strength results must be submitted to and accepted by Designer before using in work.

F. Admixtures

1. Use water-reducing admixture or high range water reducing admixture (super plasticizer) in all concrete in strict accordance with the manufacturer's printed instructions.
2. Use non-chloride accelerating admixture in concrete slabs placed at ambient temperatures below 50° F in strict accordance with the manufacturer's printed instructions.
3. Use high-range water-reducing admixture in pumped concrete, concrete required to be watertight, and concrete with water/cement ratios below 0.50.

4. Use air-entraining admixture in all concrete, unless otherwise indicated. Add air-entraining admixture at manufacturer's prescribed rate to result in concrete at point of placement having total air content of 6.5% with a tolerance of $\pm 1\text{-}1/2\%$.

G. Consistency:

1. The consistency shall be uniformly maintained within the allowable range of slump for the job materials. The specified water cement ratio shall be maintained at all times.

2.6 CONCRETE MIXING

- A. Ready-Mix Concrete: Comply with requirements of ASTM C 94, and as herein specified. Delete references for allowing additional water to be added to batch for material with insufficient slump. Addition of water to the batch will not be permitted.

1. During hot weather, or under conditions contributing to rapid setting of concrete, a shorter mixing time than specified in ASTM C 94 may be required. When air temperature is between 85°F (30° C) and 90°F (32°C), reduce mixing and delivery time from 1-1/2 hours to 75 minutes, and when air temperature is above 90°F (32°C), reduce mixing and delivery time to 60 minutes.

2. During cold weather, concrete shall not be mixed while the temperature is below 40 degrees without the permission of the Engineer. If permission is granted for mixing under such conditions, aggregates or water, or both, shall be heated and the concrete shall be placed at a temperature not less than 50 degrees nor more than 80 degrees F.

- B. High Early Strength Concrete: Follow manufacture's product specific installation guidelines. Cement shall be added to a premeasured amount of water that does not exceed the manufacturer's maximum recommended water content. Material can be extended up to 60% using pea gravel.

- C. Retempering of concrete by adding water or any other material shall not be permitted.

PART 3 - EXECUTION

3.1 GENERAL

- A. Coordinate the installation of joint materials and vapor retarders with placement of forms and reinforcing steel.

3.2 FORMS

- A. Design, erect, support, brace, and maintain framework to support vertical and lateral, static, and dynamic loads that might be applied until such loads can be supported by concrete structure. Construct formwork so concrete members and structures are of correct size, shape, alignment, elevation, position and dimensions of the concrete called for on the plans. Maintain formwork construction tolerances complying with ACI 347.

- B. Design formwork to be readily removable without impact, shock, or damage to cast-in-place concrete surfaces and adjacent materials.
- C. Construct forms to sizes, shapes, lines, and dimensions shown, and to obtain accurate alignment, location, grades, level and plumb work in finished structures. Provide for openings, offsets, sinkages, keyways, recesses, moldings, rustications, reglets, chamfers, blocking, screeds, bulkheads, anchorages and inserts, and other features required in work. Use selected materials to obtain required finishes. Solidly butt joints and provide back-up at joints to prevent leakage of cement paste.
- D. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush plates or wrecking plates where stripping may damage cast concrete surfaces. Provide top forms for inclined surfaces where slope is too steep to place concrete with bottom forms only. Kerf wood inserts for forming keyways, reglets, recesses, and the like, to prevent swelling and for easy removal.
- E. Provide temporary openings where interior area of formwork is inaccessible for clean out, for inspection before concrete placement, and for placement of concrete. Securely brace temporary openings and set tightly to forms to prevent loss of concrete mortar. Locate temporary openings on forms at inconspicuous locations.
- F. Chamfer exposed corners and edges as indicated, using wood, metal, PVC, or rubber chamfer strips fabricated to produce uniform smooth lines and tight edge joints.
- G. Provisions for Other Trades: Provide openings in concrete formwork to accommodate work of other trades. Determine size and location of openings, recesses, and chases from trades providing such items. Accurately place and securely support items built into forms.
- H. Cleaning and Tightening: Thoroughly clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt or other debris just before concrete is placed. Retightening forms and bracing after concrete placement is required to eliminate mortar leaks and maintain proper alignment.
- I. Form ties and spreaders shall be of such type as to leave no metal closer than 1 inch from the exposed concrete surfaces. Tie rod holes shall be plugged solid with mortar of same color and texture as the concrete. Cutting ties back from the surface will not be permitted.
- J. Shoring posts or uprights shall not be removed until the supported member has acquired sufficient strength to safely support its own weight and all loads upon it. Members subjected to additional loads during construction shall be adequately shored and braced. The Contractor shall assume full responsibility for any damage to the structure due to premature removal of forms.
- K. Openings, Sleeves, Pipes and Embedded Items:
 - 1. Conform to requirements of the "ACI Building Code" Section 503, pipes, conduits, etc., embedded in concrete. The Contractor shall obtain the necessary information as to the exact locations of holes, sleeves, recesses, etc. and cooperate with the interested trades so that these items will be installed in the work. Failure of the contractor to obtain the information and to cooperate shall require him to do all cutting and patching of concrete that may thereby become necessary. Provide shelves for slabs and pockets for floor beams in concrete foundation work as shown or required by structural plans.

- L. Conduits and Sleeves: The following applies to conduits, pipes, and sleeves which may be embedded in concrete. Sizes refer to outside diameter.
 - 1. Pipes shall not be coated with paint or enamel or otherwise except galvanizing, sherardizing or their approved equivalent.
 - 2. Reinforcing shall not be cut or displaced from its indicated position to accommodate pipes; in particular pipes shall not be placed between forms and bottom slab rods, or above top slab rods.
 - 3. In slab pipes shall not be larger than 1/4 the slab or wall thickness and shall be placed and kept within the middle two quarters of that thickness.
 - 4. Pipes larger than 1/6 the slab or wall thickness shall be run roughly parallel and at right angles to the reinforcing, not diagonally.
 - 5. Pipes nearly parallel shall be spaced at least three diameters on centers.
 - 6. Pipes shall not be embedded lengthwise in beams or columns.
- M. Openings Through Beams: Openings through beams from side to side may be formed within the middle third of the span. Openings not higher than 1/4 of the depth of the beam or longer than 1/2 the depth may be formed in any manner provided it is below the slab, clears bottom reinforcing by at least 2-1/2 in. and multiple openings are spaced at least thrice their length on centers.
- N. Under Slab Conduit and Utility Supports: Under slab conduit and utility supports shall be configured and spaced as per details in the Structural Drawings.

3.3 PLACING REINFORCEMENT

- A. Comply with Concrete Reinforcing Steel Institute's recommended practice for "Placing Reinforcing Bars", for details and methods of reinforcement placement and supports, and as herein specified.
- B. Clean reinforcement of loose rust and mill scale, earth, ice, and other materials which reduce or destroy bond with concrete.
- C. Accurately position, support, and secure reinforcement against displacement by formwork, construction, or concrete placement operations. Locate and support reinforcing by metal chairs, runners, bolsters, spacers, or hangers, as required.
- D. Place reinforcement to obtain at least minimum coverage for concrete protection. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position during concrete placement operations. Set wire ties so ends are directed into concrete, not toward exposed concrete surfaces.
- E. Install welded wire fabric in as long lengths as practicable. Lap adjoining pieces at least one full mesh (12 in. minimum) and lace splices with wire. Offset end laps in adjacent widths to prevent continuous laps in either direction.

- F. Material shall bear mill identification symbol, and be stored so that different types may be identified.

3.4 JOINTS

- A. Construction Joints: Locate and install construction joints as indicated, or, if not indicated, locate so as not to impair strength and appearance of the structure, as acceptable to Designer. Submit proposed construction joint locations to the Designer for approval. Provide construction joints using diamond dowel system wherever concrete placement is interrupted for more than 1/2 hour and at the end of placement. Coordinate with expansion joint locations where possible. Provide diamond dowel system at not more than 18 in. on center to transfer vertical loads but permit horizontal movement.
- B. Control Joints: [Also called "Contraction Joints"]. Provide control joints at least one-fourth the slab depth by saw-cutting, tooling, or using removable inserts. Provide plate dowel basket assembly at joint locations per manufacturer's recommendations prior to concrete placement. Provide control joints at locations indicated or approved by Designer.
- C. Unless otherwise indicated on plans provide keyways at least 1-1/2" deep in construction joints in walls, slabs, and between walls and footings; accepted bulkheads designed for this purpose may be used for slabs.
- D. Place construction joints perpendicular to main reinforcement. Continue reinforcement across construction joints, except as otherwise indicated.
- E. When the placing of concrete is suspended, necessary provisions shall be made for joining future work before the placed concrete takes its initial set. For the proper bonding of old and new concrete, such provisions shall be made for grooves, steps, keys, dovetails, reinforcing bars or other devices as may be described. Before depositing new concrete against old concrete which has hardened, the surface of the hardened concrete shall be cleaned by heavy steel broom, roughened slightly, wetted, and covered with a neat coating of cement paste or grout. Install joint sealant where shown on plans in accordance with manufacturers instructions.
- F. Expansion Joints: If indicated, shall be built in the location and to the dimensions and details shown on the plans.

3.5 INSTALLATION OF EMBEDDED ITEMS

- A. Set and build into work anchorage devices and other embedded items required for other work that is attached to, or supported by, cast-in-place concrete. Use setting drawings, diagrams, instructions, and directions provided by suppliers of items to be attached thereto.
- B. Installation of Expanding Waterstop Strip:
 - 1. Install as indicated on the plans. Waterstop must be completely encapsulated in concrete per manufacturer's recommendations. The minimum cover is 2 inches.
 - 2. Apply waterstops to smooth concrete surfaces using concrete screws placed 8 to 10 inches apart which penetrate concrete a minimum of 3/4 inch. Apply tension to the strip while screwing to obtain close adhesion to concrete. Overlap ends a minimum of 2 inches when joining. Cut the strip to fit corners closely and apply expanding sealant over joints.

3. For rough surfaces screw waterstop in place as specified above and apply a continuous 1/2" bead of manufacturer's single component hydrophilic sealant along both sides of the waterstop.

3.6 PREPARATION OF FORM SURFACES

- A. Clean re-used forms of concrete matrix residue, repair and patch as required to return forms to acceptable surface condition.
- B. Coat contact surfaces of forms with a form-coating compound before reinforcement is placed.
- C. Thin form-coating compounds only with thinning agent of type, amount, and under conditions of form-coating compound manufacturer's directions. Do not allow excess form-coating material to accumulate in forms or to come into contact with in-place concrete surfaces against which fresh concrete will be placed. Apply in compliance with manufacturer's instructions.
- D. Coat steel forms with a non-staining, rust-preventative form oil or otherwise protect against rusting. Rust-stained steel formwork is not acceptable.

3.7 CONCRETE PLACEMENT

- A. Preplacement Inspection: Before placing concrete, inspect and complete formwork installation, reinforcing steel, and items to be embedded or cast-in. Notify other crafts to permit installation of their work; cooperate with other trades in setting such work. Moisten wood forms immediately before placing concrete where form coatings are not used.
 1. Apply temporary protective covering to lower 2' of finished walls adjacent to poured floor slabs and similar conditions, and guard against spattering during placement.
- B. Coordinate the installation of joint materials and moisture barriers with placement of forms and reinforcing steel.
- C. General: Comply with ACI 304 "Recommended Practice for Measuring, Mixing, Transporting, and Placing Concrete", and as herein specified.
 1. Deposit concrete continuously or in layers of such thickness that no concrete will be placed on concrete which has hardened sufficiently to cause the formation of seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as herein specified. Deposit concrete as nearly as practicable to its final location to avoid segregation.
- D. Placing Concrete in Forms: Deposit concrete in forms in horizontal layers not deeper than 24" and in a manner to avoid inclined construction joints. Where placement consists of several layers, place each layer while preceding layer is still plastic to avoid cold joints.
- E. Consolidate placed concrete by mechanical vibrating equipment supplemented by hand-spading, rodding, or tamping. Use equipment and procedures for consolidation of concrete in accordance with ACI 309.
- F. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations not farther than visible effectiveness of machine. Place vibrators to rapidly penetrate placed layer and at least 6" into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to set. At each insertion limit duration of vibration to

time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing segregation of mix.

- G. Placing Concrete Slabs: Verify that waterproofing is in place at slab-on-grade locations and all joints sealed, all reinforcing steel placed and supported and all mechanical and electrical pipes and conduits placed. Deposit and consolidate concrete slabs in a continuous operation, within limits of construction joints, until the placing of a panel or section is completed.
- H. Consolidate concrete during placing operations so that concrete is thoroughly worked around reinforcement and other embedded items and into corners.
- I. Bring slab surfaces to correct level with straightedge and strike-off. Use bull floats or darbies to smooth surface, free of humps or hollows. Do not disturb slab surfaces prior to beginning finishing operations.
 - 1. Placement of concrete in floor slabs shall be brought to the prescribed level by the use of steel T, or pipe screeds, set to produce the required thickness of the slab above the form. The process known as "wet screeding" by use of darby without set guides will not be allowed. Use of vibrating screeding apparatus may be allowed, but not to avoid compaction by the means specified. Methods using laser light may be approved if proper procedures for establishing the thickness of the slab and the surface elevations are approved by the Designer. Tolerances in level shall not exceed those given in ACI 302.1R-89, ACI 117, and ASTM E1155 as follows:
 - a. All Elevated Slabs and Slabs Supported by Structural Steel: Floors shall conform to a Floor Flatness Number of not less than F(F) 30; and of levelness, F(L) 20; with minimum local values of flatness, F(F) 24; and of levelness, F(L) 15.
 - b.. All Slabs at Grade: Floor shall conform to a Floor Flatness Number of not less than F(F) 25 and a Floor Levelness Number of not less than F(L) 20; with minimum local values of flatness, F(F) 17; and of levelness, F(L) 15.
 - 2. Testing of F(F) and F(L) tolerances shall be conducted in accordance with the provisions set forth in ASTM E1155 and ASTM Committee E.6.21.1 using a measuring device specifically designed to measure floor flatness.
 - 3. All floor tolerance measurements shall be made within 24 hours after slab installation. Results of all tests including formal notice of acceptance or rejection of the work shall be provided to the Contractor within 72 hours after slab installation.
- J. Maintain reinforcing in proper position during concrete placement operations.
- K. Cold Weather Placing: Protect concrete work from physical damage or reduced strength which could be caused by frost, freezing actions, or low temperatures, in compliance with ACI 306 and as herein specified. Uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 50°F and not more than 80°F at point of placement.
 - 1. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
 - 2. Do not use calcium chloride, salt, and other materials containing antifreeze agents or chemical accelerators, unless otherwise accepted in mix designs.

- L. Hot Weather Placing: When hot weather conditions exist that would seriously impair quality and strength of concrete, place concrete in compliance with ACI 305 and as herein specified.
 - 1. Cool ingredients before mixing to maintain concrete temperature at time of placement below 85°F. Mixing water may be chilled, or chopped ice may be used to control temperature provided water equivalent of ice is calculated to total amount of mixing water.
 - 2. Cover reinforcing steel with water-soaked burlap if it becomes too hot, so that steel temperature will not exceed the ambient air temperature immediately before embedment in concrete. Fog spray forms, reinforcing steel, and subgrade just before concrete is placed.
 - 3. Use water-reducing retarding admixture (Type D) when required by high temperatures, low humidity, or other adverse placing conditions.
 - 4. Do not use retarding admixtures unless accepted in mix designs, or approved by Designer.
 - 5. When high temperatures, low humidity and dry winds create conditions which may produce plastic cracking (when the rate of evaporation exceeds 2 lbs. per s.f. per hr.), the evaporation retarder specified may be required to be applied by spray one or more times during the finishing operation. Placing under these conditions should be reviewed by the Designer/Testing Laboratory prior to placing any concrete.
- M. The Contractor shall be held responsible for any defective work, resulting from freezing or injury in any manner during placing and curing, and shall replace such work at no additional expense to the Department.

3.8 FINISH OF FORMED SURFACES

- A. Rough Form Finish: This finish shall be used for formed concrete surfaces not exposed-to-view in the finish work or by other construction, unless otherwise indicated. The concrete surface may have texture imparted by form facing material used. Tie holes and defective areas shall be repaired and patched and fins and other projections exceeding 1/4" in height shall be rubbed down or chipped off.
- B. Smooth Form Finish: This finish shall be used for formed concrete surfaces exposed-to-view, or that are to be covered with a coating or covering material applied directly to concrete such as waterproofing, dampproofing, painting, or other similar system. This as-cast concrete surface shall be obtained with selected form facing material, arranged orderly and symmetrically with a minimum of seams. Repair and patch defective areas with fins or other projections completely removed and smoothed.
- C. Architectural Concrete: This finish shall be used for formed concrete surfaces at exterior slab and stair locations. These surfaces shall have all bug hole greater than 1/4" filled followed by medium sandblast. Formwork and control joints locations shall be indicated on Plans. Tops of walls shall have cast chamfered edges, no tooled edges will be permitted.
- D. Related Unformed Surfaces: This finish shall be used at tops of walls, horizontal offsets and similar unformed surfaces occurring adjacent to formed surfaces. Strike-off smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces, unless otherwise indicated.

3.9 MONOLITHIC SLAB FINISHES

- A. Trowel Finish: Apply trowel finish to monolithic concrete surfaces to be exposed-to-view.
- B. Non-Slip Broom Finish: For sidewalk surfaces including steps, and ramps, and elsewhere as indicated apply non-slip broom finish and water repellent penetrating sealer specified in Section 07 19 00.
 - 1. Immediately after float finishing, slightly roughen concrete surface by brooming with fiber bristle broom perpendicular to main traffic route. Coordinate required final finish with Designer before application.
- C. Tooled Joints: Tool joints in slab surfaces shall be as indicated on Plans.

3.10 CONCRETE CURING AND PROTECTION

- A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures.
 - 1. Start initial curing as soon as free water has disappeared from concrete surface after placing and finishing. Keep continuously moist for not less than 7 days.
 - 2. Begin final curing procedures immediately following initial curing and before concrete has dried. Continue final curing for at least 7 days in accordance with ACI 301 procedures. Avoid rapid drying at end of final curing period.
- B. Curing Methods: Perform curing of concrete by curing and sealing compound, by moist curing, by moisture-retaining cover curing, and by combinations thereof, as herein specified.
- C. Provide Moisture Curing by Following Methods:
 - 1. Keep concrete surface continuously wet by covering with water. (After initial set)
 - 2. Use fog misting when the rate of evaporation exceeds 2 lbs/sq.Ft./Hour. Fogging shall continue after the finishing operation until absorptive cover is placed over the concrete.
 - 3. Cover concrete surface with specified absorptive cover, thoroughly saturating cover with water and keeping continuously wet. Place absorptive cover to provide coverage of concrete surfaces and edges, with 4" lap over adjacent absorptive covers.
- D. Provide moisture-cover curing as follows: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width with sides and ends lapped at least 4" and sealed by waterproof tape or adhesive. Immediately repair any holes or tears during curing period using cover material and waterproof tape.
- E. Curing Formed Surfaces: Cure formed concrete surfaces, including undersides of beams, supported slabs, and other similar surfaces by moist curing with forms in place for full curing period or until forms are removed. If forms are removed, continue curing by methods specified above, as applicable.
- F. Curing Unformed Surfaces: Cure unformed surfaces, such as slabs, floor topping, and other flat surfaces by application of appropriate curing method.

1. Final cure concrete surfaces to receive liquid floor hardener or finish flooring by use of moisture-retaining cover, unless otherwise directed.

3.11 REMOVAL OF FORMS

- A. Formwork not supporting weight of concrete, such as sides of beams, walls, columns, and similar parts of the work, may be removed after cumulatively curing at not less than 50°F for 48 hours after placing concrete, provided concrete is sufficiently hard to not be damaged by form removal operations, and provided curing and protection operations are maintained.
- B. Formwork supporting weight of concrete, such as the underside of beams, slabs, girders, and other similar construction, shall remain in place for a minimum of 14 days or until concrete has attained design minimum 28 day compressive strength, whichever is greater. Determine potential compressive strength of in-place concrete by testing field-cured specimens representative of concrete location or members.
- C. Form facing material may be removed 4 days after placement, only if shores and other vertical supports have been arranged to permit removal of form facing material without loosening or disturbing shores and supports.

3.12 RE-USE OF FORMS

- A. Clean and repair surfaces of forms to be re-used in work. Split, frayed, delaminated, or otherwise damaged form facing material will not be acceptable for exposed surfaces. Apply new form coating compound as specified for new formwork.
 1. When forms are extended for successive concrete placement, thoroughly clean surfaces, remove fins and laitance, and tighten forms to close joints. Align and secure joint to avoid offsets. Do not use "patched" forms for exposed concrete surfaces, except as acceptable to Designer.
 2. Forms for architectural concrete shall not be reused if there is any evidence of surface wear and tear or defect which would impair the quality of the surface. Forms shall be thoroughly cleaned and properly coated before reuse.
 3. Formwork for architectural concrete shall be observed continuously while concrete is being placed to insure that there are no deviations from desired elevation, alignment, plumbness, or camber. If during construction, any weakness develops and the falsework shows any undue settlement or distortion, the work shall be stopped, the affected construction removed if permanently damaged, and the falsework strengthened.

3.13 CONCRETE SURFACE REPAIRS

- A. General: Any defective work disclosed after removal of forms shall be immediately removed and replaced. If in the opinion of the Designer, the surface of the concrete cannot be repaired satisfactorily, the entire section shall be removed and replaced at no additional expense to the Department.
- B. Patching Defective Areas: Repair and patch defective areas with cement mortar immediately after removal of forms, when acceptable to Designer.

1. Cut out honeycomb, rock pockets, voids over 1" in any dimension, and holes left by tie rods and bolts, down to solid concrete but, in no case to a depth of less than 1". Make edges of cuts perpendicular to the concrete surface. Thoroughly clean, dampen with water, and brush-coat the area to be patched with specified bonding agent. Place patching mortar after bonding compound has dried.
- C. For exposed-to-view surfaces, blend white Portland cement and standard Portland cement so that, when dry, patching mortar will match color surrounding. Provide test areas at inconspicuous location to verify mixture and color match before proceeding with patching. Compact mortar in place and strike-off slightly higher than surrounding surface.
- D. Repair of Formed Surfaces: Remove and replace concrete having defective surfaces if defects cannot be repaired to the satisfaction of the Designer. Surface defects, as such, include color and texture irregularities, bulges, uneven surfaces, air bubbles, honeycomb, rock pockets; fins and other projections on surface; and stains and other discolorations that cannot be removed by cleaning. Flush out form tie holes, fill with dry pack mortar, or precast cement cone plugs secured in place with bonding agent.
- E. Repair concealed formed surfaces, where possible, that contain defects that affect the durability of concrete. If defects cannot be repaired, remove and replace concrete.
- F. Repair of Unformed Surfaces: Test unformed surfaces, such as monolithic slabs, for smoothness and verify surface plane to tolerances specified for each surface and finish. Correct low and high areas as herein specified. Test unformed surfaces sloped to drain for trueness of slope, in addition to smoothness using a template having required slope.
- G. Repair defective areas, except random cracks and single holes not exceeding 1" diameter, by cutting out and replacing with fresh concrete. Remove defective areas to sound concrete with clean, square cuts and expose reinforcing steel with at least 3/4" clearance all around. Dampen concrete surfaces in contact with patching concrete and apply bonding compound. Mix patching concrete of same materials to provide concrete of same type or class as original concrete. Place, compact, and finish to blend with adjacent finished concrete. Cure in same manner as adjacent concrete.
- H. Repair isolated random cracks and single holes not over 1" in diameter by dry-pack method. Groove top of cracks and cut-out holes to sound concrete and clean of dust, dirt, and loose particles. Dampen cleaned concrete surfaces and apply bonding compound. Mix dry-pack, consisting of one part Portland cement to 2-1/2 parts fine aggregate passing a No. 16 mesh sieve, using only enough water as required for handling and placing. Place dry pack after bonding compound has dried. Compact dry-pack mixture in place and finish to match adjacent concrete. Keep patched area continuously moist for not less than 72 hours.
- I. Perform structural repairs with prior approval of Designer for method and procedure, using specified epoxy adhesive and mortar.
- J. Repair methods not specified above may be used, subject to acceptance of Designer.

3.14 ENCASEMENT OF COLUMNS

- A. Encasement of steel columns shall conform to the 2005 State Building Code requirements in Table 601 for Type IB construction.

- B. Encasement of steel columns shall conform to the 2005 State Building Code requirements in Chapter 7.
- C. Steel columns shall be cleaned of loose rust, mill scale and any other material that could affect the integrity of the concrete encasement. The floor slab at the base of the column shall be roughened prior to placement of the welded wire fabric and forms. Welded wire fabric need not be attached to the column, but must be positively offset from the interior surface of the forms to ensure compliance with requirements in the State Building Code.
- D. Concrete encasement shall be installed on all columns on Column Lines B and E and the columns at the intersections of Column Lines C-7 and C-12. Encasement shall extend 8'-0" above the finished floor elevation and shall be enlarged at the column base so that the entire structural steel base plate is encased.
- E. Corner protective elements shall be installed on each exposed corner of each column and shall extend the full height of the concrete encasement.

3.15 QUALITY CONTROL TESTING DURING CONSTRUCTION

- A. The Contractor shall employ a testing laboratory to perform tests and to submit test reports.
 - 1. Sampling and testing for quality control during placement of concrete may include the following, as directed by the Engineer.
- B. Sampling Fresh Concrete: ASTM C 172, except modified for slump to comply with ASTM C 94.
 - 1. Slump: ASTM C 143; Upon verification of the initial slump by the Testing Agency, perform one test for each concrete load at point of discharge and one test for each set of comprehensive strength test specimens. Perform additional tests when visual inspection indicates consistency has changed, and as directed by the Engineer.
 - 2. Air Content: ASTM C 173, volumetric method for lightweight or normal weight concrete; ASTM C 231 pressure method for normal weight concrete; one for each day's pour of each type of air-entrained concrete.
 - a. Concrete Temperature: Test hourly when air temperature is 40°F and below, and when 80°F and above; and each time a set of compression test specimens are required.
 - b. Compressive Strength Tests: ASTM C 39; one set for each day's pour exceeding 5 cu. yds. plus additional sets for each 50 cu. yds. over and above the first 25 cu. yds. of each concrete class placed in any one day; one specimen tested at 7 days, two specimens tested at 28 days, and one specimen retained in reserve for later testing if required.
 - c. When frequency of testing will provide less than 5 strength tests for a given class of concrete, conduct testing from at least 5 randomly selected batches or from each batch if fewer than 5 are used.
 - d. When total quantity of a given class of concrete is less than 50 cu. yds., strength test may be waived if, in the judgment of the Engineer, adequate evidence of satisfactory strength is provided.

- e. When strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, evaluate current operations and provide corrective procedures for protecting and curing the in-place concrete.
 - f. Strength level of concrete will be considered satisfactory if averages of sets of three consecutive strength, and no individual strength test result falls below specified compressive strength by more than 500 psi.
- C. Test results will be reported in writing to Designer, Engineer, and Contractor within 24 hours after tests. Reports of compressive strength tests shall contain the project identification name and number, date of concrete placement, name and location of concrete batch in structure, design compressive strength at 28 days, concrete mix proportions and materials; compressive breaking strength and type of break for both 7-day tests and 28-day tests.
- D. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted but shall not be used as the sole basis for acceptance or rejection.
- E. Additional Tests: The Contractor's Independent testing service shall make additional tests of in-place concrete when test results indicate specified concrete strengths and other characteristics have not been attained in the structure, as directed by Designer. Testing service may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42, or by other methods as directed.

END OF SECTION 03 30 00

SECTION 07 42 63 - FABRICATED WALL PANEL SYSTEM

PART 1 - GENERAL

1.1 SUMMARY

- A. The work of this Section includes, but is not limited to, the following:
 - 1. Designing, engineering and providing all framing elements, fasteners, connections and sealants related to the horizontal and vertical wall panel systems.
 - 2. Steel faced, pre-finished, insulated composite wall panels with double interlocking side joints, integral vapor seals, and concealed structural fastening.
 - 3. Aluminum face and liner, composite factory formed wall panel units with integral reveals and rout and return joinery.
 - 4. Furnishing and installation of integrated fixed & sliding aluminum windows, louvers and translucent panels within the insulating wall panel systems.
 - 5. Furnishing and installation of glazing within the aluminum composite panel system.
 - 6. Sealants and gasketing between panels, windows and their intersections.

1.2 RELATED WORK SPECIFIED ELSEWHERE

- A. Carefully examine all of the Contract Documents for requirements which affect the work of this section.
- B. Other specifications sections which directly relate to the work of this section include, but are not limited to, the following:
 - 1. Section 03 45 00 - Architectural Precast Concrete
 - 2. Section 04 22 00 - Concrete Unit Masonry; substrate.
 - 3. Section 05 10 00 - Structural Metal Framing.
 - 4. Section 05 50 00 - Metal Fabrications; requirements for miscellaneous supports.
 - 5. Section 07 92 00 - Joint Sealants; sealant requirements.
 - 6. Section 08 41 13 - Aluminum Framed Entrances and Storefronts.
 - 7. Section 08 81 00 - Glass and Glazing

1.3 REFERENCES

- A. American Architectural Manufacturer's Association (AAMA):
 - 1. AAMA 501.2 - Quality Assurance and Diagnostic Water Leakage Field Check of Installed Storefronts, Curtain Walls and Sloped Glazing Systems.
 - 2. AAMA 605.2 - Voluntary Specification for High Performance Organic Coatings.
 - 3. AAMA 2605 - Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels.
 - 4. AAMA 508-05 – Test method for Pressure Equalized Rain Screen Wall Systems.

B. American Society of Civil Engineers (ASCE):

1. ASCE 7- Minimum Design Loads for Buildings and Other Structures.

C. ASTM International (ASTM):

1. ASTM A 653 - Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
2. ASTM A 755 - Specification for Steel Sheet, Metallic Coated by the Hot-Dip Process and Prepainted by the Coil-Coating Process for Exterior Exposed Building Products.
3. ASTM A792 – Standard Specification for Steel Sheet 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process
4. ASTM C 1363 - Standard Test Method for thermal performance of building materials and envelope assemblies by means of a Hot Box Apparatus.
5. ASTM C 645 - Specification for Nonstructural Steel Framing Members.
6. ASTM C 920 - Specification for Elastomeric Joint Sealants.
7. ASTM E 72 - Standard Test Methods of Conducting Strength Tests of Panels for Building Construction.
8. ASTM E 84 - Test Methods for Surface Burning Characteristics of Building Materials.
9. ASTM E 96 - Test Methods for Water Vapor Transmission of Materials.
10. ASTM E 119 - Test Methods for Fire Tests of Building Construction and Materials.
11. ASTM E 283 - Test Method for Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors under Specified Pressure Differences across the Specimen.
12. ASTM E 330 - Test Method for Structural Performance of Exterior Windows, Curtain Walls, and Doors by Uniform Static Air Pressure Difference.
13. ASTM E 331 - Test Method for Water Penetration of Exterior Windows, Curtain Walls, and Doors by Uniform Static Air Pressure Difference.
14. ASTM E 1886 – Standard Test Method for Performance of Exterior Windows, Curtain Walls, Doors, and Impact Protective Systems Impacted by Missile(s) and Exposed to Cyclic Pressure Differentials.
15. ASTM E 1996 – Standard Specification for Performance of Exterior Windows, Curtain Walls, Doors and Impact Protective Systems Impacted by Windborne Debris in Hurricanes.

D. Factory Mutual Global (FMG):

1. FMG 4880 Standard for Evaluating Insulated Wall & Roof/Ceiling Assemblies.

E. Sheet Metal and Air Conditioning Contractors National Association, Inc. (SMACNA):

1. Architectural Sheet Metal Manual.

F. Underwriters Laboratories, Inc. (UL):

1. UL 263 - Fire Resistance Tests of Building Construction and Materials.
2. UL 723 - Test for Surface Burning Characteristics of Building Materials.
3. UL Fire Resistance Directory.
4. UL 1715 Room Corner Test.

1.4 QUALITY ASSURANCE

- A. Manufacturer: Provide siding systems which are the products of one manufacturer. Manufacturer shall have a minimum 10 years experience in manufacturing of architectural metal panel systems.
- B. Installer: A firm which has at least five years experience in work of the type required by this section and which is acceptable to the manufacturer of the wall panel system.
- C. Mock-Ups: Before beginning primary work of this section, complete 9 linear feet of the wall panel system that incorporates both types of panels, translucent panels, aluminum windows and louvers to serve as a mock-up and obtain Designer's acceptance of visual qualities. Protect and maintain acceptable mock-ups throughout the work of this section to serve as criteria for acceptance of this work. Approved mock-up may be incorporated into the finished work. Use mock-up area for required field tests.
- D. Subdivision of Work: To limit responsibility, assign the complete prefabricated metal siding system including, but not limited to, panels, framing, subframing, fasteners, flashings, counterflashings, joint sealers and fillers, to one manufacturer and one installer.
- E. Fire Resistance Ratings: Where indicated by design designations, provide metal wall panels tested per ASTM E 119 or UL Standard 263 by a testing and inspecting agency acceptable to authorities having jurisdiction.
 - 1. Fire-Test-Response Characteristics per ASTM E 84 or UL Standard 723:
 - a. Flame spread index: 25 or less.
 - b. Smoke developed index: 450 or less.
 - 2. FMG Listing: Class 1 Insulating Wall or Ceiling Panel per FMG 4880.
 - 3. UL Listing for UL 1715 room corner test.
 - 4. NFPA 286 room corner test.
 - 5. NFPA 285 ISMA test.
- F. Pre-Installation Meeting: Convene a pre-installation meeting to establish procedures to maintain optimum working conditions and to coordinate this work with related and adjacent work.

1.5 PERFORMANCE REQUIREMENTS

- A. Secondary support framing system for the metal wall panels, louvers, windows and translucent panel system shall be designed in accordance with AISC or Aluminum Association design procedures.
- B. The support system for the complete wall panel systems shall be designed and installed by the wall panel manufacturer and certified wall system contractor.
 - 1. Secondary supports shall not vary from theoretical plane by more than the specified tolerances.
 - a. $\frac{1}{4}$ inch in any 20 foot length vertically or horizontally.

- b. + or – ½ inch maximum in building elevation.
 - c. + or – 1/8 inch within 5 feet of any change in plane such as corners and soffits.
2. Cold-formed steel girts, subgirts, or studs which insulated metal panels are attached shall be minimum 16 gauge (SSMA 54 mils). Cold formed steel 18 gauge (SSMA 43 mils) or lighter shall not be used as structural supports. All cold-formed framing shall be designed in accordance with the latest edition of AISI or North American Standard Specification. Double studs or minimum 4” wide bearing surface shall be provided at all vertical joints of horizontal panel systems and at all horizontal stack joints of vertical panel systems to insure the integrity of the liner side seal.
- C. Air Infiltration: Maximum 0.06 cfm/sf per ASTM E 283 at a static-air-pressure difference of 6.24 lbf/sf, using minimum 10 feet by 10 feet test panel that includes horizontal and vertical joints.
 - D. Water Penetration – Dynamic Testing: No uncontrolled water penetration per AAMA 501.1 at a minimum pressure differential of 15 lb/sf using a minimum 10 feet by 10 feet test panel.
 - E. Horizontal Panel Joint Performance - Static test per ASTM E331 with all horizontal seals removed - 1 inch in 10 feet lengths to simulate seal defects. No uncontrolled water penetration permitted at a pressure of 15 lb/sf.
 - F. Pressure Equalization of Horizontal Joinery – Passes the Criteria for a Pressure Equalized Horizontal Joint in accordance with AAMA 508-05 a test method for Pressure Equalized Rain Screen Wall Systems.
 - G. Structural Performance: Provide metal wall panel assemblies capable of withstanding the effects of indicated loads and stresses within limits and under conditions indicated, per ASTM E 72:
 1. Wind Loads: Determine loads based on uniform pressure indicated on Plans or calculated per IBC 2003 whichever is more stringent.
 2. Deflection Limits: Withstand test pressures of inward and outward wind-load design pressures with maximum deflection of L/180 of the span with no failure.
 3. Secondary Framing: Design secondary framing system according to AISI "Standard for Cold-Formed Steel Framing - General Provisions." Provide bearing surface for metal wall panels at the following locations:
 - a. Horizontal Panel System: At vertical joints 4 inches minimum.
 - b. Vertical Panel System: At horizontal stack joints 4 inches minimum.
 - H. Seismic Performance: Comply with ASCE 7, "Minimum Design Loads for Buildings and Other Structures": Section 9, "Earthquake Loads".

1.6 SUBMITTALS

- A. Submit the following in accordance with Form 816 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR - SUBMITTALS.

- B. Product Data: Manufacturer's data sheets for metal wall panels and accessories.
- C. Shop Drawings: Prepared by manufacturer. Include elevations showing metal wall panels, windows, louvers and translucent panels and details of each condition of installation and attachment. Indicate coordination dimensions related to structural support system elements provided by others as well as secondary framing provided as part of this specification section.
 - 1. Include structural data indicating compliance with performance requirements.
- D. Selection Samples: For each finish product specified, two complete sets of color chips representing manufacturer's full range of available colors and patterns.
- E. Verification Samples: For each finish product specified, two samples, minimum size 6 inches square, representing actual product, color, and patterns.
- F. Warranty: Submit proposed warranty meeting requirements of this Section.
- G. Quality Assurance Submittals:
 - 1. Manufacturer Certification Letter in accordance with NOTICE TO CONTRACTOR - POTENTIAL FOR ASBESTOS CONTAINING MATERIALS.
 - 2. Source quality-control test reports.
 - 3. Field quality-control test reports.

1.7 DELIVERY, STORAGE AND HANDLING

- A. Refer to Form 816 Article 1.06.03 and Form 816 Article 1.20-1.06.03 for additional information.
- B. Protect metal wall panels during shipping, handling, and storage to prevent staining, denting, or other visible damage. Deliver, unload, store, and erect metal wall panels and accessory items without misshaping panels or exposing panels to surface damage from weather or construction operations.

1.8 WARRANTIES

- A. Refer to Form 816 Article 1.20-1.06.08 and NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS for additional information.
- B. Panel System Warranty: Provide written warranty signed by manufacturer, installer and Contractor, agreeing to repair or replace work which exhibits defects in materials or workmanship. "Defects" is defined to include, but is not limited to, leakage of water, abnormal aging or deterioration, and failure to meet performance requirements. Include requirement for removal and replacement of covering and connected adjacent work.
 - 1. Warranty Period: 5 years from date of issuance of the Certificate of Compliance.
- C. Finish System Warranty: Provide written warranty signed by manufacturer, installer and Contractor, agreeing to repair or replace work which exhibits defects in finish materials or workmanship. "Defects" is defined to include, but is not limited to, checking, crazing, cracking, lifting, mottling, peeling, fading, noticeable color change, and other defects. Color change shall not exceed 5E units [National Bureau of Standards] throughout the warranty period.

1. Warranty Period: 20 years from date of issuance of the Certificate of Compliance.
- D. Special Installer's Warranty: In form acceptable to the Department, in which Installer agrees to repair or replace metal wall panel assemblies that fail in materials and workmanship within two years from date of issuance of the Certificate of Compliance.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturer: Subject to compliance with requirements, provide products by one of the following:
1. IPS Insulated Panel Systems.
 2. KingSpan Insulated Panels.
 3. Metlspan Architectural Wall Panels.
 4. Or Approved Equal.

2.2 PRODUCTS

A. PANEL DESIGNS

1. Panel units shall consist of roll formed steel face and liner elements bonded to an insulated core.
2. Panel edges shall be double tongue and groove design with factory applied vapor seal. Structural fasteners and clips shall be concealed within the side joint, mechanically engage both face and liner elements and be designed to prevent crushing of the insulated core during fastener installation.
3. Panel units shall be the following:
 - a. Vertical Panel Units: 3 inch thick by 30 inch wide panel with a tested R value minimum of 20, or approved equal.
 - b. Horizontal Panel Units: Custom panel module as indicated on the Architectural Drawings with a total R value minimum of 20, or approved equal.
4. Custom width panels shall be required to achieve layout pattern shown on plans.

2.3 INSULATED METAL WALL PANELS

A. Panel exterior skin shall be the following:

1. Horizontal Panel Units: ASTM A653, Grade 37, G90 galvanized steel or Galvalume Grade 37 in accordance with ASTM 792; in non-directionally embossed surface, 22 gauge.
2. Vertical Panel Units: ASTM A653, Grade 37, G90 galvanized steel or Galvalume Grade 37 in accordance with ASTM 792; in non-directionally embossed surface, 22 gauge.

B. Panel interior skin shall be the following:

1. Horizontal Panel Units: ASTM A653, Grade 37, G90 galvanized steel or Galvalume Grade 37 in accordance with ASTM 792; non-directionally embossed in 22 gauge.
 2. Vertical Panel Units: ASTM A653, Grade 37, G90 galvanized steel, non-directionally embossed and planked in 22 gauge
- C. Panels Insulation shall be a polyisocyanurate core which between the steel face and liner to fill all voids in the panel and have the following minimum physical properties:
- Density - 2.6 pcf
 Shear stress - 20 psi
 Compressive strength - 20 psi
 Tensile strength - 25 psi
- D. Strippable plastic film shall be used to protect the exterior finish through all stages of roll forming and fabrication

2.4 SECONDARY SUPPORT FRAMING SYSTEM

- A. The design, fabrication and installation of the secondary support framing system including bracing as required for the support of the wall systems specified herein shall be the responsibility of the panel manufacturer and certified wall system installer.
- B. Secondary support system shall include all tubes, girts, subgirts, angles and clips required for the support of the insulated metal wall panel, windows, louvers and translucent panels. These supports are to be distinct and separate from the supports shown and sized in the structural drawings. Other required supports for the supports of frames, doors, pre-cast panels and other elements not specifically included in this section shall be furnished and installed under separate specification sections.
- C. Secondary support framing shall meet the performance requirements as outlined in section 1.5 Performance Requirements.
- D. All structural framing furnished and installed as part of this specification section shall be designed by a professional engineer. Structural calculations shall be sealed by a professional engineer licensed in the state of Connecticut.

2.6 INTEGRATED TRANSLUCENT PANELS

- A. Integrated Translucent Windows will be supplied by the wall panel manufacturer as a part of the integrated wall panel assembly. The complete system will be engineered and installed as a single source responsibility wall system including wall panels, louvers, windows and translucent panels. The translucent window units will include grid pattern, clips, fasteners and accessories at locations as shown on the drawings.
- B. Panels shall be as specified in Section 08 45 00 - Translucent Panel Wall Unit System.

2.7 INTEGRATED LOUVERS

- A Extruded aluminum louvers will be supplied by the wall panel manufacturer as a part of the integrated wall panel assembly. The complete system will be engineered and installed as a single source responsibility wall system including wall panels, louvers, windows, and aluminum or steel through tube supports. The louvers will include blades; special heads, sill and jambs that integrate with the metal panels joinery; and accessories at locations as shown on the drawings.
1. The Louver Frame shall integrate with the surrounding panel joinery without face sealing and be tested to perform at 12 PSF per ASTM E331.
 2. Louver Model : A 4157 Double drainable fixed extruded mullion louver by Construction Specialties or approved equal.
 3. Depth: 4 inches
 4. Free Area Required: 51.4 %
 5. Rain Defense: 1123 fpm when measured in accordance with AMCA.
 6. Standard 500 Static Pressure Drop: 0.19 in. H₂O
 7. Flashing at Louver penetrations will not be accepted
 8. Finish: Provide minimum 1.2 mil dry film thickness of thermo-cured fluorocarbon coating containing minimum 70% Kynar 500 resin over substrate which has been prepared by inhibited chemical cleaning, conversion coating, and priming in compliance with coating manufacturer's instructions and recommendations.
 - a. Colors: Provide colors as selected by Designer from manufacturer's complete line of standard colors.

2.10 FACTORY PAINT FINISH

- A. Panels exterior finish shall be the following in manufacturer's standard color for that finish.
1. 0.8 mil primer with 0.8 mil 70 percent PVDF fluoropolymer color coat, and a 0.8 mil 70 percent PVDF fluoropolymer clear top coat or approved equal.
 2. Colors: Provide color as selected by Designer from Panel Manufacturer's standard series (non-mica, metallic or brilliant series) or custom color as selected from within this range of colors. Allow for up to three (3) colors for the exterior metal wall panels.
 3. The interior finish for the metal wall panels where exposed to view shall be 0.2 mil primer and 0.6 mil polyester in a color selected by the Designer. Where the metal panel interior face is concealed manufacturer's standard primer and wash coat will be acceptable.
- B. Manufacturer shall warrant that the exterior coating shall not blister, peel, crack, chip, or experience material rust through for 20 years and that for a period of 20 years chalking shall not exceed #8 - ASTM and fading shall be 5 ΔE Color Difference Units or less.

2.11 ACCESSORIES

- A. Metal wall panel accessories:
1. Provide complete metal wall panel assembly incorporating trim, copings, fascia, parapet caps, soffits, sills, inside and outside corners, jambs and miscellaneous flashings. Include required fasteners, gaskets, closure strips and sealants.

2. All accessories as indicated in A.1. above to be extrusions of 6063-T5 aluminum unless as noted on the contract plans.

a. Provide extrusions at the wall base and at all head, sill and jamb conditions for windows, doors and other wall openings that are thermally broken and have no thermal shortcuts.

3. All exposed trim and extrusions shall be finished to match panels.

2.12 MISCELLANEOUS MATERIALS

A. Sealant: Synthetic non-skinning butyl rubber sealant, as recommended by panel manufacturer, for metal wall panel assemblies to remain watertight.

B. Fasteners: Self-tapping screws, bolts, nuts, and other acceptable fasteners recommended by panel manufacturer. Where exposed fasteners cannot be avoided, supply corrosion-resistant fasteners with heads matching color of metal wall panels by means factory-applied coating.

PART 3 - EXECUTION

3.1 EXAMINATION

A. The Installer/Erector shall examine substrates, supports, and conditions under which this work is to be performed and notify Contractor, in writing, of conditions detrimental to the proper completion of the work. Do not proceed with work until unsatisfactory conditions are corrected. Beginning work means Installer accepts substrates and conditions.

B. Examine metal wall panel supports, substrates, and conditions for compliance with requirements for installation tolerances and other conditions affecting work.

1. Verify that structural panel support members and anchorage have been installed within the following tolerances:

- a. +/- 1/4-inch in 20 feet.
- b. +/- 1/2-inch across building elevation.
- c. +/- 1/8-inch within 5 feet of any change in plane.

2. Correct out of tolerance work and deficient conditions prior to proceeding with metal wall panel installation.

3.2 PREPARATION

A. Install miscellaneous framing and anchorage according to ASTM C 754, metal wall panel manufacturer's written recommendations, and approved shop drawings.

3.3 METAL WALL PANEL INSTALLATION

A. Install metal wall panels and accessories in accordance with manufacturer's recommendations and approved shop drawings.

- B. General: Install metal wall panels in orientation, sizes, and locations indicated. Anchor metal wall panels and other components securely in place. Provide for thermal and structural movement.
 - 1. Apply elastomeric sealant continuously between metal base channel (sill angle) and concrete, and elsewhere as indicated or, if not indicated, as approved by manufacturer.
 - 2. Field cutting of metal wall panels is not permitted.
 - 3. Fasten metal wall panels to supports with concealed clips at each joint at location, spacing, and with fasteners recommended by manufacturer. Install clips to supports with self-tapping fasteners. Metal chips resulting from the installation of the self-tapping screws shall be completely removed from the channel at the base of the wall panel.
 - 4. Provide weatherproof escutcheons for pipe and conduit penetrating exterior walls.
- C. Fasteners for Steel Wall Panels:
 - 1. Exterior: Stainless-steel.
 - 2. Interior: Carbon steel.
- D. Metal Protection: Provide metal wall panel manufacturer's recommended permanent separation material where dissimilar metals will contact each other or corrosive substrates.
- E. Joint Sealers: Install gaskets, joint fillers, and sealants where indicated and where required for weatherproof performance of metal wall panel assemblies.
 - 1. Seal metal wall panel end laps to supports or back-up flashing sealant, full width of panel. Seal side joints where recommended by metal wall panel manufacturer. Do not install sealant in locations that will interfere with drainage of pressure-equalized panel chambers.
 - 2. Prepare joints and apply sealants per requirements of Section 07 92 00 "Joint Sealants."

3.4 ACCESSORY INSTALLATION

- A. General: Install metal wall panel accessories with positive anchorage to building and weathertight mounting and provide for thermal expansion. Coordinate installation with flashings and other components.
 - 1. Install related flashings and sheet metal trim per requirements of Section 07 60 00 "Flashing and Sheet Metal."
 - 2. Install components required for a complete metal wall panel assembly, including trim, copings, corners, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items.
 - 3. Comply with performance requirements and manufacturer's written installation instructions.
 - 4. Provide concealed fasteners except where noted on approved shop drawings.

5. Set units true to line and level as indicated. Install work with laps, joints, and seams that will be permanently watertight and weather resistant.

3.5 FIELD QUALITY CONTROL

- A. Testing Agency: An independent testing and inspecting agency acceptable to the Department to perform field tests and inspections and to prepare test reports.
- B. Water-Spray Test: After completing portion of metal wall panel assembly including accessories and trim, test 2-bay area selected by the Designer for water penetration, according to AAMA 501.2. Wall areas should be tested as a routine QA procedure. Areas erected by each crew should be checked at various stages of erection.
- C. Manufacturer's Field Service: Engage a service representative authorized by metal wall panel manufacturer to inspect completed installation. Submit written report. Correct deficiencies noted in report.

3.6 CLEANING AND PROTECTION

- A. Remove temporary protective films. Clean finished surfaces as recommended by metal wall panel manufacturer. Clear weep holes and drainage channels of obstructions, metal chips resulting from self-tapping screw installation, dirt, and sealant. Maintain in a clean condition during construction.
- B. Replace damaged panels and accessories that cannot be repaired by finish touch-up or minor repair.

END OF SECTION 07 42 63

SECTION 11 10 00 – EQUIPMENT SCHEDULE

PART 1 – GENERAL

- A. The following Equipment Schedule provides information on equipment shown on the Industrial drawings. Equipment is listed numerically by mark number with the following information:
1. Mark # - All identical equipment items are assigned the same number. The Equipment Mark Number coordinates this schedule with Industrial drawings and the specifications.
 2. Item Description.
 3. Spec Section - Identifies division or section where technical specifications for the equipment item can be found. NIC means "Not in Contract".
 4. Procurement Method
 - a. CF/CI = Contractor Furnished/Contractor Installed.
 - b. OF/OI = Owner Furnished/Owner Installed.
 - c. OF/CI = Owner Furnished/Contractor Installed.
 - d. OF/VI = Owner Furnished/Under Floor Wheel Lathe (UFWL) Vendor Installed.
 5. Submittals - Identifies type(s) of submittals required:
 - a. PD = Product Data
 - b. SD = Shop Drawings
 - c. OM = Operation and Maintenance Manuals
 - d. T = Training of Owner's personnel on specific equipment items

Mark	Description	Section	Method	Submittals
1130	Cabinet, computer, shop	NIC	OF/O	
1140	Cabinet, flammable materials, large	NIC	OF/O	
1320	Locker, tool, 2-tier, 8-compartment	NIC	OF/O	
1860	Workbench, severe use	NIC	OF/O	
2085	Buffer/grinder, 8", w/ pedestal	11 24 00	CF/CI	PD, OM, T
2215	Drill press, variable speed, 20"	11 24 00	CF/CI	PD, OM, T
2539	Press, hydraulic, 20 ton	11 24 00	CF/CI	PD, OM, T
2835	Vise, combination, swivel base, 6"	NIC	OF/O	
3560	Tank, parts cleaning, medium	11 24 00	CF/CI	PD,
5048	Crane, bridge, top running, 3 ton	41 22 13	CF/CI	PD, SD, OM, T
5464	Hopper, self-dumping, 2 yard	11 90 00	OF/VI	
5995	Utility vehicle, car mover	11 90 00	OF/VI	
6720	Wheel truing machine, dual axle	11 90 00	OF/VI	

PART 2 – PRODUCTS

2.01 Not Used

PART 3 – EXECUTION

3.01 Not Used

END OF SECTION 11 10 00

SECTION 11 24 00 – GENERAL SHOP EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

- A. Equipment items as listed below by Equipment Mark Number:
 - 1. 2085 BUFFER/GRINDER, 8 INCH, WITH PEDESTAL (Ref. Part 2.1)
 - 2. 2215 DRILL PRESS, VARIABLE SPEED, 20 INCH (Ref. Part 2.2)
 - 3. 2539 PRESS, HYDRAULIC, 20 TON (Ref. Part 2.3)
 - 4. 3560 TANK, PARTS CLEANING, MEDIUM (Ref. Part 2.4)
- B. Roughing-in, installation of equipment, and final connection of utilities, with labor, services, and incidentals necessary for complete and operational equipment installation.
- C. Piping, wiring, and switching between equipment and utilities.

1.2 RELATED WORK SPECIFIED ELSEWHERE:

- A. Carefully examine all of the Contract Documents for requirements which affect the work of this section.

1.3 QUALITY ASSURANCE:

- A. Experience: Equipment shall be produced by a manufacturer of established reputation with a minimum of five years experience supplying specified equipment.
- B. Manufacturer's Representative:
 - 1. Installation: Provide a qualified manufacturer's representative at site to supervise work related to equipment installation, check out and start up.
 - 2. Training: Provide technical representative to train Department's maintenance personnel in operation and maintenance of specified equipment.

1.4 SUBMITTALS:

- A. Submit the following in accordance with Form 816 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR - SUBMITTALS.
- B. Product Data:
 - 1. Submit Product Data.
 - 2. Restrict submitted material to pertinent data. For instance, do not include manufacturer's complete catalog when pertinent information is contained on a single page.

C. Operation and Maintenance Manual:

1. Provide complete parts, operating, and maintenance manual covering equipment at time of final inspection including, but not limited to:
 - a. Description of system and components.
 - b. Schematic diagrams of electrical, plumbing and compressed air systems.
 - c. Manufacturer's printed operating instructions.
 - d. Printed listing of periodic preventive maintenance items and recommended frequency required to validate warranties. Failure to provide maintenance information will indicate that preventive maintenance is not a condition for validation of warranties.
 - e. List of original manufacturer's parts, including suppliers' part numbers and cuts, recommended spare parts stockage quantity and local parts and service source.
2. Assemble and provide copies of manual in 8-1/2 by 11 inch format. Foldout diagrams and illustrations are acceptable. Manual to be reproducible by dry copy method. Provide copies per provisions of the NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS.

D. Shop Drawings: Submit Shop Drawings in accordance with the NOTICE TO CONTRACTOR - SUBMITTALS.

1.5 PRODUCT SELECTION

- A. Product selection shall be in accordance with Form 816, Article 1.20-1.06.25 and the General Requirements and Covenants of the Contract.

1.6 WARRANTY

- A. Refer to Form 816 Article 1.20-1.06.08 and NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS for additional information.
- B. Warrant work specified herein for one year from issuance of Certificate of Compliance against defects in materials, function and workmanship.
- C. Warranty shall include materials and labor necessary to correct defects.
- D. Defects shall include, but not be limited to noisy, rough, or substandard operation; loose, damaged, and missing parts; and abnormal deterioration of finish.
- E. All parts shall be readily available locally in the United States.

1.7 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Refer to Form 816 Article 1.06.03 and Form 816 Article 1.20-1.06.03 for additional information.

- B. Deliver equipment in manufacturer's containers, appropriately packaged and/or crated for protection during domestic shipment and storage in humid, dusty conditions.
- C. Indelibly label all containers, including those contained in others, on outside with item description(s) per title and Mark Number of this specification.
- D. Provide equipment and materials specified complete in one shipment for each equipment item. Split or partial shipments are not permissible.

1.8 LABELING

- A. Manufacturer shall securely attach in a prominent location on each major item of equipment a noncorrosive nameplate showing manufacturer's name, address, model number, serial number, and pertinent utility or operating data.
- B. All electrical equipment and materials shall be new and shall be listed by Underwriter's Laboratories, Inc. (U.L.) in categories for which standards have been set by that agency and labeled as such in the manufacturer's plant.

PART 2 - PRODUCTS

2.1 BUFFER/GRINDER, 8 INCH, WITH PEDESTAL
Equipment Mark Number: 2085

- A. Capacities and Dimensions:
 - 1. Buffer/grinder:
 - a. Motor: 3/4 HP, 3600 RPM.
 - b. Wheel:
 - 1) Diameter: 8 inches.
 - 2) Thickness: 1 inch.
 - 3) Bore: 3/4 inch.
 - c. Wheel spacing: 17 inches.
 - d. Height to center of spindle: 39 inches.
 - e. (Buffer/grinder; 7-3/8 inches, pedestal 32 inches.)
 - 2. Overall dimensions:
 - a. Width: 22 inches.
 - b. Depth: 10-7/8 inches.
 - 3. Gross weight: 200 pounds.

- B. Features and Construction:
1. Motor: Totally enclosed, direct drive motor rated for continuous service, with permanently lubricated ball bearings.
 2. Wheels: One each, medium grit and general purpose wire wheel.
 3. Wheel guards: Adjustable for wheel wear, provided with exhaust outlets, adjustable work rests and spark breakers.
 4. Pedestal: Provide pedestal base with tool tray and water pot.
 5. Power cord: Unit shall be provided with a minimum 6-foot power cord and plug compatible with facility's receptacles.
- C. Controls: ON/OFF toggle switch and other electrical controls meeting applicable National Electrical Code requirements.
- D. Accessories:
1. Illuminated eyeshields: Installed, Cincinnati No. 000-131, or approved equal, one set of two each per grinder.
 2. Wire wheel: Factory installed, general purpose, 8 by 1 inch wire wheel, one each.
- E. Utilities Available: 460 VAC, 3 phase, 3/4 HP.
- F. Finish: Durable enamel in manufacturer's standard color.
- G. Manufacturers Reference:
1. Prime manufacturer: Specifications are based on equipment identified herein by manufacturer's name and model to establish acceptable standards of quality, performance, features, and construction.
 - a. Cincinnati Electrical Tool, Inc.
5928 State Route 128
Cleves, Ohio 45002
Phone: (513) 941-5000
Fax: (513) 353-4040
Website: www.cincinnatielectrical.com
 - b. Model: 102-134 with Accessories
 2. Other manufacturers: Contingent upon compliance with these specifications and documentation requirements set forth in SUBMITTALS, equipment produced by other manufacturers, including the following, may be considered for approval as equal.

- a. Delta International Machinery Corp.
246 Alpha Drive
Pittsburgh, PA 15238
Telephone: (412) 963-2400, (800) 223-7278
Website: www.deltawoodworking.com
- b. Baldor Electric Company
5711 R.S. Boreham, Jr. Street
Fort Smith, AK 72901
Telephone: (479) 646-4711
Fax: (479) 648-5792
Website: www.baldor.com

2.2 DRILL PRESS, VARIABLE SPEED, 20 INCH
Equipment Mark Number: 2215

A. Capacities and Dimensions:

- 1. Motor: 1-1/2 HP, 1,725 RPM.
- 2. Overall dimensions, nominal:
 - a. Width: 22inches.
 - b. Depth: 36 inches.
 - c. Height: 69 inches.
- 3. Working dimensions:
 - a. Spindle to table: 33-1/8 inches.
 - b. Spindle to base: 43-3/8 inches.
- 4. Table working surface:
 - a. Width: 22 inches.
 - b. Depth: 19-1/2 inches.
 - c. T-slots: Two at 15-1/2 inches long for 1/2 inch T-bolts.
- 5. Quill:
 - a. Stroke: 0 to 6-1/2 inches.
 - b. Diameter: 2-1/2 inches.
- 6. Capacities:
 - a. Diameter hole:
 - 1) In steel: 7/8 inch.

- 2) In cast iron: 1-1/8 inch.
 - b. Throat: 10 inches.
 - 7. Spindle:
 - a. Speeds: Infinitely variable, 300 to 2000 RPM.
 - b. Spline: 10 at 3/4 inch diameter.
 - 8. Column:
 - a. Wall thickness: 1/2 inch.
 - b. Diameter: 4 inches.
- B. Features and Construction:
- 1. Speed control: Speed control shall be operable while machine is running and shall hold speed setting constant under all rated load conditions.
 - 2. Belt drive: Alignment and tension of belt shall be automatically maintained.
 - 3. Bearings: Spindle assembly shall be supported by not fewer than eight permanently lubricated ball bearings.
 - 4. Work table: Four diagonal T-slots and two parallel T-slots shall be provided for worktable.
 - 5. Table lock: Expanding bushing table lock shall be provided for rigid positioning of table at any angle.
 - 6. Floor base: Two full-length T-slots shall permit insertion of T-bolts from front and rear.
 - 7. Safety features:
 - a. Chuck key: Unit shall include self-ejecting chuck key.
 - b. Guard: Steel clip on guard shall completely enclose drive.
 - 8. Spindle: No. 3 Morse Taper shall accept accessory Jacobs type chuck for use with standard bits.
 - 9. Motor: Unit shall be totally enclosed, fan cooled.
 - 10. Depth control: Self-locking adjustment depth stop shall be provided for feed.
 - 11. Table adjustment: Hand gear crank shall permit table elevation.
 - 12. Function controls: Knobbed spoke wheels shall be provided for manual speed selection and feed.

13. Power cord: Unit shall be provided with a minimum 6 foot power cord and plug compatible with facility's receptacles.
- C. Controls: 24 volt pushbutton control station with shrouded START button and protruding STOP button, magnetic starter with transformer and no voltage/low voltage and three leg overload protection. Switches and other electrical controls shall meet applicable National Electrical Code requirements.
 - D. Accessories:
 1. Magnetic Starter and Reversing Drum Switch, Clausing No. 2375MT, one each, installed.
 2. Drill Chuck, Clausing No. 1897, one each.
 - E. Utilities Available: 460 VAC, 3 phase, 1-1/2 HP.
 - F. Finish: Durable enamel in manufacturer's standard color.
 - G. Manufacturers Reference:
 1. Prime manufacturer: Specifications are based on equipment identified herein by manufacturer's name and model to establish acceptable standards of quality, performance, features, and construction.
 - a. Clausing Industrial
1819 North Pitcher Street
Kalamazoo, MI 49007
Phone: (616) 345-7155
Fax: (616) 345-5945
Website: www.clausing-industrial.com
 - b. Model: 2274 with Accessories
 2. Other manufacturers: Contingent upon compliance with these specifications and documentation requirements set forth in SUBMITTALS, equipment produced by other manufacturers, including the following, may be considered for approval as equal.
 - a. Jet Tools
427 New Sanford Rd
La Vergne, TN 37086-4184
Phone: (615) 793-8900
Fax: (615) 793-8905
Website: www.jettools.com

2.3 PRESS, HYDRAULIC, 20 TON
Equipment Mark Number: 2539

- A. Capacities and Dimensions:
 1. Overall dimensions:

- a. Width: 31 inches.
 - b. Depth: 30 inches.
 - c. Height: 74 inches.
2. Capacity: 20 tons.
 3. Inside width: 24 inches.
 4. Width between table rails: 5 inches.
 5. Maximum vertical clearance: 37-1/2 inches.
 6. Ram travel: 6 inches.
 7. Ram diameter: 2-1/4 inches.
 8. Cylinder bore: 2-1/4 inches.
 9. Left to right cylinder movement: None, cylinder fixed at center.
 10. Shipping weight, nominal: 265 pounds.
- B. Features and Construction:
1. Head and bed rails: Constructed of 6 inch channel steel with channel ends and corners cut and ground.
 2. Pump: Single speed hand operated hydraulic pump with spring loaded chevron packing and hardened and ground pump plungers with bronze guides in honed cylinders.
 3. Table: Vertically adjustable with self-locking table winch.
 4. Gauge: Large dial-type pressure gauge mounted with pump controls on outside of frame isolating gauge from mechanical shock.
 5. Equipment protection: Ram travel limit valve to prevent overextension of ram and maximum capacity relief valve to prevent loading more than 110 percent of press capacity.
 6. Standard equipment: Two flat parallels and two V-blocks.
- C. Finish: Durable enamel in manufacturer's standard color.
- D. Manufacturers Reference:
1. Prime manufacturer: Specifications are based on equipment identified herein by manufacturer's name and model to establish acceptable standards of quality, performance, features, and construction.

- a. Nugier Press Company, Inc.
18031 La Salle Avenue
Gardena, CA 90248
Phone: (310) 515-6025
Fax: (310) 527-7362
Website: www.nugier.com
 - b. Model: H20-6
2. Other manufacturers: Contingent upon compliance with these specifications and documentation requirements set forth in SUBMITTALS, equipment produced by other manufacturers, including the following, may be considered for approval as equal.
- a. Dake, Division of JSJ Corporation
724 Robbins Road
Grand Haven, MI 49417
Phone: (616) 842-7110, (800) 937-3253
Fax: (800) 846-3253
Website: dakecorp.com
 - b. OTC Division of SPX
655 Eisenhower Drive
Owatonna, MN 55060
Phone: (507) 455-7000, (800) 533-6127
Fax: (507) 455-8354
Website: www.otctools.com

2.4 TANK, PARTS CLEANING, MEDIUM
Equipment Mark Number: 3560

- A. Capacities and Dimensions:
- 1. Pump motor: 1/3 HP.
 - 2. Pump output:
 - a. Tank jets: 40 GPM.
 - b. Flush hose: 18 GPM.
 - 3. Overall dimensions, nominal:
 - a. Width: 42 inches, less accessory shelf.
 - b. Depth: 30 inches.
 - c. Height, cover upright: 66 inches.
 - 4. Soak tank:
 - a. Length: 30 inches.

- b. Width: 29 inches.
 - c. Solvent depth: 16 inches.
 - 5. Fluid capacity: 85 gallons.
- B. Features and Construction:
 - 1. Spray hose: Pistol-grip flush nozzle with neoprene hose shall be adjustable from fine spray to solid stream.
 - 2. Flush hose: Flexible metal hose shall include nozzle and valve.
 - 3. Work shelves: Bi-level shelves shall be included, one expanded metal and one flanged steel.
 - 4. Solvent filter: Mesh element shall be located above fluid level for ease of service.
 - 5. Safety cover: Spring loaded, soft closing safety cover with fusible link shall automatically close at 165 degrees F.
 - 6. Pump assembly: Sparkless pump motor shall have screened intake.
 - 7. Construction: Unit shall be constructed of 14 gauge and 16 gauge steel.
 - 8. Clean out: 2-inch NPT bottom drain plug and two removable sludge trays shall be included.
 - 9. Power supply: 6 foot, 3 wire cord shall be grounded with three prong plug.
- C. Controls: Recessed switch with amber POWER ON light. Switching and other electrical controls shall meet applicable National Electrical Code requirements.
- D. Accessories: External drain shelf, Model No. L-6, one each.
- E. Utilities: 120 VAC, 1/3 HP.
- F. Finish: Durable enamel in manufacturer's standard color.
- G. Manufacturers Reference:
 - 1. Prime manufacturer: Specifications are based on equipment identified herein by manufacturer's name and model to establish acceptable standards of quality, performance, features, and construction.
 - a. Graymills Corporation
3705 North Lincoln Avenue
Chicago, IL 60613
Phone: (773) 248-6825, (773) 477-4100
Fax: (800) 478-8673
Website: www.graymills.com

- b. Model: 800A with Accessories
- 2. Other manufacturers: Contingent upon compliance with these specifications and documentation requirements set forth in SUBMITTALS, equipment produced by other manufacturers, including the following, may be considered for approval as equal.
 - a. Build-All Corporation
5203 W. Clinton Ave.
Milwaukee, WI 53223
Phone: (414) 716-0023
Fax: (414) 716-0030
Website: www.build-all.com
 - b. Justrite Manufacturing Co.
2454 Dempster Street
Des Plaines, IL 60016
Phone: (847) 298-9250
Fax: (847) 298-9261
Website: www.justritemfg.com

PART 3 - EXECUTION

3.1 INSPECTION

- A. Coordinate location of rough-in work and utility stub-outs to assure match with equipment to be installed.
- B. Inspect delivered equipment for damage from shipping and exposure to weather. Compare delivered equipment with packing lists and specifications to assure receipt of all items.

3.2 INSTALLATION

- A. Perform work under direct supervision of Foreman or Construction Superintendent with authority to coordinate installation of scheduled equipment with Engineer.
- B. Install equipment in accordance with plans, shop drawings and manufacturer's instructions:
 - 1. Positioning: Place equipment in accordance with any noted special positioning requirements generally level, plumb and at right angles to adjacent work.
 - 2. Fitting: Where field cutting or trimming is necessary, perform in a neat, accurate, professional manner without damaging equipment or adjacent work.
 - 3. Anchorage: Attach equipment securely to floor, as directed by Engineer, to prevent damage resulting from inadequate fastening. Installation fasteners shall be installed to avoid scratching or damaging adjacent surfaces.
 - 4. Upon completion of work, finish surfaces shall be free of tool marks, scratches, blemishes, and stains.

3.3 TESTING

- A. After final connections are made and prior to authorizing payment, specified equipment shall be tested for compliance with all specified features in the presence of the Engineer using acceptance procedures provided by the manufacturer.

3.4 CLEANUP

- A. Touch-up damage to painted finishes.
- B. Wipe and clean equipment of any oil, grease, and solvents, and make ready for use.
- C. Clean area around equipment installation and remove packing or installation debris from job site.
- D. Notify Engineer for acceptance inspection.

3.5 TRAINING

- A. Refer to Form 816 Article 1.20-1.08.14 subsection 3 for additional information.
- B. Direct the technical representative to provide specified hours of training to designated Department's maintenance personnel in operation and maintenance of the following equipment. Coordinate, with Department, training schedule and list of personnel to be trained.
 - 1. 2085 BUFFER/GRINDER, 8 INCH, WITH PEDESTAL (Ref. Part 2.2): 2 hours.
 - 2. 2215 DRILL PRESS, VARIABLE SPEED, 20 INCH (Ref. Part 2.4): 2 hours.
 - 3. 2539 PRESS, HYDRAULIC, 20 TON (Ref. Part 2.8): 2 hours.
 - 4. 3560 TANK, PARTS CLEANING, MEDIUM (Ref. Part 2.4): 2 hours.
- C. Obtain, from technical representative, a list of Department's personnel trained in equipment operations and maintenance.

3.6 COMPLETION

- A. All guarantees, as required in Part 1 of this specification shall be submitted for approval prior to final payment.

END OF SECTION 11 24 00