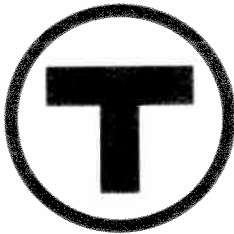


FIELD INSPECTORS HANDBOOK



MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

QUALITY ASSURANCE

- FIELD INSPECTORS HANDBOOK
- CONVERSION TABLES
- INSPECTION CHECKLISTS

HANDBOOK USE

This handbook will assist you in verifying the quality of field installed items, systems and components. The checklists contained within are to be used in conjunction with the contract specifications and drawings. The checklists are a guide only and as such the requirements of the contract specifications and drawings govern if there are any conflicts between these checklists and the contract specification. Certain sections of the Handbook have been left intentionally empty. Additional checklist will be developed in the future and added as necessary. It is suggested that this handbook be in the possession of the field Inspector at all times and used as a reference when performing inspections.

This handbook is the property of the Massachusetts Bay Transportation Authority and is provided for your use and shall be returned upon request.

WEIGHTS AND MEASURES

CUBIC MEASURE

1,728 cubic inches	.....	cubic foot
27 cubic feet	.....	1 cubic yard
128 cubic feet	.....	1 cord (wood)
2,150.42 cubic inches	.....	1 standard bu.
231 cubic inches	.....	1 U.S. standard gal.

DRY MEASURE

2 pints	.....	1 quart
8 quarts	.....	1 peck
4 pecks	.....	1 bushel

LIQUID MEASURE

4 gills	.....	1 pint
2 pints	.....	1 quart
4 quarts	.....	1 gallon
3 1/2 gallons	.....	1 barrel

IMPERIAL LIQUID MEASURE

1 U.S. gallon	.....	0.833 Imperial gallon
1 U.S. gallon	.....	3.785 liters
1 Imperial gallon	.....	1.201 U.S. gallons
1 Imperial gallon	.....	4.546 liters
1 liter	.....	0.264 U.S. gallon

LONG MEASURE

12 inches	.....	1 foot
3 feet	.....	1 yard
5 1/2 yards	.....	1 rod
40 rods	.....	1 furlong
8 furlongs	.....	1 statute mile
3 land miles	.....	1 league

MARINER'S MEASURE

6 feet	.....	1 fathom
120 fathoms	.....	1 cable length
5,280 feet	.....	1 statute mile
6,076.11 feet	.....	1 nautical mile

TEMPERATURE CONVERSIONS

To convert Fahrenheit degrees into Celsius, subtract 32, multiply by 5, and divide by 9.

To convert Celsius into Fahrenheit, multiply by 9, divide by 5, and add 32.

The freezing point of water is 32°F., 0°C. The boiling point of is 212°F., 100°C.

METRIC EQUIVALENTS

LINEAR MEASURE

1 centimeter	0.3937 inch
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1 inch	2.54 centimeters
1 foot	0.3048 meter
1 meter	39.37 inches
1 yard	0.9144 meter
1 rod	.....	5.029 meters
1 kilometer	.....	0.621 miles
1 mile	.....	1.609 kilometers

SQUARE MEASURE

1 sq. centimeter	.....	0.1550 sq. inch
1 sq. inch	.....	6.452 sq. centimeters
1 sq. foot	.....	0.0929 sq. meter
144 sq. in.	.....	1 sq. ft
9 sq. ft	.....	1 sq. yd
30-1/4 sq. yds	.....	1 sq. rod
1 sq. meter	.....	1.196 sq. yards
1 sq. yard	.....	0.8361 sq. meters
1 hectare	.....	2.47 acres
1 sq. acre	.....	0.4047 hectare
640 sq. acres	.....	1 sq. mile
1 sq. kilometer	.....	0.386 sq. mile
1 sq. mile	.....	2.59 sq. kilometers

WEIGHTS

1 gram	.....	0.03527 ounce
1 ounce	.....	28.35 grams
1 kilogram	.....	2.2046 pounds
1 pound	.....	0.4536 kilogram
1 metric ton	.....	0.98421 English ton
1 English ton	.....	1 metric ton

MEASURE OF VOLUME

1 cubic centimeter	.....	.061 cubic inch
1 cubic inch	.....	16.39 cubic centimeters
1 cubic foot	.....	0.0283 cubic meter
1 cubic meter	.....	1.308 cubic yards
1 cubic yard	.....	0.7646 cubic meter
1 liter	.....	1.0567 quarts liquid
1 quart dry	.....	1.101 liters
1 quart liquid	.....	0.9463 liter
1 liter	1.0567 quarts
1 gallon	3.78541 liters
1 peck	8.810 liters
1 hectoliter	2.8375 bushels

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MANAGEMENT OF TIME AND MATERIAL WORK

1. Progress Photographs

- A. Purpose: To describe the requirements of the contractors progress.
- B. Resident Engineers photographs are taken to record accidents, or damages, unsafe working conditions, and areas where claims or changes are anticipated.
- C. Photographs must be taken when Time and Material Work is being done.
- D. Photographs/sheets shall contain the following information:
 - Date fo the photograph
 - Photograph number
 - Contract number
 - Direction of view
 - Location and description

2. Inspector's Diary Content:

- Description of the work
- Type, location and quality of the work performed to the greatest extent possible. Example: Station 1+00 to 2+00 installation of waterstips, grout pipes and welding. Quantities must be measured and recorded.
- If work on time and material is not continous for the entire shift, note the start and stop times to the greatest extent possible.
- If rework is being performed, indicate the reason.
- Photographs taken of the work performed.
- The equipment and work force will be documented each day and recorded on a Time & Material form. Each piece of equipment should be listed separately.

CONTROL OF RODENT/HOUSEKEEPING

Preplanning

Pest control, within the contract area, will be performed by a pest control contractor under a separate contract. This work will include poison baiting for rats and mice inside manholes, catch basins and rodent burrows. It will also include weekly inspections for pest activity and sanitation deficiencies in all work areas, laydown areas and bordering blocks.

Work by the pest control contractor will be directed by the MBTA Environmental Group.

Review the requirements for pest-control related activities of the contractor.

Operations

Assure that metal or heavy-duty plastic refuse containers with tight-fitting lids are used for disposal of all garbage and trash associated with food.

Prior to mobilization, obtain written notification from the Environmental Group that rodent populations have been effectively controlled, by the pest control contractor in the areas to be occupied.

Following site clearing and before demolition, excavation, or construction, inspect work and laydown areas to ensure that all remaining trash, debris, and weeds have been removed.

Verify that work and laydown areas are maintained free of trash, garbage, weeds and debris. Assure proper use of refuse containers so that rodents and other pests are not harbored or attracted.

Assure specific locations are designated as lunch and coffee break areas. Prevent random disposal of garbage and trash. Ensure refuse containers are upright and have tight-fitting lids.

Assure all refuse containers are emptied daily to maintain site sanitation.

Notify the Environmental group within 24 hours whenever rodents (rats or mice) or signs of rodent activity (burrows or droppings) are observed in work or laydown areas.

CONSTRUCTION SAFETY

["Each employer shall furnish to each of his employees employment and a place of employment which are free from recognized hazards that are causing or are likely to cause death or serious physical harm to his employees."] Occupational Safety and Health Act of 1970

Preplanning

- Review MBTA Contract Specification's (safety) language of the following Division 1, General Requirements sections:

[01000] Special Conditions;
[01550] Hot Work;
[01567] Health and Safety;
[01568] Construction Safety;
[01570] Traffic Regulation; and,
[01571] Maintenance and Protection of Railroad Traffic.

- Verify project office/presence of the required and approved site-specific safety plan of the general contractor as well as the resume(s) of the full time, on-site safety representative(s).
- Verify via telephone with the Safety Department or meeting minutes, that the general contractor had been briefed (at the pre-bid/award meetings) of the requirements of the Contract Specifications and Safety and the First Aid Section – Article 5.15.

Operations – General Safety & Health

- Meet with the general contractor's full time, on-site safety representative and the assigned Safety Department representative to improve job site (safety related) communications.
- Ensure the job site is secured with appropriate fencing, signs, signals and barricades as needed.
- Ensure contractor compliance with OSHA's General Safety and Health Provisions: fire protection and prevention (fully charged and easily accessible fire extinguishers); job site housekeeping, adequate job site illumination, presence of drinking water, and disposable cups.
- Ensure the presence of an adequate number of toilet facilities as required by OSHA, and that the general contractor has adequate servicing of those facilities.
- Verify that all job site personnel and visitors have and are using the required personal protective equipment (PPE): hard hats, safety glasses, high visibility/reflective safety vests and proper footwear.
- Ensure that the general contractor provides employees with an adequate supply of drinking water in a tightly capped container with a dispensing tap, disposable drinking cups, and a receptacle for disposed drinking cups.

Operations – Welding & Cutting (Hotwork)

- Ensure that all hot work (welding & cutting) by the general contractor has been properly permitted by the local fire department. Ensure that the tanks are properly stored and in the upright position with valve caps secured. Ensure fire extinguishers are fully charged.

Operations – Fire Protection and Prevention

- Ensure each of the following: 1) All fire extinguishers are fully charged and conspicuously located; 2) one or more fire extinguishers, rated not less than 2A, is provided on each floor (multi-story buildings require one near each stairway); 3) travel from any point of the protected area to the nearest fire extinguisher does not exceed 100 feet; and 4) a fire extinguisher, rated not less than 10B, is provided within 50 feet of wherever more than 5 gallons of flammable or combustible liquids are being used on the job site.

Operations – Electrical

- Ensure general contractor compliance with OSHA's electrical standards (i.e. the employee must be protected against electric shock by de-energizing the circuit and grounding it, or by guarding it effectively by insulation or other means). This must be done using the "lockout-tagout" procedure (tagging at all points where circuits can be energized).
- Ensure that flexible electrical extension cords are not damaged.
- Ensure that ground-fault circuit interrupters (GFC) are present for all 120 volt, single-phase, 15 and 20 ampere receptacle outlets on construction sites that are not part of the permanent wiring of the building or structure.

Operations – Scaffolds

- Ensure that employees working on scaffolds more than ten feet above a lower level are provided fall protection. That protection should include a guardrail and a personal fall arrest system.
- Ensure the presence of the required "competent person" to determine the feasibility and safety of providing fall protection for employees erecting or dismantling supported scaffolds.

- Ensure that the scaffold platform is planked or decked as fully as possible with the space between the platform and uprights not more than one inch (1") wide. The work area for each scaffold platform and the walkway must be at least eighteen inches (18") wide.
- Ensure that access is provided for scaffold platforms that are more than two feet above or below a point of access. Cross-braces must not be used as a means of access.

A competent person must inspect scaffolds, and their components, before each work shift and after any occurrence that could affect the structural integrity. This person also must ensure that prompt corrective action is taken.

Operations – Trenching & Excavations

- Verify general contractor contacted "Dig Safe" as required.
- Ensure that employees in excavations five feet or greater are protected from cave-ins by an adequate protective system. Protective systems (e.g. trench boxes) must have the capacity to resist, without failure, all loads that are intended or could reasonably be expected to be applied or transmitted to the system.
- Ensure that daily inspections of excavations, the adjacent areas, and the protective systems have been made by the "competent person."
- Ensure that a stairway, ladder, ramp, or other safe means of egress is located in trench excavations that are four (4) feet or more in depth, and that lateral travel to that egress is no more than 25 feet.
- Ensure that in open excavations, underground installations are protected, supported, or removed, as necessary, to safeguard employees.

Operations – and Ladders

- Ensure that all ladders are tied off and secured.

DEMOLITION OF BUILDINGS

Preplanning

Check the specifications and permits for other appropriate requirements.

Caution: The demolition of buildings and structures can be environmentally sensitive, therefore, it is imperative that all permitting and specification requirements are followed to the letter and that the demolition contractor complies with any directives of the City, State and Federal requirements.

Review the drawings and establish what buildings are to be demolished.

Check the demolition plan against the drawings to coordinate one with the other.

Verify that the contractor has written approval from the Resident Engineer for the demolition.

Verify that the contractor has made the necessary arrangements and has secured all the required agreements and permits.

Assure that the contractor erects a fence around the demolition site.

Assure that the demolition site has been properly secured.

Check if the building has an underground or surface petroleum fuel tank. Permits shall be secured and the conditions that were placed on the permit shall be met. (Dust, rodent, noise, etc.)

Check if the building is serviced or has been serviced by a septic tank or cesspool. If such a condition does exist, these depositories must be removed completely and the cavities must be backfilled in accordance with the specifications.

Check that the contents of any tank, i.e. septic, cesspool, oil, etc., have been removed and disposed of in a manner that conforms to the permit and all environmental regulations.

Verify that the contractor has solid fill to backfill the holes left by the demolition.

Note: Solid fill is considered to be "non-combustible" material such as brick, stone and plaster (but not wood lath) and shall contain no piece larger than one-half cubic yard in volume or greater than 3 feet in dimension).

Operations

Verify that the building has been completely cleaned of unsuitable (hazardous) material.

Verify that foundations walls have been broken down to at least one (1) foot below existing grade.

Check that basement floors have been broken into at least four foot square pieces. For buildings without basements, assure that concrete floors are removed to existing ground.

Assure that all fences, debris, etc., have been removed from the entire parcel and the property has been left in a neat and safe condition.

Verify that the contractor has left the fill less than one (1) foot below existing grade.

Verify that all pipes and conduits have been removed or plugged with brick and mortar. Check that all drainage structures have been removed completely and the cavity completely filled with selected fill-in at eighteen (18) inch layers and completely compacted.

Verify the special provisions to the contract are fully met and complied with.

DEMOLITION OF BRIDGES

Verify that the contractor has the required permits before the disturbance of any utilities (i.e. water, sewer, gas, telephone, electric, steam or similar services) that cross or have been supported by the bridge.

Check if the contractor will be required to maintain any part of the superstructure as a support.

Verify that the contractor is maintaining the safety of the bridge after notice by the engineer that the bridge has been closed to the public.

Note: When the bridge crosses a body of water, check the permits for water

quality, erosion, fish kills, etc.

EXCAVATION

Preplanning

Verify that plans for caissons have been reviewed by the Engineer.

Assure that all archaeological sites are marked.

Review site plans and note any underground structures which are to be avoided (pipes, utilities, etc.).

Check that contractor has called underground Utility Companies prior to excavation (1-800-322-4844 Dig Safe).

Operations

Verify clearing, grubbing and stripping operations are complete to the areas shown on the site excavation drawings.

Note: No burning is allowed.

Assure that grubbed materials (i.e. logs, trees, brush, etc.) have been removed to approved waste areas as shown on the drawings.

Assure that sumps and wellpoints are constructed and adequate pumps are provided to prevent ground water accumulation in the excavation.

Verify that water passes into a sediment tank prior to its entering the drainage system.

Perform random sampling and testing excavated material to determine any changes in soil classification or physical properties.

Notify Resident Engineer if any hazardous materials are encountered.

If hazardous materials are encountered, assure they are disposed of properly.

Assure that completed excavations are inspected, tested and accepted prior to placement

of mud mats, slabs, utilities, pipes, etc. and/or structural backfill.

Assure that material below and beyond excavation limits are preserved in an undisturbed condition.

Note: Archaeological artifacts uncovered during excavation shall be reported to the Resident Engineer immediately.

EXCAVATION FOR STRUCTURES

Preplanning

Familiarize yourself with the MBTA plan for maintenance of utilities.

Check adequacy of supports for utility lines and assure that the work is satisfactory to utility owners.

Operations

Promptly report unsafe or hazardous conditions to the Resident Engineer if cooperation is lacking from the contractor.

Document deviations in location of existing utility lines.

Record and document any damage to utilities and the contractor's method of repair.

Assure that the contractor notifies the utility owner of any damage.

EXCAVATION FOR ROADWAY STRUCTURES

Document the amount of excavated material disposed of daily (number of cubic yards) and provide a general description of material (i.e. clay, sand, silt rock, wet, dry, etc.). Document the amount of contaminated and acceptable material that has been removed

Document where and how material was hauled (i.e. trucks, conveyor belt, barges, how much was hauled by each method).

Assure that contractor makes provisions for controlling dust, truck covers and wash stations.

Assure that mud and dirt is not left on adjacent streets during hauling operations and is being cleaned by wet street sweepers.

Salvage all materials required by plans and specification and record quantity and disposition of salvage.

Check condition of foundation for final grade prior to placing leveling mud slab, if required, or reinforcing steel for structural slab.

CUT AND COVER EXCAVATION AND BACKFILL

Preplanning

Assure that material for backfill is from an approved source. (Approved by the QC Lab)

Familiarize yourself with material requirements and required compaction equipment.

Assure that the foundation is approved before placement begins.

Operations

Check that required lift thickness is being maintained.

Assure that the contractor inspects and tests fill material at the required intervals.

Assure that soil is stabilized as soon as possible with mulch, seeding or asphalt.

BACKFILLING

Assure that material for backfill is from an approved source.

Record the method of placing and compacting.

Assure that waterproofing is protected, if applicable.

Assure that the method of compaction around and under utilities is in accordance with applicable contract specifications.

Check top soil for conformance to contract specifications, where required, to include

planted areas.

Assure that all voids created by removal of temporary material re filled with suitable material (i.e., sand, lean grout, as required).

Assure that moisture and density tests are performed at random locations and at specified frequencies.

Assure that the final grade is tested and inspected.

DEWATERING

Preplanning

Assure that the necessary permits have been approved and review the requirements of the contract. Example: National Pollutant Elimination Discharge Systems (NEPDS); Department of Environmental Protection (DEP) Water quality.

Assure that the specifications and working drawings indicate the type of system, location, depth, complete description and materials to be used, what procedures are to be followed, standby equipment, standby power supply, etc., and the locations of the points of discharge with sedimentation tanks.

Sedimentation tanks require the following: Inlet elbows and outlet tees; Baffle, absorbent bent boom is required at the outlet. Tanks shall be sized for the maximum pump rate.

Verify that the contractor has obtained written approval prior to beginning the installation of the system.

Check that the contractor has coordinated the installation and operation of the dewatering system and piezometer with others concerned and with other MBTA contractors.

Verify that the contractor has submitted the required test data and certificates for the material that will be used in the construction.

Determine if soil particles are being removed by the system.

Check for deposits of "fines" at discharge.

Monitor any movement of adjacent areas. If movement is observed, determine if the movement is being caused by the dewatering system.

Assure that the system is modified if, after installation and while in operation, the system is causing or threatens to cause any damage to existing buildings, structures, utilities or facilities.

Establish an initial set of reference water level readings for each dewatering point. Assure that the contractor maintains a record of observation readings, as specified, to insure a continued adequacy or drawdown per the requirements.

Note: When specified, the contractor will be required to leave, in place, those sumps that are required to remove water from adjacent contract areas.

Verify removal of all elements of the dewatering system.
Observation well holes shall be filled with sand.

Assure the contractor returns surface areas to original condition.

INSTALLATION OF SUPPORT STRUCTURES FOR EXCAVATION

Assure that a Pile Driving Report is completed.

Check adjacent property for harmful effects of vibration.

Assure that the contractor performs settlement monitoring, as required.

Record the number of piles driven each day, the number of blows per foot and movement. Where pre-drilling is used, record the depth of hole.

Lagging: Check spacing for possible loss of ground. Check tightness to adjacent ground for voids. Assure that lagging follows closely behind excavation at safe intervals. Check for any bulging of lagging.

Wales and Bracing: Assure that members are properly preloaded where required. Check all welded joints for imperfections or omissions. Assure that the Maximum vertical distance between level of bracing and excavation does not exceed specified distance.

DRIVEN PILES

Preplanning

Review the pile specifications and drawings for the following: Types of pile(s); type of hammer(s) and cushion; load test requirements; pre-drilling, where required; installation/acceptance criteria, i.e., based on blows per foot and other measures; pile splicing requirements; inspection of previously driven piles for uplift, alignment and heave; vibration limits and noise limits.

Review site plans and note any structures to be avoided (pipes, utilities, etc.).

Operations

Caution: No impact pile driving is allowed within 110 feet of historic structures.

Assure that survey control/layout is established prior to pile installation.

Check for obvious pile defects prior to putting in the leads.

Check that the piling type, grade, size (length and cross-sectional dimension or diameter) is received. For PPC piles, allow driving only after tests indicate that concrete has required compressive strength.

Assure that proper driving equipment, hammer rating, cap blocks/driving caps, pile shoes, etc., is used. Check against "Pile and Driving Equipment Data Form" submitted by contractor.

Assure that proper handling and storage techniques are employed. Lift points are as shown on the drawings.

Assure the proper alignment of brace frames that are used as driving templates.

Assure that corner sections are kept vertical. Note: Tipping or leaning at the corners will cause bending in the interlocks.

Assure that corner sections are kept slightly ahead of the other sheets as the driving proceeds.

Assure the proper driving pattern is maintained to bring the sheets down together.

Assure that splices are made as specified. No welding is permitted in the interlocks.

Assure that sheet piling is driven to specified depth.

Assure that back-fill for tie back system is approved.

Operations-Installation of Bracing

Note: Special consideration shall be given to the installation of the bracing system.

Assure that wales, kickers, cable supports, corner struts, tiebacks, supports and vertical soldier beams, etc., are properly installed and connected in accordance with the approved design.

Assure that the sequence and depth of excavation prior to bracing installation is as shown in the drawing.

Assure that methods are established to minimize hydrostatic pressure.

Assure that strut monitoring devices are installed in accordance with manufacturer's instructions and in proper locations.

Operations-Bearing Piles

Check the number and arrangement of piles within each group.

Check the location of isolated piles.

Assure that pre-drilling is performed at locations and that the proper diameter and depth is as specified. Piles installed in predrilled holes are driven within the specified time.

Assure that pile tips (shoes) are installed as specified.

Welding is in accordance with AWS D1.5.

Assure that pile installation sequence is maintained. The top and bottom pile sections should be installed before driving the next pile.

Check the interface with battering pile.

Assure that piles which heave are re-driven beyond the pile heave range, as specified.

Assure that pile tip elevation and butt location are as specified.

Check that the cut off elevation is within 6".

Check that penetration is as specified.

Check that pile shell and monotube are inspected internally for damage, misalignment and the presence of water or foreign material.

Assure that the final set measurements are taken and are correct.

Assure that the contractor properly fills out and maintains the pile driving record.

Operations-Encasements

Assure that pipe pile is cleaned out as specified.

Assure that pre-fabricated reinforcing steel cage installed as specified.

Assure that concrete placed as tremie is as specified.

Assure that concrete is sampled and tested as specified.

Operations-Bored Cast-In-Place Piles

Assure that holes are drilled to the specified depth and diameter. Temporary casings at the unstable ground top area helps to prevent debris and spoil from falling into the hole.

Assure that undermining is performed as specified.

Assure that the bottom of hole is cleared of loose material in "dry" holes. Check that the amount of water in the bottom of the hole is only as allowed.

Assure that bored holes are inspected by a responsible engineer/geologist as required prior to rebar installation.

Assure that prefabricated rebar cage is properly installed.

Assure that concrete placed by tremie method meets specified requirements.

- Where casting method is used, the casing shall be extracted as specified. Bottom of casing is always below concrete during placement.
- Where slurry method is used, bentonite slurry pumped to waste area or holding tanks as concrete displaces the slurry.
- Assure that concrete is sampled and tested as specified.
- Assure that equipment is cleaned in designated areas only.

Assure that cast-in-place piles are performed as specified.

Assure that pile load testing is performed as specified. Record test results.

Assure that dynamic load testing (PDA) is performed prior to and during production installation.

CAISSONS

Preplanning

Review the geotechnical data and caisson specifications. Major items to be considered, are:

- Drilling/driving equipment
- Casings
- Reinforcement.
- Underreaming.

Review site plans to note the in-situ conditions and any underground structures to be avoided (pipes, utilities, electrical duct bank, etc.).

Operations

Assure that caissons are properly located as shown on the plans.

Where unsuitable soil exists, assure that steel casings are driven to the specified depth.

Assure that caissons are drilled to the specified depth and diameter.

Assure that underreaming is performed to the specified width and depth.

Assure that the bottom of the hole is cleaned of all loose material and is dewatered.

Assure that the hole is inspected by the responsible engineer/geologist, as specified.

Assure that prefabricated rebar cage is properly installed and secured.

Assure that concrete placed by the tremie method is to the specified elevation.

Where water or slurry is present, assure that it is pumped to a waste or holding tank as the concrete displaces the water or slurry.

Assure that the concrete is sampled and tested as specified.

Assure that concrete equipment is cleaned in designated areas.

SLURRY WALL CONSTRUCTION

Preplanning

The three types of slurry walls are:

- Reinforced Concrete Panels - This method produces concrete walls that are reinforced with cages of steel reinforcing bars.
- Soldier Pile and Tremie Concrete (SPTC) Walls - This method produces concrete walls that are reinforced with individual structural steel shapes.
- Tangent pile Walls - This method uses structural steel shapes, or steel reinforcement set into augured holes to create a wall.

Prior to placement of structural steel sections or reinforcing steel and concrete, holes shall be checked and adjusted for plumb within specified tolerances.

Operations

Assure that a base line of excavation is established.

Assure that the excavation and wall placement is performed in a staged manner. The wall is in alternating individual panels in the length specified on the drawings.

Assure that open trenches are constantly kept filled with slurry to maintain sidewalls of the

trench from collapsing during excavation operations.

Assure that reinforced steel cages are fabricated in accordance with placement drawings.

Assure that tie back anchor plate embedments are properly located and secured.

Assure that concrete is properly placed.

Assure that concrete is sampled and tested as specified.

Note: End Casing Removal - After the concrete panel has properly set and excavation is complete for the succeeding panel, the end casing is extracted and reinstalled for the next concrete panel placement.

Cased or slurry-stabilized holes shall be drilled to the depths at the locations shown on the drawings and within the tolerances specified. Primary holes shall be alternated and shall not be maintained in an opened condition and prevented from collapsing until filled with concrete.

Assure that as each alternate augured primary hole opened, the structural steel is seated in each hole, in a plumb position and encased in concrete form tip to the elevation shown on the contract drawings.

Assure that no more than two alternate augured primary holes are maintained in an unfilled condition at only one time.

After concrete in primary holes has attained a sufficient strength to ensure integrity of desired resistance, structural or reinforcing steel shall be installed in a plumb position. Steel shall be encased in concrete from tip to the elevation shown on the contract drawings.

Whenever two adjacent tangent piles are not contiguous at their perimeters, additional holes shall be augured and grouted to produce a continuous wall.

Review the rock and soil checklist upon completion of the cast-in-ground perimeter wall of the area to be excavated.

Assure that the excavation is down to the first anchor level.

Assure that welding is performed to AWS.

Assure that tieback anchor holes are drilled at the plate locations to the inclined angles and to the depth and diameter as specified.

Assure that anchors are installed in accordance with manufacturer's instructions.

Assure that encased tendons are in grout.

Verify that the wedges are evenly spaced and adequately seated in the anchor.

Verify that the stressing equipment is well maintained and the calibration charts are current.

Verify that tendons are stressed slowly to allow the strand to overcome friction.

Assure that the load is applied in accordance to the specifications.

Assure that tie backs are stressed to 140% of the design load for 30 minutes.

Verify that all wedges are seated evenly and under pressure.

Measure and record the elongation to assure that the requirements are being met.

Assure that after 30 minutes the stress is reduced to the design load.

Reject any tie-backs with more than 5% loss of proof load.

AVOIDING DAMAGE TO EXISTING UTILITIES

Preplanning

Caution: Assume that within any work area of the MBTA project there exists a utility "barrier" from the surface down to a depth of about 12 feet (or greater in some locations). Every penetration of the earth for whatever purpose risks damage to existing utilities and severe injury to construction workers. Extreme caution should be exercised.

Review all contract drawings showing underground utilities and structures.

Verify that contractors physically locate all active shut-off valves from either plans or

respective utility companies and that they have the necessary equipment to operate these valves.

Verify that contractors contact abutting maintenance and service utilities, including building and property managers abutting the work area, to notify them of the intended work in order to verify the locations of subsurface structures and the service and the service connections.

Verify that the contractor has a foreman who demonstrates knowledge of underground utilities in the work zone and is present during construction.

Verify that the contractor has drawings showing existing underground utilities, structures and foundations available in the field and that those drawings are continually referred to by the contractor's workers.

Verify that the contractor has called Dig Safe (1-800-322-4844) and other appropriate agencies, as applicable.

Verify that the contractor has a plan for emergency action.

Verify that utility locations are marked on the surface.

Operations

Verify that contractors excavate by hand whenever they are in close proximity to utilities or when directed by the Resident Engineer.

Verify that clear utility location markings are maintained throughout the progress of the work. Utility location markings shall be offset before removal of pavement.

Document deviations of locations from existing documents.

If damage to utility occurs, the contractor shall notify the utility owner and Resident Engineer immediately.

Document any damage to utilities, as well as the contractor's method of repair.

FORMWORK

Assure that form design has been approved by the Engineer.

Assure that forms are constructed as designed.

Assure that forms meet shape, form, line, grade and dimension. Assure that alignment shall be free of waviness or irregularities.

Assure that form panels are constructed of sound sheet material.

Assure that chamfer strips are properly installed, where required.

Assure that form ties are properly spaced, arranged, installed, and secured.

Assure that forms are properly cleaned and coated with an approved form release agent.

Assure that joints and seams are tight.

Assure that allowance is made for camber, deflection or settlement.

Assure that blockouts are installed as shown on the drawings and are properly braced. Pour pockets and access holes are provided for placing and vibrating concrete.

Assure that the location, elevation and orientation of forms are correct and adequate anchorage provided for conduit, drains, structural embedments and penetrations.

Assure that cleanouts are provided, as required.

Assure that forms are adequately braced and supported.

Assure that control joints are located as shown on the drawings.

Assure that contraction/expansion joint is located as shown on the drawings.

Assure that joint filler is in place.

Assure that shoring is constructed as designed and locked together.

Assure that shoring is set on firm level base and is adequately braced.

Assure that adjustable screw jacks are not overextended.

Assure that concrete inserts, grade strips, and key ways are properly installed.

Assure that waterstops are located and aligned properly.

Assure that access walkways and other falsework is safe.

Assure that all openings in floors, temporary or permanent, are provided with guard rails or other protective means.

Review specification regarding the timing for the stripping of forms, see ACI-347.

Assure that forms are removed by methods what will not damage the concrete.

Assure that after form removal, the finished concrete surfaces shall be protected from damage by construction equipment, materials or the elements.

Note: Action for repair of defects should be taken immediately. Refer to "Concrete Repairs Checklist."

Assure that water used to clean forms passes through a sedimentation tank before discharge to the drainage system.

CONCRETE REINFORCEMENT

Assure that certified mill test reports meet the requirements for that steel.

Assure that rebar is free of loose rust and mill scale, dirt, oil, paint, or any coating that would reduce the bond of the steel and concrete.

Assure that bar identification is intact and legible.

Assure that field bending or straightening of rebar is performed in accordance with the specification requirements. Assure that no cracks appear and assure that damage bars are replaced.

Document results on pre-placement checklist.

Operations-Epoxy Coated Rebar

Inspect coating for damage during shipping.

Verify that the rebar is stored on timbers or protective cribbing.

Assure that appropriate lifting equipment is used (i.e., coated slings, nylon, spreader bars, etc.) that does not damage rebar.

Assure that any damaged bars are repaired in accordance with the specifications. Note: Specifications permit only limited damage of epoxy coatings. The maximum amount of damage shall not exceed 1% of the total surface area in each linear foot per ASTM A-775 (Table 1) below.

Assure that when repairing epoxy bars, the epoxy is mixed (1 hr. prior to repair), applied and cured as required by the manufacturer's specification.

ASTM A-775 TABLE 1

<u>BAR SIZE</u>	<u>DIAM. - INCHES</u>	<u>SURFACE AREA SQ. IN/FT.</u>
#3	0.375	14.14
#4	0.500	18.85
#5	0.625	23.56
#6	0.750	28.27
#7	0.875	32.99
#8	1.000	37.70
#9	1.128	42.53
#10	1.270	47.88
#11	1.410	53.16
#14	1.693	63.84
#18	2.257	85.08

Operations-General

Assure that rebar conforms to approved shop drawings and the specification. i.e., location, size and spacing.

Assure that proper clearances are maintained between rebar and form work to allow for proper placement. Check for slab or wall spacers to maintain clearance during placements.

Assure that splices are in proper location, type and clearance, as specified.

Assure that for parallel bars the distance between bars equals the nominal diameter of the bar but not less than one inch.

Assure that spacers (chairs) are installed to ensure proper clearance from subgrade or form surfaces.

Check that bars are tied with coated wire.

Verify that bar supports are epoxy coated.

Document results on the concrete placement form.

Assure that the concrete covers the bars sufficiently and meets the requirements of the specification.

CONCRETE PREPLACEMENT

Assure that placing equipment is clean and free of loose concrete, mud and other debris.

Assure that embedded items are properly located and secured. Review survey/layout records or logs.

Assure that embedded piping is tested, as specified.

Note: Temporary service water supply piping should be removed and rerouted.

Assure forms and joints are free of laitance, clean and free of foreign material.

Assure that rebar moved to allow access for cleanup operations are properly replaced and secured prior to placement.

Determine the quantity of concrete for the scheduled placement and verify that sufficient materials are on hand.

Assure that sufficient chutes, hoppers and drop pipes are available for use.

Assure that adequate lighting is available during placement.

Assure that necessary weather protection is provided.

Assure that a sufficient number of vibrators and of the proper type and size are available.

Assure that auxiliary power sources are available, as needed.

Assure that hot or cold weather procedures as appropriate, are available and have been approved by the Lab.

COLD WEATHER CONCRETE PROTECTION

Preplanning

Assure that equipment and materials are at the work site before start of placement.

Assure that the contractor has a cold weather concrete procedure approved by the Lab.

Operations

Assure that, when required, heat is applied to resteel, subgrade and area around the work immediately prior to placement to reduce temperature loss in the concrete.

Assure that newly placed concrete is provided protection whenever freezing is likely to occur. Note: Special attention should be given to corners, edges and thin sections as they are more vulnerable to freezing and are difficult to maintain at required temperatures.

Assure that the minimum temperature of concrete at the time of placement is within the 50 °F to 90°F range. 70°F for mass concrete.

Assure that heated enclosures are used and are structurally adequate, windproof and fire resistant. Open fires and salamanders should be avoided.

Monitor those conditions that are likely to cause damage such as local overheating and/or drying of newly placed concrete.

Assure that rapid temperature changes in the concrete do not occur before the strength has developed sufficiently to withstand temperature stresses. Maximum of 1 Deg.F per hour.

HOT WEATHER CONCRETE PROTECTION

Preplanning

Assure that equipment and materials are at the work site before start of placement.

Assure that the contractor has a hot weather concrete procedure approved by the Lab.

Shade should be provided for equipment (mixers, belts, pump lines, chutes) and equipment should be painted white where practical. All practical means should be used to keep concrete cool.

Operations

Assure that the time between batching and placing concrete is kept below 90 minutes.

Assure that forms, subgrades and area around the work is wet down to reduce moisture loss and to cool surrounding air before, during and after placements.

Assure that fog spray is used to cool forms and resteel immediately ahead of placement.

Assure that insulation is provided for water lines.

Assure that water spray is used or wet burlap on pump lines and other equipment to help hold or reduce concrete temperature.

Assure that batch plant activities are coordinated to minimize holding periods at the point of placement.

Assure that the maximum temperature of concrete does not exceed 90°F.

Assure that ice is mixed prior to delivery.

Assure that moist curing is initiated as soon as possible without damaging the concrete surface.

Assure that evaporation is minimized, particularly during the first few hours immediately subsequent to placing. Careful use of fog sprays is recommended. Avoid excessive use.

Assure that forms are loosened as soon as concrete is sufficient strong to provide for curing water to contact the concrete surfaces.

Assure that a wet cover is provided for the surfaces and protection against exposure to the sun and wind during form removal to prevent dry out of newly exposed concrete.

CONCRETE PLACEMENT

Assure that all pre-placement checks have been made.

Where new concrete is placed on previously placed concrete, the surface should be prepared by sandblasting or other approved means to remove loose materials laitance, oil etc.

When heating or housing is required, assure that materials and equipment are in place and operating before placement is started.

Assure that each lift does not exceed specified thickness (1 1/2 to 2 feet) and is placed within the time restrictions (90 mins. from batching).

Assure that the vertical drop of concrete does not exceed the maximum of three feet.

Assure that cold joints are not formed. Concrete should be placed before the previous lift excessively dries.

Assure that concrete is not dragged horizontally with a vibrator.

Assure that contractor has a concrete cylinder storage box at the placement. Storage boxes shall include a thermostat and light bulb(s) that will maintain a temperature of 50°F to 90°F in the winter and sufficient ice in the summer to maintain the same temperatures.

Assure that concrete is sampled and tested at specified frequencies i.e., slump, air, temperature, unit weight and cylinders. Check temperatures of concrete more often if there is a possibility of exceeding specified limits.

Assure that concrete is placed uniformly and free from segregation.

Assure that concrete is sufficiently consolidated using spading, vibrating or other

approved means. Assure there is penetration into the previous lift.

Assure that concrete is brought to final grade.

Collect and review concrete delivery slips and verify mix, time of delivery, additions of water and authorized signatures.

Assure that form work has not moved during placement.

FINISHING

Assure that concrete is distributed properly at the point of placement to avoid stacking.

Assure that excessive water is removed by blotting, screeding or evaporation. Do not allow sprinkling of dry cement on the surface. Note: Excessive water (bleedwater) results from too wet or too sandy a mix, or from overworking.

Assure that excessive troweling does not occur. This will cause dust to form and will deteriorate.

Assure that concrete does not dry too quickly as hairline cracks will occur.

CONCRETE REPAIRS

Check for imperfections that affect structural integrity or serviceability.

Check exposed concrete surface for imperfections as soon as practical after forms are removed.

Assure that contractor removes unacceptable concrete to sound concrete to determine the extent of repair.

Assure that the contractor uses the correct method of repair.

Assure that concrete is repaired as soon as practical after initial placement.

Assure that the surface to be prepared is in a moist condition and an approved concrete adhesive is applied.

Assure that material used for repair meets specification requirements.

Assure that the completed repair is:

- Bonded and does not sound hollow when tapped.
- Free of shrinkage cracks.
- Matched to the adjacent concrete.

Assure that proper curing of repaired surfaces occurs.

CONCRETE CURING AND PROTECTION

Preplanning

Assure that the contractor has approved curing procedures.

Assure that the proper method of curing is to be used (moist blanket, sheet membrane, liquid membrane) and length of curing period.

Curing is dependant upon variable conditions and requirements, as follows:

- Surface being cured (construction joint, special finished surfaces, etc.)
- Size and location of area
- Final surface coating to be used (paint, epoxy, etc.)
- Seasonal temperature/daily temperature
- Work area affected by curing
- The start and length of curing period
- Curing method selected meets specification requirements
- Cold weather or hot weather protection, as applicable.

Operations-Moist or Blanket Curing

Water from an approved source is available in sufficient quantities.

Water lines are available and protected from interruption and from freezing.

Concrete is kept continuously moist for the required period.

Operations-Sheet Membrane Curing

Assure that approved material is on hand.

Assure that material is laid properly over damp surfaces.

Assure that material sheets are sealed together and continuous coverage is maintained for the required period.

Operations-Liquid Membrane Curing

Assure that approved material is on hand.

Assure that concrete surface is damp immediately prior to application.

Assure that material is applied in accordance with the methods and rates as specified in the manufacturer's instructions.

Assure that coverage is maintained for the required period.

Operations-Mass Concrete Curing

Verify that concrete is covered with polyethylene as soon as concrete becomes hard.

Verify that insulation blankets(s) are placed over the polyethylene to maintain temperature.

Monitor the temperature readings daily to verify the differential temperature doesn't exceed 35 degrees F.

Note: The blankets are used to minimize the temperature differentials measured by the thermocouple installed in the concrete.

Verify that the blankets and polyethylene remain intact until the highest temperature in the concrete is not more than 35 degrees F higher than the average daily temperature prior to removing the blankets.

Verify that the peak temperature in the concrete does not exceed 135 degrees F.

Operations-General

Assure that concrete is protected from mechanical or physical stresses, i.e., heavy equipment movement causing load stress, load shock or excessive vibration.

Assure that forms and shores (except those used for slabs on grades and slip-forms) are not removed until the concrete has gained sufficient strength to support its weight and superimposed as specified.

Assure that reshores are in place before shoring is removed.

CONCRETE EXPANSION ANCHORS

Preplanning

Anchor requirements and installation specifications are contained in the manufacturer's literature.

Operations

Verify that reinforcing steel has been identified on the concrete surface.

Assure that the maximum deviation of the anchor bolt from perpendicularity with concrete surfaces does not exceed 5 degrees.

Assure that full thread engagement of the nut. Installation torque may be exceeded to achieve full thread engagement.

Assure that the minimum center to center spacing and edge distance are as specified on the design drawing.

Assure that level nuts or pipe shims are not used on the anchor unless specified on the design drawings.

Assure that NO alteration is allowed to expansion anchors such as cutting, threading or machining.

Assure that expansion type concrete anchors are tested to the values in Table #1 using a calibrated torque wrench.

Assure that expansion anchors that fail torque tests are repaired as required and torqued and re-inspected.

Assure that sheet type anchors (drop-in) are checked for the following:

- Setting plug is present.
- Anchor setting tool of 1 3/4" minimum shank length is flush with the top of the anchor shell.
- Bolts or threaded bars inserted into anchor shells have thread engagements equal to the threaded depth of the anchor shell.

Repairs of Anchor Failures:

Failure due to concrete breakout-Anchors may be installed provided that the regained embedment is beyond breakout depth. Concrete that is damaged shall be removed to sound concrete and repaired. (See Concrete Repair Checklist)

Failure due to anchor Breakage-Anchors shall be drilled out and provided that the integrity of the surrounding concrete is maintained, the hole re-drilled and the next larger sized diameter anchor is installed in the same location. The replacement anchor embedment length shall be at least equal to the minimum embedment for the next larger anchor.

Failure due to anchor slippage or torque-Anchors may be reoriented and retightened once for testing. If the anchor cannot be torqued, the anchor shall be removed, provided the integrity of the surrounding concrete is maintained, and the next size anchor replaced as noted above.

TABLE #1

Torque Values for Hilti, Philips and Ramset Expansion Anchors

<u>Anchor Size</u> <u>Inches</u>	<u>Verification torque</u> <u>Values Ft./Lbs</u>	<u>Installation Torque</u>
1/4"	9	
3/8"	24	
1/2"	45	
5/8"	75	
3/4"	100	
1"	254	

* Value includes $\pm 4\%$ error for torque wrench calibration.

Installation torque values are to be used as guidelines to ensure that verification torque values are met. Installation torque values were chosen from the recommended range of torque values that consistently preset the anchors to 150% of their working loads.

MASONRY FINISHES

(Masonry/Brick/Glazed Masonry)

Preplanning

Assure that mock-ups, where required, have been installed and approved. Mock-ups are not to be part of the permanent installation.

Operations

Assure that brick and masonry units are free of defects such as chips, cracks, crazing, warps, and kiln marks on the face. Also check the sizing differential.

Assure that precautions are taken for heating and/or protection of masonry in cold weather. (ACE 5.30, 1-ASCE 6).

Assure that reinforcement is of the type, size, splicing and spacing required. Doweled, tied and otherwise properly installed.

Assure that bending or re-bending of rebar to fit masonry cells is performed only where specifications permit.

Assure that Anchors, forming, supports and other embedded materials are properly installed.

Assure that the layout of work, coursing, bond pattern and dimensions are as required.

Assure that bricks and masonry units are properly bedded in mortar.

Assure that exposed surfaces are kept clean of grout and mortar.

Assure that prior to grout pour, all wythes, reinforcements, etc., are properly cleaned and that clean-outs are properly secured.

Assure that pipes, conduits, sleeves, and boxes are located as required.

Assure that grout mix was tested and approved prior to pour.

Assure that Cells or cavities are grouted and properly puddled or vibrated to remove air

voids.

Check that lifts of grout are poured in a timely sequence and as required. Grout should be held to the mid-section of the last block in the course to form a key for the next grout placement.

Wall prisms or grout cylinders are made and tested as required.

Assure that mortar is cured 24 hours before filling between wythes.

Verify that concrete class is as specified.

Assure that concrete has been sampled and tested as specified.

Assure that curing of block wall performed as specified.

Operations-Glazed Masonry

Verify the lines, level and coursing is as specified.

Assure that units are laid in complete bond.

Assure that there are no buttering of corners of joints and excessive furrowing of mortar joints.

Assure that weeps are provided as required.

Assure that mortar is placed within the specified time limits.

Assure that mortar is sampled and tested as specified.

Assure that joint size, type and tooling methods are as specified.

Assure that excess mortar droppings are removed.

Assure that mortar joints are tooled concave.

Assure that masonry units are not wet prior to laying. (Controlled wetting is permissible with clay brick.)

Assure that masonry units are cut with motor-driven saws to provide clean edges.

Assure that lintels are of the required type and size, with required bearings at each jamb.

Assure that bond beams and lintels are installed at locations shown on the drawings.

Verify that flashing and sleeves are the required type and profile and they are installed at locations shown on the drawings.

Assure that hollow metal frames are filled solid with mortar, unless shown or specified to be insulated.

Assure that expansion and control joints are located as shown on the drawings.

Assure the repair and pointing of exposed work.

Assure that tolerances are in accordance with specified requirements.

CERAMIC, QUARRY, CLAY PAVER TILES AND GRANITE PANELS

Preplanning

Assure that the manufacturer is approved for the material.

Verified that delivered materials are undamaged.

Assure that sealants are unopened and they have labels indicating manufacturer, product name, color, expiration date, pot life and curing time.

Assure that quarry material is stored on pallets.

Assure that cementitious materials are off the ground and in a dry location.

Operations

Verify that the materials are in compliance with the specification and drawings.

Assure that tile and grout conform to approved samples for color and type.

Assure that substrates are clean and free of laitance by power washing.

Assure that tile is not set when the temperature is below 50°F.

Assure that the bond coat, scratch coat and float coat are installed in accordance with the manufacturer's instructions.

Assure that the scratch coat is cured with a light fog spray every 12 hours up to 72 hours, until the float coat is applied.

Assure that there is a uniform slope of the tile to the floor drains as required.

Assure that control and expansion joints are placed in the tile to correspond with the location of the base slab joints.

Assure that the patterns are laid according to the drawings.

Assure that improperly bedded tile is replaced.

Assure that joints between tiles are level, plumb and the correct width.

Assure that surfaces are cleaned after installation.

Operations-Setting Granite Panels

Verify that only power saws are used to cut Panels.

Verify that panels comply with requirements.

Assure that any variation from plumb does not exceed 1/4" in 10".

Assure that variation from indicated slope does not exceed 1/2" in 20' nor 3/4" in 40'.

Assure that the variation from alignment of edges and faces does not exceed 1/8".

Assure that all cavities behind granite panels are grouted with Portland Cement grout.

Assure that when grout has set sufficiently it is raked out from the joints as follows:

- One inch minimum depth for epoxy grout.
- 2 1/2" minimum depth for sealant joints indicated.

Verify that all joints that are required to be sealant joints are grouted with epoxy not less than 4 days after the back-up grout is placed.

Assure that sealant joints are not made until the adjacent epoxy grout is fully cured.

Assure that sealant joints are provided at the specified locations and at a maximum of 15 feet on center.

Assure that quarry panels and related work are replaced if they are:

- Broken, chipped, stained or otherwise damaged.
- Installed with defective joints.
- Not like the field constructed mock-ups.
- Not in compliance with requirements.

Assure that stone work is cleaned within 6 days of completion.

STRUCTURAL STEEL

Preplanning

Verify that specified documentation is received and on file. Verify that the steel was made in the U.S.A.

Operations

Inspect deliveries for evidence of damage. Reject or require corrective action to be taken in case of damage.

Verify that the unloading of structural steel is performed with care to avoid possible strains and impact that could damage material, such as:

- Bending or breaking clip angles.
- Buckling of loosely attached members.
- Denting or nicking flange angles.

Check that structural steel members are properly marked in accordance with the project requirements.

Check that members are the correct size and shape as shown on the drawings.

Storage of steel should avoid over stressing material, i.e.,

- Improper supports.
- Over-stacking or faulty stacking.
- When stored for long periods, steel shall be reinspected prior to erection and rusted or corroded surfaces repaired or touched up as specified.

Assure that equipment is in satisfactory working condition and adequate for the work required.

Assure that contractor's operations do not interfere with work of other contractors or with traffic on the streets in the vicinity.

Verify that all steelwork conforms accurately to dimensions and details as specified, such

as:

- Punched, reamed, and drilled holes match within specified tolerances.
- Should errors be detected in fabrication or assembly, correction should be obtained prior to final bolting, riveting or welding.
- Anchor bolts are to be checked to determine whether they are set within permissible tolerances.

Verify that all steel, as it is being erected, is adequately supported and braced until sufficient permanent bracing and secondary steel is in place to assure stability of the work.

Assure that steel that does not have all bracing installed should be guyed as protection against wind, particularly at the end of a work shift.

Ensure that sufficient temporary bolts in all connections are installed to guarantee that steel work will hold alignment during final riveting, bolting or welding operations.

Verify that bolts are installed and torqued as specified using a calibrated torque wrench or impact wrench.

Notify the Lab for witnessing or performing the rotational capacity test.

Assure that all welding is performed by qualified welders and they are using approved weld procedures.

WELDING/BRAZING

Preplanning

Verify that the following have been submitted and approved by the MBTA.

- welding/Brazing procedures.
- welders/brazers/tackers qualification records.
- weld/brazing procedure qualification test record.
- post-weld heat treatment procedure.
- NDE and inspection procedures.
- filler material control procedure.

Operations

Verify that welding/brazing is performed in accordance with the approved procedures.

Note: Temporary welds must be welded to the same requirements as a permanent weld.

Verify that the welding machine is calibrated, if required.

Verify that the proper amperage/voltage/polarity is as required by the welding procedure.

Verify that the joint configuration is as specified on the drawings.

Verify that no rust, burning slag, grease, paint, moisture or other foreign matter is present on the joint. Note: Do not allow welding in the rain.

Verify that root openings do not exceed tolerances. For fillet welds the maximum root opening is 3/16". If the root opening is greater than 1/16, the leg of the fillet weld shall be increased by the amount of root opening.

Verify that the correct type and size of rod is being used.

Assure that rods are stored in unopened hermetically sealed containers.

Assure that loose rods are stored in holding ovens at 250 Deg.F (120 Deg.C) Minimum.

Assure that rods, which have been exposed to the atmosphere, are used within 4 hours or returned to a holding oven for a period of 4 hours before reissue.

Assure that rods are not re-dried more than one time. Rods that have been wet shall not be used.

Verify the proper use of pre-heat as follows:

AWS D1.5.88 Table 4.4 For A36 steel up to 3/4" in thickness, the steel temperature prior to welding must be a minimum of 50°F (10°C) prior to welding. As material thickness increased a higher pre-heat is required.

AWS D1.1.92 Table 4.3 For A36 steel up to 3/4" in thickness the steel temperature prior to welding must be a minimum of 32°F (0°). Steel must be pre-heated to a minimum of 70°F (21°C). As material thickness increases, a higher pre-heat is required.

Verify proper back gouging or grinding of root to sound metal prior to second side welding.

Check fillet welds for leg and throat size.

Check butt/groove welds for excessive or insufficient reinforcement.

Check for defects such as undercut, overlap, porosity, slag inclusion, excessive convexity.

Any weld requiring repairs must be reported to the Resident Engineer.

The extent of all cracks shall be verified by NDE after removal of weld metal for the full length of the crack, plus 2" beyond each end, then re-welded.

Non-Destructive Examination-Notify the Resident Engineer when NDE is required by drawings or specifications.

Notify the Resident Engineer if there is reason to question a welder's ability to make good welds on a reasonably consistent basis.

Note: Do not allow the following:

- Tack welds to rebar, anchor bolts, or structural steel without MBTA approval.
- Heating or cutting of structural steel without MBTA approval.
- Welding of surfaces that are wet or exposed to rain or snow.

NONDESTRUCTIVE EXAMINATION

Preplanning

There most common non-destructive examinations used on MBTA contracts, other than visual, are Radiography, Ultrasonic, Magnetic Particle, and Liquid Penetrant. A brief description of each process follows:

Radiography - This method employs x-rays or gamma rays to penetrate an object and detect any discontinuity by the resulting image on a recording or a viewing medium usually a film). A penetrometer of lead alloy is used to determine the quality of the radiographic technique.

Liquid Penetrant-This method reveals open discontinuities by bleedout of a liquid penetrant medium against a contrasting background developer. A penetrant is applied to the material and will be drawn into any surface opening. If the discontinuity is significant, penetrant will be held in the cavity when the excess is removed from the surface. Upon application of a developer, blotter action draws the penetrant from the discontinuity to provide a contrasting indication on the surface. This method will detect surface discontinuities only.

Magnetic Particle - This method uses the principal that magnetic lines of force in a ferromagnetic material will be distorted by a distinct change in material continuity. A ferromagnetic material can be magnetized either by passing an electric current through the material or by placing the material within a magnetic field originated by an external source. The limitations of this method are that it is only applicable to ferro-magnetic metals in which the deposited weld metal is also ferromagnetic. It can only detect surface and near surface discontinuities.

Ultrasonic Testing - This method uses a beam of high frequency sound waves to penetrate the test object and detect and locate surface and internal discontinuities. The sound beam is directed into the test object on a predictable path and is reflected at interfaces or other interruptions in material continuity. The reflected beam is detected and analyzed to define the presence and location of discontinuities.

Assure that NDE procedures and personnel qualification records have been approved. If an outside NDE contractor is used assure that they have been approved.

Review the specification and drawings to assure the following is specified:

- location, area and extent of the required examination.
- correct equipment, material and technique to be used.

- calibration standards and acceptance criteria.
- sequence and timing of examination relative to welding and heat treatment.
- preparation and cleaning of examination surface.

Operations

Assure that NDE is performed in accordance with the approved procedures and the results are recorded on appropriate inspection documentation.

Notify the Lab for witnessing of NDE.

HEAT TREATMENT

Preplanning

Review the specifications and drawings to determine the location, size and extent of welds to be treated.

Assure that the contractor has approved heat treating procedures.

Assure that temperature monitoring equipment is available and determine the location and number of thermocouple.

Assure that heating, controlling and recording devices are available.

Assure that the surface has been prepared properly.

Operations

Assure that heating and cooling rates, holding temperatures are measured and recorded.

Assure that the type, number and location of temperature measuring and recording devices are recorded.

Assure that the temperature of weldments and adjacent base material are at proper levels before protective insulation is stripped off.

Assure that thermocouple and other temporary attachments are removed and affected areas are visually inspected.

Assure that weld and base metal surfaces (internal and external) are cleaned and restored.

CADWELD SPLICING

Assure that splicing materials are maintained in a controlled hazard storage area.

Assure that splicing sleeves remain wrapped or protected until use.

Assure that rebar ends and splicing materials (sleeves, graphite, pouring basins and crucibles) are thoroughly cleaned and dried prior to splicing.

Assure that rebar ends (last 12 inches) meet deformation requirements and that ends are square within 1/8 inch.

Assure that crew members are qualified for the splice position and bar size to be cadwelded.

Assure that ends of rebar are visible through the sleeve tap hole (T-Series only).

Splicing equipment and rebar are properly assembled for cadweld process.

Upon completion of splices, assure that packing material is removed and the splice is inspected of excessive voids.

Assure that the splice is identified and recorded on a production log and as-built drawings, where required.

EXTERIOR WATERPROOFING AND DAMPPROOFING

Preplanning

Review the specification and drawings to determine the materials for exterior waterproofing.

Operations-Built-up Asphalt and Fabric Membrane

Assure that surfaces that are to receive membrane are smooth and free from projections or holes.

Assure that surfaces are cleaned of all laitance, dust, dirt, oil or other matter.

Assure that concrete surfaces have reached the required strength prior to waterproofing.

Assure that prepackaged materials are in the original sealed packages and are clearly marked.

Assure that materials are placed using an approved method as specified.

- Check for proper lapping of each ply of fabric.
- Assure that fabrics are mopped with asphalt.
- Verify that asphalt is heated within acceptable temperature range and meets the manufacturer's recommendations.
- Check quantities of materials actually installed. Compare with specification requirements.

Assure that protection of completed membrane is provided.

Check any special applications required at construction and expansion joints, edges and laps.

Operations-Synthetic Membrane

Assure that surfaces are in the same condition as required for built-up membrane.

Assure that materials conform to specification and that the manufacturer's Certificate of Compliance has been received.

Assure that installation methods and procedures are in accordance with drawings.

Assure that the adhesive material for bonding of butyl sheets is applied by full bedding and at the rated specified.

Assure that the amount of lapping of each section, flashing and tightness of edges are as specified.

Assure that protection of material is provided as soon as practicable after membrane is finished.

Operations-Flexible Polyethylene Membrane

Assure that the contractor protects the membrane in storage with canvas tarpaulins, or equal.

Assure that tests are performed in accordance with approved procedures.

Assure that a record of test results, repairs and retesting is maintained.

When double seam testing is used, assure that the initial air pressure between seams is 30 PSI for a period of 10 minutes. Recheck seam is the pressured falls below 25 PSI.

Assure that the membrane is pulled tight to the concrete structure form the 1/4" arch to the crown.

Assure that the contractor has an approved plan for checking the seals at the intersections of "T" splices.

Verify that prior to sealing any joint, the installer has cleaned the material of all oil, dust, mud and foreign matter.

Check the surface of the material after installation for holes, nicks and scuffed material prior to installation of reinforcing steel or form work.

Inspect any patches or spod seals for soundness of weld.

Check that the contractor has a plan for protecting the waterproof membrane during the backfilling operations.

Operations-Repair of Leaks

Verify that materials have been approved by the Lab.

Assure that proper preparation has been made and materials are injected in accordance with the specifications.

Make core tests of epoxy injections to ascertain the amount of penetration.

Check for compatibility of back-up material with sealant and for the proper size. Sealant should not adhere to back-up material.

Check for special color requirements for caulking or sealant.

Check that manufacturer's ambient temperature, humidity and pot life limitations are observed.

Assure that sealant is installed in a uniform, continuous ribbon without gaps or air pockets.

Check special requirements for patching.

ELASTOMERIC ROOFING

Assure that materials are in compliance with contract documents.

Assure that the application equipment is the correct type and clean.

Verify that the substrate is clean and dry and that other special preparation requirements have been followed.

Assure that roof penetrations are formed in.

Assure that work is performed under proper conditions of temperature and humidity.

Assure that liquid applied films have complete coverage and correct thickness, color and

are applied at the proper rate.

Monitor roof during rain to check for leaks.

ROOF FLASHING

Assure that materials comply with the specification and drawings, particularly the metal type, shape, gauge, priming and that all accessories are provided.

Check for separation of dissimilar metals.

Check that flashing are properly incorporated into roof insulation and built-up roofing.

Assure that fasteners are of the required type, spacing and are concealed, where possible.

Check the lap distance requirements at joints and embedment sealant.

Check parapet flashing for alignment and crimped edges.

Verify that expansion joints and sealants are installed at locations as shown on the drawings.

Assure that all penetrations have "framed-in" structural supports.

Assure that all exposed surfaces are cleaned after installation.

Monitor roofs during rain to check for leaks.

BUILT-UP ROOFING

Preplanning

Assure that materials are in compliance with contract documents.

Review roofing material manufacturer's specifications and recommendations, UL and FM requirements and warranty requirements.

Operations

Verify that the substrate (deck, including flute openings on metal decking) are clean, dry and free of loose debris prior to application of roofing components.
Assure that roof drains and other penetrations are installed correctly.

Assure that crickets and cants are installed so that all areas drain.

Assure that expansion joints are properly constructed.

Assure that building surfaces adjacent to and below roofing areas are protected from roofing operations.

Assure that a vapor barrier is installed in all areas where specified and that it is free from punctures.

Verify that concrete decks are primed to receive insulation.

Assure that insulation is dry prior to installation.

Assure that insulation is properly supported on raised portion of metal decking.

Assure that the longitudinal joints of the insulation runs parallel to the slope of the roof.

Assure that the mechanical fasteners used to secure insulation to metal roof decking are the correct type and are properly spaced and installed.

Assure that rubber mallets are used for installing mechanical fasteners when required by the manufacturer.

Assure that multiple layers of insulation have staggered joints.

Assure that hot roofing materials are applied only during temperature and weather conditions permitted and that they are within the manufacturer's specifications.

Assure that the kettle temperature of bitumen is within allowable limits and that fire extinguishers are available in the immediate area.

Assure that the bitumen is solid with no observable blank spots.

Assure that the unrolling direction of roofing felts is perpendicular to the slope of the roof and perpendicular to the longitudinal joints of the roof insulation.

Assure that roofing tiles are shingled to shed water and achieve the required uniform thickness.

Assure that the quantity of aggregate surfacing is correct and spread to a uniform thickness so that all areas drain properly.

Monitor roofs during rain to check for leaks.

FIELD PAINTING

Preplanning

Verify that the paint delivered is approved and meets the contract specifications and is accompanied by a Certificate of Compliance.

Operations

Ensure that surfaces to be painted are clean and free from moisture, dust, grease and other deleterious materials.

Field welds should be primed immediately after acceptance of the welds.

Assure that field painting is discontinued when weather conditions or condition of steel surfaces are not suitable.

Assure that when the thickness of the paint is specified, that the Lab is notified and performs the test.

Assure that the contractor documents painting inspections.

PIPING

Assure that pipe, fittings and associated material are properly marked and identified.

Assure that material that does not conform to the design requirements is properly segregated and/or processed.

Assure that piping that requires coating and wrapping has been completed.

Assure that areas have been checked for interferences with reinforcing bar, structural and forming (embedded pipe).

Assure that piping is located in accordance with the drawings.

Assure that piping is properly supported and secured against movement during concrete placement (embedded pipe).

Assure that piping system or partial system has been pressure tested and accepted prior to encasement in concrete (embedded pipe).

Assure that all openings in the system (e.g., floor drains, equipment drains, connecting piping joints) have been sealed and any valves in the vicinity of the concrete placement or backfill have been protected for cleanliness and against damage (embedded pipe).

ELECTRICAL

Preplanning

Check that material received is of the type and quality specified and bears the UL label.

Check that any cable and raceway is stored where it will be kept clean and protected against damage.

Operations-Raceway installation

Verify that raceway installation is in accordance with raceway schedules, specifications, drawings, notes and details.

Check that embedded conduit is installed correctly before concrete is placed.

Verify that raceway is installed to the requirements for cable installation, such as:

- Conduit radius and number of bends between points is correct.
- Location of pulling points is identified.
- Pull cards/wire installed in conduit.
- Access for pulling equipment and cable reels at pull points.

Check that protective end laps or plugs are installed in the ends of embedded conduits and ducts to keep foreign matter from entering raceway.

Verify raceway is properly grounded, supported and identified.

Assure that the raceway card system, if used or other system is functioning correctly.

Operations-Cable Installation

Assure that necessary material and cable pulling equipment is available and adequate to perform the installation.

Assure that there is communication among the crews during installation.

Assure that installation meets the manufacturer's recommendations.

Assure that an approved pulling compound is used.

Check weather conditions prior to pulling outdoors and assure that temperature is not below the recommended minimum.

Check that raceway, conduit, duct bank, etc., are complete, clean and that cable can be installed.

Check set-up and pulling equipment (Safety).

Assure that the cable pulling tension is correct.

Check that cable tags are secured to cable after pull-in.

Check that coils of wire are supported properly after pulling.

Keep accurate account of installed wire and cable.

Assure that the contractor has appropriate measuring devices to prevent maximum pulling tensions from being exceeded.

LIGHTING SYSTEMS

Preplanning

Review the applicable electrical specifications and drawings.

Operations - Fixtures and Switches

Review the lighting layout drawing to locate fixtures and switches.

Check that conduits and boxes are installed per conduit layout drawings for the lighting system and that they are properly supported.

Check that fixtures including hangers are installed as per specifications and drawings.

Check the light switch mounting heights.

Operations-Convenience Outlets

Review layout drawings for receptacle locations.

Check the type of receptacles against electrical specifications.

Review the contractor's conduit layout field sketches for receptacles.

Check receptacle mounting height against the electrical specification.

Operations-Wiring

Check the electrical specification for the type of lighting wires and color code and that wiring is installed accordingly.

Operations-Lighting Panels

Check that the type, size and rating of lighting panel is in agreement with lighting panel schedule.

Check the mounting of lighting panels and boxes are in accordance with the drawings.

Check that name plates show lighting panel number and locations as required by the drawings.

Check that lighting panels have a typed circuit directory and a holder on the inside of the door and protected by a clear window.

Check that branch circuit breaker ratings agree with those shown on latest lighting panel schedule.

Operations-Transformers

Check that the type, size and rating of transformers is in accordance with the single line diagrams.

Check that the transformer equipment and neutral grounds are properly installed.

Operations-Pole Mounted Fixtures

Assure that the concrete base is in accordance with details.

Verify that grounding of lighting standards is in accordance with job specifications.

Operations-Tunnel Lighting

Assure that work is performed in accordance with the requirements of NFPA 70 and other authorities having jurisdiction.

Verify that other construction work is complete to the extent that lighting fixtures may be installed.

Assure that the contractor has provided accessories as required for ceiling construction type.

Verify that appropriate supports for each lighting fixture is as specified. Fixtures and support elements shall not be mounted on or in contact with ducts or pipes.

Assure that the contractor has installed rows of fixtures accurately and in a straight line unless otherwise indicated on the drawings and that all necessary hangers, channels, bars, supports and rods are installed.

Verify that fixtures with vent holes are free from obstacles.

Assure that pendant mounted fixtures are supported from ceiling framework or from inserts into the slab and supported by stem hangers.

Verify that the final aiming of all adjustable fixtures is as specified. Aiming shall take place immediately before "final project inspection".

Assure that the contractor has performed the following:

- Cleaned the bottoms, trim, reflecting surfaces, lenses, baffles, louvers and reflector cones of the lighting fixtures.

- Masked the trims and bottom of the fixture to protect it during installation.
- Installed the correct lamp for each fixture.

Verify that all temporary lighting, fixtures, lamps, and/or associated wiring, conduit and boxes are removed once the permanent system is fully operational.

Verify that exit fixtures are installed directly over doorways.

GROUNDING

Operations-Equipment Grounding

Assure that all normally non-current carrying metal parts or electrical equipment, enclosures, building steel and other specified structures are effectively grounded as follows:

- Steel columns are grounded to grounding grid, as specified.
- Motors are grounded to the ground grid or to a grounded structural member, as specified.
- With gears, load center, MCC's and control cabinets are effectively grounded by connecting each end of the ground bus to the ground grid or as specified by the drawings.
- Metallic raceway (tray, conduit, junction boxes, etc.) is properly grounded in accordance with specified requirements.

Operations-Ground Grid

Check that stub-ups and ground pads are properly located, as specified.

Assure that grid is installed not less than 30" below finish grade.

Assure there is a 24" minimum separation between ground rods and/or bare grounding conductors, concrete structures or piles.

Assure that ground rods are driven into the ground until the top of the rod is 6" above the elevation of the grounding conductor.

Ground cable shall be #4/0 AWG stranded bare copper cable, unless otherwise specified.

Operations-Ground Fault Return Path

Assure that all electrical equipment is energized from a low-resistance or solidly grounded system operating at greater than 120 volts has a continuous ground fault return path using the following methods:

- Trays carrying power cables require a bare conductor along the outside of the tray.
- Rigid steel conduits are considered an effective ground fault return path and require not conductor with conduits. However, the tray ends of rigid steel conduits shall be jumped to the tray's ground fault conductor.
- Flexible conduits 1 1/2" and larger carrying power cables have a ground fault conductor.
- Embedded non-metallic conduits carrying power cables have a ground fault conductor.
- Duct banks have a ground fault conductor embedded in the top center surface of the duct bank concrete or on top of the duct bank. Power conduits branching off also require the ground fault conductor to follow. The ground fault conductor must be continuous inside the manhole.
- Ground fault conductors should be installed to both ends of the ground bus for MCC's, switchgear or load centers.

PRIMARY SWITCH GEAR

Verify that mounting channels and brackets are located as specified.

Assure that embedded floor mounting channels are level and on the same plane.

Assure that there are no high spots between mounting channels which could cause warping of switch gear panels.

Assure that panels are not racked or warped during transit.

Assure that all jacks are raised evenly when jacking switchgear to remove shipping skids.

Assure that embedded conduit and ground cables are not damaged when setting

switchgear.

Assure that panels and switchgear are adequately protected from dust, moisture, water, and mechanical damage.

Assure that switchgear and instrument shipping blocks are kept in place until heavy cables are installed.

Assure that wall mounted panels are adequately braced prior to concreting top prevent warping.

Assure that actual wiring agrees with the wiring diagram.

Assure that all devices, equipment, etc., are free from damage and are adjusted properly.

Assure that bolted bus joints are in accordance with the manufacturer's instructions for torque. Calibrated torque wrenches are required.

Assure that mechanical operator and contact alignment tests on breakers and operating mechanisms are in accordance with the manufacturer's instructions.

Witness minimum pickup voltage tests on all trip and closing coils.

Review electrical continuity checks on all current, potential and control circuits.

Witness insulation resistance test at 1000 volts DC on all control wiring. Minimum insulation resistance shall be 1,000,000 Ohms.

Verify the proper type, range and connections of all instrument transformers. Confirm correct polarity of all current transformers electrically.

Verify that the contractor has removed short-circuit links from current transformers after checking that secondary circuits are complete.

Verify that all meter connections and insure proper calibration.

Verify that all protective relays, auxiliary relays, trip coils, trip circuit seal-in and target coils, and fuses are of the proper type and range.

Verify that the contractor has removed wedges, ties and blocks that were installed by the manufacturer to prevent damage during shipping.

Check all relays in accordance with manufacturer's instructions. Set all relays in accordance with provided settings and check time-current characteristics with a test kit which has been approved by the relay manufacturer.

Measure battery system charging voltage and each individual cell voltage assuring that measured values are within manufacturer's specified tolerances.

CAUTION: All changes of connection, insertion and removal of meters, relays, etc., must be made in such a manner that the secondary circuits of energized current transformers are not opened even momentarily.

ELECTRICAL EQUIPMENT

Verify that temporary storage is provided for protection against moisture, blowing dust, or temperature extremes and according to manufacturer's instructions.

Verify that manufacturer's representative is available during installation when required.

Verify that foundation grades and bolt locations are correct before installing equipment.

Check that equipment is installed in accordance with manufacturer's instructions.

Verify that electrical service conforms to the specification and drawings.

Check leveling and alignment of equipment to specified tolerances.

Check torquing of mounting bolts.

Verify that base plates or equipment is shimmed, leveled and aligned before grouting.

Check grout mixing and placement is performed as recommended by the manufacturer.

Verify that welding conforms to AWS structural welding codes.

Verify that the equipment is correctly and permanently identified as required by specifications and drawings.

Verify that power, instrumentation and control cables are identified at each end.

Assure that all test equipment used for testing is calibrated and operation properly.

Compare actual connections with wiring diagrams.

Inspect all devices, equipment, etc., for damage or maladjustment caused by shipment or installation.

Assure that tightness of bolted bus joints are in accordance with manufacturer's recommendations (use calibrated torque wrenches).

Witness electrical continuity checks of all current, potential, and control circuits referring constantly to the diagrams.

Witness insulation resistance test at 1000 volts DC on all control wiring. Minimum insulation resistance shall be 1,000,000 Ohms.

Verify that the contractor has removed short-circuiting links from current transformers after checking that secondary circuits are complete.

Verify the proper type, range and connections of all instrument transformers. Confirm correct polarity of all current transformers electrically.

Verify all meter connections and assure proper calibration.

Verify that the contractor has removed wedges, ties and blocks installed by the manufacturer to prevent damage during shipping.

Assure that Certified copies of all test results are provided to the Engineer.

CONDUIT

Check conduits and fittings are of the size and type indicated in the drawings or specifications.

Check the location of conduits and stub ups agree with approved drawings.

Verify that there are no running threads on conduit. (not allowed by the specification or N.E.C.)

Check approved expansion couplings are installed at all expansion joints and in conduit runs longer than 300 feet and painted with bituminous paint 12" on either side of the coupling.

Check that couplings are installed in one of the blocks as follows: coupling face to be flush with face of block, conduit from other block to cross joint at 90 Deg. and free to move within fixed couplings when blocks move.

Assure that installed couplings are listed as "concrete tight" (embedded conduit).
Check that all conduit runs cross contraction or expansion joints are at 90° to the joint.

Check that all conduits are independently supported to maintain the correct location and spacing prior to embedment.

Check that conduit is supported clear of rebar and is of a rigid type (embedded conduit). (wooden supports are not acceptable.)

Assure that for embedded conduits which may come in possible contact with rebar are wrapped with bituminous compound or tape.

Assure that all conduits are capped and pull box openings are sealed to prevent ingress of foreign material which could block conduit.

Assure that conduits are swabbed, rodded or bailed after installation to remove foreign material, then replace caps on the system.

Assure that all conduit bends meet specification requirements.

Assure that field bends are free from cuts, dents or flats.

Check that the number of bends in a run of conduit between junction boxes do not exceed a total of 270 Degrees.



Assure that damaged galvanizing on conduit has been repaired with an approved material.

Assure that conduit is securely fastened to tray.

Ensure that conduit terminals are tagged and pull strings are installed where required by the specification.