

SECTION 02200

EARTHWORK

A. DEFINITIONS

1. Summary of Work:
 - a. The cost of all excavation required for the installation, construction, or demolition of buildings, structures, walls, utilities, etc., is to be included in the base bid. The Contractor is responsible for assessing the existing rock and soil conditions on site, and for making his own determination as to the size and type of equipment, time, and materials required to complete his work. All excavations shall be in accordance with OSHA 2226 "Excavating and Trenching Operations".
2. Excavation: Any manmade cavity or depression in the earth's surface made up of sidewalls, bottom or faces, vertical or inclined, formed by the removal of material producing unsupported earth conditions. If forms or similar structures are installed reducing the depth-to-width relationship, an excavation may be a trench.
3. Competent Person: An individual who by Registration, Education, Training, or Work Experience is capable of performing the proper analysis of the soil conditions encountered and design a shoring system to maintain a safe working environment within the excavated area.
4. Backfill: Material used to fill an excavation. The material used, may be an approved soil or Flowable fill.
5. Subgrade: The bottom of an excavation that is prepared and compacted to support a structure or piping, the elevation of which is the bottom of that excavation.
6. Borrow: Material, which is soil, and obtained off-site when sufficient approved soil material is not available from excavations.
7. Subbase Course: The layer placed between the subgrade and base course in a paving system or the layer placed between the subgrade and surface of a pavement or walk or the layer placed between.
8. Bedding Course: Layer placed over the excavated subgrade in a trench before laying pipe or under a structure.
9. Base Course: A type of soil where the particles are coarse and angular in shape, and are not cohesive.
10. Trench: A narrow excavation made below the initial surface of the ground. In general, the depth is greater than the width, but the width of a trench is not greater than 15 feet.
11. Unauthorized Excavation: The removal of earthen materials beyond the indicated subgrade elevations and/or dimensions without the direction by the Contractor's and/or Owner's Representative. Unauthorized excavation, as well as remedial work directed by the Owner, shall be at the Contractor's expense.
12. Structures: Buildings, footings, foundations, retaining walls, slabs, manholes, catch basins, tanks, curbs, mechanical and electrical appurtenances, or other man-made stationary features constructed above or below the initial ground surface.
13. Utilities: Underground pipes, conduits, ducts, and cables, as well as underground services within building lines.

B. EXCAVATION

1. Priorities:
 - a. Safety
 - b. Damage to existing services and structures
 - c. Disruption of shipyard production
 - d. Unscheduled interruption of services
 - e. Quality
 - f. Schedule
 - g. Cost.
2. Existing subsurface conditions are unusual and therefore the contractor may not be familiar with these types of conditions. Subsurface conditions may include:
 - a. Services/Utilities; Air-low pressure, Air-high pressure, Argon, Carbon Dioxide, CASCON Distribution System, C-5 gas, Data Distribution System, Electrical Distribution, Fresh (Potable) Water, Fire Alarm System, Fire (Water) Protection, Hydrogen, Natural Gas, Nitrogen, Oxygen, Propane, Pure Water, Sewage, Steam Condensate, Steam, Storm Drain, Telephone System, etc.
 - b. Interferences; boulders, ledge, foundations, seawalls, land reclamation fill, abandoned services/utilities, manholes, etc.
 - c. Hazardous materials; Asbestos, lead, petroleum products, PCB's, etc.
 - d. Ground water.

3. Information available from Electric Boat may include:
 - a. Drawings, photographs, first hand knowledge
 - b. Any information is provided for the convenience of the Contractor. Provided information may, or may not be, complete or correct, including size, location and elevation of any and all underground structures, and utilities. The Contractor shall perform his own inspection, including soils sampling and testing, of the work site and not rely upon the information provided. Any information that the contractor may find from his inspection that is additional or different from that provided, a copy of the same, shall be given to the Owner.

4. Procedures:
 - a. **Approval from Facilities is required prior to any excavation.**
 - b. The following instructions **must** be reviewed and complied with by the Electric Boat project manager and the contractor.
 - 1) Electric Boat, Facilities Department Instruction # 508-001.
 - 2) Electric Boat, Facilities Department Instruction # 508-002.
 - 3) Electric Boat, Facilities Department Instruction # 508-003.
 - c. The contractor shall submit a work, excavation, and safety plan. Plans shall be reviewed by Facilities prior to any excavation beginning. Disapproval or corrections to any of the stated plans shall not alleviate the contractor from completing the project on time and within contract amount.
 - d. The contractor shall coordinate with the Electric Boat project manager for photographs during excavation and construction to document existing conditions, installation of new material/equipment, modifications of existing material/equipment, and final conditions prior to back filling.
 - e. The contractor is responsible for the proper design of any trench protection system based on the conditions encountered. The trench protection system shall be designed by a "Competent Person".
 - f. The Contractor is responsible to protect all utilities and structures not scheduled to be removed or demolished and shall exercise extreme care in the performance of his work.
 - g. The Contractor shall notify the Owner of any discrepancies between provided information and actual field conditions.
 - h. Do not interrupt existing utilities except when permitted in writing by the Owner. Provide a minimum 48-hours' notice to the Owner and receive written notice to proceed before interrupting any utility.

5. Methods
 - a. Excavation methods will be detailed in the submitted work, excavation, and safety plans. These methods may differ from the contractors normal methods, due to B1 through B4 above. Methods will also vary from location to location in the shipyard and vary from project/task to project/task.
 - b. Excavation in the shipyard normally requires significant manual hand work and/or different equipment.
 - c. Excavation where utilities are present should be accomplished in a layered fashion, using hand tools or/and vacuum equipment.
 - d. All machine/equipment operators shall be experienced and qualified on the machine/equipment being used.
 - e. The Contractor should consider digging test pits to field locate utilities and to predetermine that new utilities can be constructed at the locations shown without interference.

C. QUALITY ASSURANCE

1. Codes and Standards: Perform earthwork complying with requirements of authorities having jurisdiction.
2. Perform work in accordance with the provisions of the current Industrial Codes established by OSHA, or the standards and appeals. Provide sheeting and shoring where required by code, for safety and/or to protect adjacent utilities and structures.
3. Comply with applicable requirements of NFPA 495, "Explosive Materials Code."
4. Seismic Survey Agency: An independent testing agency, acceptable to authorities having jurisdiction, experienced in seismic surveys and blasting procedures to perform the following services:
 - a. Report types of explosive and sizes of charge to be used in each area of rock removal, types of blasting mats, sequence of blasting operations, and procedures that will prevent damage to structures on Project site and adjacent properties.

5. Blasting
- a. Blasting Operations. The blasting shall be conducted by blasting experts who hold all necessary licenses or permits required for the use of explosives. All drilling and blasting shall be done under the direction of experienced fully qualified foremen. Blasting operations shall be timed to minimize impacts to the Owner's operations and to the public.
 - b. Regulatory Requirements. The purchase, transportation, use, storage, and safeguarding of all explosives and explosive devices brought on to the Site or otherwise used in the Work shall be in accordance with all applicable Laws and Regulations. The Contractor shall obtain all required licenses or permits before explosives and explosive devices are brought on Site.
 - c. Blasting Plan: At least 30 Days prior to any blasting, a blasting plan shall be submitted to the Engineer. The blasting plan shall include:
 - 1) Seismic Specialist. The Contractor shall provide the Engineer with seismic specialist's resume citing, in addition to other pertinent information, his past experience, training, and education. The acceptability of the seismic specialist shall be subject to the approval of the Engineer.
 - 2) Blasting Specialist. The Contractor shall submit the resume, experience, and training of the blasting specialist to the Engineer. The submittal shall detail the experience and training which the Contractor believes qualifies the specialist for work under this contract. The Contractor shall coordinate the proposed type and method of blasting with the Owner. The acceptability of the blasting specialist shall be subject to the approval of the Engineer.
 - 3) The Contractor shall perform a preblast survey of the surrounding buildings and homes. The contractor shall document the findings of the survey with photographs, and crack maps of adjacent buildings prior to starting blasting operations. Copy of the documentation shall be submitted to the Engineer for review and approval. Photographs taken at the site must be taken by the Owner. Contractor shall provide the Owner 48 hour notice to coordinate taking of photographs. Owner will provide contractor with approved photographs within 7 days.
 - 4) Method of detonation shall be provided and coordinated with Electric Boat's Fire Department and City of Groton's Fire Department.
 - 5) Twenty-four hours prior to each blast the following information shall be submitted, and the Owner shall be informed to coordinate blast activities:
 - (a) Drawings or sketches showing the location and spacing of blast holes and free faces, fully dimensioned;
 - (b) Number, diameter, and depth of holes;
 - (c) Weight and type of powder to be loaded in each hole;
 - (d) Total powder to be used in the blast;
 - (e) Delays to be used in the blast;
 - (f) Method of wiring the blast;
 - (g) Number of pounds of powder per delay;
 - (h) Water conditions in each hole; and
 - (i) Results of vibration monitoring of structures for the previous blast.
 - d. Blast Vibration Monitoring
 - 1) General. Vibration monitoring of all blasts is required of the Contractor. The blasts shall be monitored to ensure that the peak particle velocity measured at the nearest structure does not exceed 2 inches per second. The Contractor shall submit the proposed locations of the monitoring devices to the Engineer for approval.
 - 2) Seismic Specialist. The Contractor shall employ a qualified seismic specialist trained in vibration control methods and capable of analyzing results obtained from blasting seismographs.
 - 3) Measuring and Recording Instruments. The Contractor shall provide at least four instruments with specifications equal to the Series 5000, Vibra-Tape, available from Vibra-Tech, Hazelton, PA, or equal **with current proof of calibration**. The instruments shall be appropriately placed upon the structures surrounding the blast.
 - 4) Seismograph Operator. The seismograph operator shall be a qualified person capable of setting the instrument up at designated locations and effectively recording the blast.
 - 5) Results of Vibration Monitoring. The results of vibration monitoring in the form of peak readings for each blast shall be provided to the Engineer prior to any further blasting. No blast shall be made before the results from the previous blasting have been furnished to the Engineer and approved. Instruments that provide only peak

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readings from an analog view-meter type display will not be acceptable. Results in the form of peak readings will be acceptable provided they are obtained from the vibration record and not from a separate device as previously mentioned. The Contractor shall take all necessary precautions to assure that the peak readings available from the blast record are accurate to the maximum extent possible, as defined by the manufacturer of the equipment. The equipment, including peak readout, shall be certified by the manufacturer to be within acceptable calibration limits.

- e. Blasting for Excavation:
- 1) Storage of explosives at the site will not be permitted. Explosives shall only enter the site through gates designated by the Owner.
 - 2) Blasting shall be performed using modern controlled methods such as pre-splitting, cushion blasting, smooth blasting, and line drilling. Blasting techniques shall be developed and applied, and revised as necessary, to maintain the tolerances specified herein and as directed. Excavation adjacent to the final rock faces shall be carried on in such manner that the face shall be undisturbed. Whenever further blasting may damage the rock upon or against which concrete or fill is to be placed, the use of explosives shall be discontinued, and the excavation shall be completed by wedging, barring, channeling, line drilling and broaching, or other suitable methods.
 - 3) Blasts shall be planned and designed to ensure that peak particle velocities measured at the adjacent structures are less than 2 inches per second. Test shots with small charges shall be performed to allow the Contractor's program to be adjusted to ensure conformance with this requirement.
 - 4) Heavy blasting will not be permitted against final rock surfaces or concrete surfaces scheduled to remain. Final grades shall be prepared by drilling, pre-splitting, picking, barring, wedging, light blasting, and similar methods which will leave surfaces in the best practicable condition.
 - 5) Special precautions shall be taken in excavating by blasting. Extra care shall be used in order to ensure that the vertical surfaces remaining after the excavation are undamaged. Special procedures shall include.
 - (a) Line drilling holes around the perimeter of areas that will be excavated by blasting methods;
 - (b) Carefully control the drilling and blasting operation progressively reducing blasting lifts and the quantity of explosive used as final grades are approached to avoid disturbing the rock surface outside final excavation lines and grades;
 - (c) Perform heavy scaling as required during excavation operations.
 - (d) Special care is also required in the vicinity of existing structures to ensure that structures designated to remain are undamaged by the excavation process. Any rock adjacent to the existing structures shall be excavated by non-explosive methods to create an open relief zone. Non-explosive methods shall include presplitting, line drilling, the use of boom-mounted demolition hammers and other non-explosive type excavation techniques.
 - 6) Coordination: The Contractor shall coordinate all blasting operations with Electric Boat's Fire Department and City of Groton's Fire Department before commencement of blasting operations.
 - 7) Safety: Proper precautions shall be taken during blasting operations for the protection of all persons, work, and property. The Contractor's blasting plan shall include a description of the safety precautions that will be implemented to protect all persons, the work, and property. The safety precautions shall include but not be limited to the following:
 - (a) Warning signals shall be sounded prior to each shot, and "all-clear" signal shall be sounded after each shot.
 - (b) The Contractor shall contact the City of Groton and arrange to have adjacent streets temporarily closed during each shot. The Contractor shall be responsible for all coordination, permits, flagmen, warning signs, and other conditions required by the City.
 - (c) The Contractor's blasting plan and procedures should take into consideration the location of existing utilities in and around the site, some of which are high pressure steam, argon, propane, and oxygen.
 - (d) All blasts shall be planned and performed to preclude the possibility of flying fragments. Blasting mats and other such devices shall be used to prevent flying fragments.

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- 8) Procedures: Blast hole patterns, use of burn and relief holes, use of milli-second delay detonators, and use of trim shots may be required for the protection of the work, and for the protection of adjacent structures and underground utilities. Explosives used shall be of such quality, power, and in such locations as to not disturb materials, structures, or utilities outside the prescribed limits of the excavation. All rock shattered outside the established or minimum limits of excavation shall be removed.
 - 9) Care shall be exercised to avoid excessive overbreak beyond the limits required to construct the work. The Contractor will be required to backfill over excavated areas with suitable fill material acceptable to the Engineer. No payment will be made for over excavation of rock or for the fill material required to backfill over excavated rock.
 - 10) Pre-Splitting. The hole spacing used in pre-splitting shall not exceed 10 times the hole diameter unless otherwise approved. Other methods of controlled blasting may be permitted provided comparable results are demonstrated.
 - 11) Line Drilling. Line drilled holes shall be 2 to 3 in. in diameter. The spacing of the drilled holes shall not be more than twice the hole diameter, center to center. The line drilled holes shall be drilled with equipment capable of maintaining the alignment and plane of the drilled hole throughout the full depth of the holes. Line drilling shall be performed in such a manner that the faces remaining shall be undisturbed rock and that the faces shall not project inside the excavation lines. Line drilling shall be performed around the perimeter of areas that will be excavated by blasting methods.
 - 12) Damage occurring as a result of the Contractor's blasting operations shall be repaired by the Contractor to the satisfaction of the Owner at no additional expense to the Owner.
6. Field Quality Control
- a. Testing Agency Services: Engage a testing agency to perform laboratory analysis, inspect and test each subgrade and each fill or backfill layer. Do not proceed until test results for previously completed work verify compliance with requirements. **Note: When any radioactive source is used for testing, the EBC Project Engineer shall be notified one day in advance, and his approval received prior to bringing into the shipyard.**
 - b. When testing agency reports that subgrades, fills, or backfills are below specified density, scarify and moisten or aerate, or remove and replace soil to the depth required, recompact and retest until required density is obtained.
 - c. Moisture Control:
 - 1) Uniformly moisten or aerate subgrade and each subsequent fill or backfill layer before compaction to within 2 percent of optimum moisture content. **Ponding or puddling to compact soil shall be prohibited.**
 - (a) Do not place backfill or fill material on surfaces that are muddy, frozen, or contain frost or ice.
 - (b) Remove and replace, or scarify and air-dry satisfactory soil material that is too wet to compact to specified density.
 - (1) Stockpile or spread and dry removed wet satisfactory soil material.
 - d. Compaction:
 - 1) Place backfill and fill materials in the lift thicknesses specified in Table 1 below:

Table 1

Compaction Method	Maximum Loose Lift Thickness	
	Below Structures and Pavement	Less Critical Areas
Hand-operated vibratory plate or light roller in confined areas	6"	8"
Hand-operated vibratory drum rollers weighing at least 1,000# in confined areas.	8"	10"
Light vibratory drum roller, minimum weight at drum 5,000#, minimum dynamic force 10,000#	10"	12"
Medium to heavy vibratory drum roller, minimum weight at drum 10,000#, minimum dynamic force 20,000#	12"	16"

- 2) Compaction of fill or backfill within 2 feet of buildings and structures shall be done with hand-operated equipment. Extreme care shall be taken to avoid damaging waterproofing and insulation materials.
- 3) Place backfill and fill materials evenly on all sides of structures to required elevations. Place backfill and fill uniformly along the full length of each structure.
- 4) Percentage of Maximum Dry Density Requirements: Compact soil to not less than the following percentages of maximum dry density according to ASTM D 1557, latest edition:
 - (a) Under structures, building slabs, steps, and pavements, compact each layer of **structural** fill material to 95 percent maximum dry density.
 - (b) Under walkways, compact each layer of **structural** fill material to 95 percent maximum dry density.
 - (c) Under lawn or unpaved areas, compact each layer of backfill or fill material to 92 percent maximum dry density.

D. SOIL MATERIALS

1. General: Provide approved borrow soil materials from off-site when sufficient approved soil materials are not available from excavations.
2. Satisfactory Soil Materials: ASTM D 2487 soil classification groups GW, GP, GM, SW, SP, and SM; free of rock or gravel larger than 2 inches in any dimension, debris, waste, frozen materials, vegetation and other deleterious matter.
3. Unsatisfactory Soil Materials: ASTM D 2487 soil classification groups GC, SC, ML, MH, CL, CH, OL, OH, and PT.
4. Backfill and Fill Materials: Satisfactory soil materials conforming to the requirements of the specified materials.
5. Subbase Material: Refer to Contract Drawings for specified material.
6. Processed Aggregate Base: A dense graded high stability crushed stone mix meeting the requirements of Article M.05.01 of ConnDOT "Standard Specifications for Roads, Bridges, and Incidental Construction," Form 814A, 1995.
7. Granular Fill: Clean, dense graded sand and gravel Granular Fill shall meet the requirements of Articles M.02.01 and M.02.06 (Grading "A") of ConnDOT "Standard Specifications for Roads, Bridges, and Incidental Construction," Form 814A, 1995.

8. Structural Fill: Clean, well graded gravelly sand or sand and gravel. Structural fill should satisfy the following gradation requirements:

<u>Sieve Size</u>	<u>Percent Passing by Weight</u>
6"	100
No. 4	40-75
No. 10	15-60
No. 40	5-35
No. 200	0-15

9. Pipe Bedding Material:
- Sand or sandy soil, all of which passes a 3/8 inch sieve, and not more than 10 percent passes a No. 200 sieve.
 - Crushed aggregate meeting the requirements of Connecticut Department of Transportation Material for Item No. M.01.01 - Crushed stone, No. 6.
10. Filtering Material: Evenly graded mixture of natural or crushed gravel or crushed stone and natural sand, with 100 percent passing a 1-inch sieve and 0 to 5 percent passing a No. 8 sieve.
11. Select Fill Material: Well graded granular material or bank run gravel, free from organic matter. Not more than 70 percent by weight shall pass through a No. 40 sieve; not more than 10 percent by weight shall pass through a No. 200 sieve; and 100 percent shall pass a 4 inch square sieve.
12. Stone Filling: Well graded stone, air cooled blast furnace slag, cobbles or gravel that meets the following requirements:
- Maximum 10 percent loss by weight after 25 cycles of frequency and thawing (Freeze-Thaw Test).
 - Maximum 10 percent loss by weight after 10 cycles of the magnesium sulfate soundness test.
 - Gradation:

<u>Gradation</u>	<u>Percent of Total by Weight</u>
Smaller than 8 Inch	90-100
Larger than 3 Inch	50-100
Smaller No. 10 Sieve	0-10

Materials shall contain a sufficient amount of stones smaller than the average stone size to fill the voids between the larger stones.

13. Common Fill Material and Common Earth
- Provide approved soil materials for fill, free of clay, rock, or gravel larger than 6 inches in any dimension, debris, waste, frozen materials, vegetable and other deleterious matter.
14. Select Granular Material
- Select granular material shall be well graded granular material or bank run gravel, free from silt, clay and organic matter, approved by the Architect/Engineer and meeting the following gradation requirements:

<u>Nominal Sieve Size</u>	<u>Amounts Finer than Size of Sieve (Percent by Weight)</u>
2"	100
#40	0-70
#200	0-10

15. Run of Bank Gravel: Clean, well graded granular material approved by the Architect/Engineer.
16. Unstable Material: Debris and material of any nature and all wet, soft, or loose earth located below the bottom limits of excavation which does not provide sufficient bearing capacity to satisfactorily support pipes or other work placed thereon.
17. Unsuitable Material: Excavated material, which includes "unstable material."
18. Solid Rock: Rock 1/2 cubic yard and larger in volume which cannot readily be removed by a power driven excavator of 2/3 cubic yard capacity and of modern design and in good working condition, except after preliminary breaking by drilling, shall be considered solid rock.
19. Loose Rock: Shale, slate, soft sandstone, nested boulders and such other rock material which is decomposed, stratified or shattered to such extent that it can be readily removed, without need for drilling, by a power driven excavator of 2/3 cubic yard capacity and of modern design and in good working condition.

E. ACCESSORIES

1. Filter Fabric: Manufacturer's standard nonwoven pervious geotextile fabric of polypropylene, nylon or polyester fibers, or a combination.
 - a. Provide filter fabric that meet or exceed the listed minimum physical properties determined according to ASTM D 4759 and the referenced standard test method in parentheses:
 - 1) Grab Tensile Strength (ASTM D 4632): 100 lb.
 - 2) Apparent Opening Size (ASTM D 4751): #100 U.S. Standard sieve.
 - 3) Permeability (ASTM D 4491): 150 gallons per minute per sq. ft.

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SECTION 02510

WATER DISTRIBUTION

A. SYSTEM PERFORMANCE REQUIREMENTS

1. Minimum Working Pressures: The following are minimum pressure requirements for piping and specialties, unless otherwise indicated:
 - a. Potable-Water Service: 160 psig (1100 kPa).
 - b. Fire-Protection Water Service: 150 psig (1035 kPa).

B. QUALITY ASSURANCE

1. Comply with standards of authorities having jurisdiction for potable water-service piping. Include materials, installation, testing, and disinfect ion.
2. Comply with standards of authorities having jurisdiction for fire-protection water-service piping. Include materials, hose threads, installation, and testing.
3. Comply with NFPA 24 latest editions, "Installation of Private Fire Service Mains and Their Appurtenances," for materials, installations, tests, flushing, and valve and hydrant supervision.
4. Comply with NFPA 70 latest editions, "National Electrical Code," for electrical connections between wiring and electrically operated devices.
5. Provide listing/approval stamp, label, or other marking on piping and specialties made to specified standards.

C. PIPES AND TUBES

1. Ductile-Iron, Push-on-Joint Pipe: AWWA C151, with cement-mortar lining and seal coat according to AWWA C104. Include rubber compression gasket according to AWWA C111.
2. Ductile-Iron, Mechanical-Joint Pipe: AWWA C151, with cement-mortar lining and seal coat according to AWWA C104. Include gland, rubber gasket, and bolts and nuts according to AWWA C111.

D. PIPE AND TUBE FITTINGS

1. Ductile-Iron, Mechanical-Joint Fittings: AWWA C110, ductile-iron or cast-iron; or AWWA C153, ductile-iron, compact type. Include cement-mortar lining and seal coat according to AWWA C104 and glands, rubber gaskets, and bolts and nuts according to AWWA C111.
2. Ductile-Iron, Flanged Fittings: AWWA C110, with cement-mortar lining and seal coat according to AWWA C104 or epoxy, interior coating according to AWWA C550. Include gaskets and bolts and nuts.
3. Cast-Iron Flanged Fittings: ASME B16.1, Class 125, unless otherwise indicated.

E. JOINING MATERIALS

1. Ductile-Iron Piping: The following materials apply:
 - a. Push-on Joints: AWWA C111 rubber gaskets and lubricant.
 - b. Mechanical Joints: AWWA C111 ductile-iron or gray-iron glands, high-strength steel bolts and nuts, and rubber gaskets.
 - c. Flanged Joints: AWWA C115 ductile-iron or gray-iron pipe flanges, rubber gaskets, and high-strength steel bolts and nuts.
 - 1) Gaskets: Rubber, flat face, 1/8 inch (3 mm) thick, unless otherwise indicated; and full-face or ring type, unless otherwise indicated.
 - 2) Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.

F. RESTRAINED JOINT PIPING SYSTEMS

1. Restrained Joints: All pipe and fittings shall have restrained joint restrained by the methods described.
 - a. Mechanical Joints
 - 1) Retainer glands, AWWA C111, 250 psi working pressure, six set screws minimum, torque indicator type.

- b. Push-On
 - 1) Locking ring or cams or integral glands for Ductile Iron Pipe, AWWA C111, 250 psi working pressure.
- c. Clamps and Rods
 - 1) Rods: All thread rod shall be COR-TEN, ASTM A242-81 3/4 inch diameter with rolled threads, tensile strength 70,000 minimum, corrosion resistant. Ends of rod shall be painted gold by manufacturer for easy identification as COR-TEN. Manufactured by Continental Eastern Corp., or as approved.
 - 2) Bent Eye Bolts: ASTM A242-81 3/4 inch diameter, eye welded closed and heat treated, same length as standard tee bolt.
 - 3) Lugs: Ductile iron pipe lugs shall be 80,000 psi minimum tensile strength, 60,000 minimum yield strength per ASTM A476-70 or higher strength. Continental's C-80, or as approved.
 - 4) Clamps: Designed for restraining AWWA ductile iron pipe joints. Washers shall be included. Electro-zinc corrosion resistant finish. Two clamps per joint with tie rods. Stellar Clamps Figure 380 ASTM A36-81, or as approved.
 - 5) Nuts: COR-TEN nuts for 3/4 inch x 10 rolled thread UNC2A rod and bolts.

G. VALVES

- 1. Nonrising-Stem, Resilient-Seated Gate Valves, 3-Inch NPS (DN80) and Larger: AWWA C509, gray- or ductile-iron body and bonnet; with bronze or gray- or ductile-iron gate, resilient seats, bronze stem, and stem nut. Include 200-psig (1380-kPa) minimum working-pressure design, interior coating according to AWWA C550, and push-on- or mechanical-joint ends.
- 2. Nonrising-Stem Gate Valves for fire protection piping, 4-Inch NPS (DN100) and Larger: UL 262, FM approved, iron body and bonnet with flange for indicator post, bronze seating material, inside screw, 175-psig (1200-kPa) working pressure, and mechanical-joint ends. Provide with flanged ends for pit installation.
- 3. Valve Boxes: Cast-iron box with top section and cover with lettering "WATER," bottom section with base of size to fit over valve and barrel approximately 5 inches (125 mm) in diameter, and adjustable cast-iron extension of length required for depth of bury of valve.
 - a. Provide steel tee-handle operating wrench with each valve box. Include tee handle with one pointed end, stem of length to operate valve, and socket-fitting valve-operating nut.
- 4. Indicator Posts: UL 789, FM-approved, vertical-type, cast-iron body with operating wrench, extension rod, and adjustable cast-iron barrel of length required for depth of bury of valve.
- 5. Tapping Sleeve and Tapping Valve: Complete assembly, including tapping sleeve, tapping valve, and bolts and nuts. Use sleeve and valve compatible with tapping machine.
 - a. Tapping Sleeve: Cast- or ductile-iron, 2-piece bolted sleeve with flanged outlet for new branch connection. Sleeve may have mechanical-joint ends with rubber gaskets or sealing rings in sleeve body. Include sleeve matching size and type of pipe material being tapped and of outlet flange required for branch connection.

H. FREESTANDING FIRE HYDRANTS

- 1. Description: Cast-iron body, compression-type valve, opening against pressure and closing with pressure, 6-inch (DN150) mechanical-joint inlet, and 150-psig (1035-kPa) minimum working-pressure design.
- 2. Outlet Threads: NFPA 1963, with external hose thread used by local fire department. Include cast-iron caps with steel chains.
- 3. Operating and Cap Nuts: Pentagon 1-1/2 inch (40 mm) point to flat.
- 4. Direction of Opening: Open hydrant valve by turning operating nut to left or counterclockwise.
- 5. Exterior Finish: Red alkyd-gloss enamel paint, unless otherwise indicated.
- 6. Dry-Barrel Fire Hydrants: UL 246, FM-approved, two 2-1/2-inch NPS (DN65) and one 4-1/2-inch NPS (DN115) outlets, 5-1/4-inch (133-mm) main valve, drain valve, and 6-inch NPS (DN150) mechanical-joint inlet.

I. ANCHORAGES

- 1. Clamps, Straps, and Washers: ASTM A 506, steel.
- 2. Rods: ASTM A 575, steel.
- 3. Rod Couplings: ASTM A 197 (ASTM A 197M), malleable iron.
- 4. Bolts: ASTM A 307, steel.
- 5. Cast-Iron Washers: ASTM A 126, gray iron.

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6. Concrete Reaction Backing: Portland cement concrete mix, 3000 psig (20.7 MPa).
 - a. Cement: ASTM C 150, Type I.
 - b. Fine Aggregate: ASTM C 33, sand.
 - c. Coarse Aggregate: ASTM C 33, crushed gravel.
 - d. Water: Potable.

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SECTION 02513

BITUMINOUS CONCRETE PAVEMENT

A. REFERENCED STANDARDS

1. Standard Specifications for Roads, Bridges, and Incidental Construction, published by the State of Connecticut, Department of Transportation, Form 814A, 1995.

B. PAVEMENT COMPOSITION

1. The various types of materials included under this work are specified as:
 - a. Bituminous Concrete - Connecticut DOT Class 1.
 - b. Bituminous Concrete - Connecticut DOT Class 4.
 - c. Cold Mix Bituminous Pavement - As approved by the Owner.
 - d. Asphalt Emulsion Tackcoat - Connecticut DOT Material for Tack Coat.

C. MATERIAL APPROVALS

1. The various bituminous pavement items noted shall be mixed at a plant regularly supplying the same items to the Connecticut Department of Transportation.
2. Aggregates for the various bituminous pavement items shall be obtained from sources currently approved by the Connecticut Department of Transportation.
3. Bituminous material and mineral filler shall be accepted on the basis of certification by the manufacturer or producer that the material complies with the material requirements of the specifications in all respects. Certification shall be furnished to the Owner before final acceptance of the item.

D. REFERENCED SPECIFICATION

1. Construction of bituminous concrete pavements shall comply in all respects to the applicable requirements of the referenced Department of Transportation specification.

E. TEMPORARY PAVEMENTS

1. Construct temporary pavements from cold mix bituminous material, as required, to maintain the traveled way following trenching for the installation of piped utilities at all locations where permanent pavement reconstruction will not closely follow, as approved.

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SECTION 02515

CONCRETE PAVEMENTS AND CURBS

A. CONCRETE FORMWORK

1. Forms
 - a. Steel, wood, or other suitable material of size and strength to resist movement during concrete placement and to retain horizontal and vertical alignment until removal. Use straight forms, free of distortion and defects.
 - b. Use flexible spring steel forms or laminated boards to form radius bends as required.
 - c. Coat forms with a nonstaining form release agent that will not discolor or deface surface of concrete.

B. CONCRETE CURING MATERIALS

1. Moisture Retaining Coverings
 - a. Waterproof Paper, Polyethylene Film, or White Burlap-Polyethylene Sheet: ASTM C171 "Sheet Materials for Curing Concrete."
2. Curing Compound: ASTM C309. The compound shall be a dissipating resin curing compound. The compound must chemically break down in a two to four week period after application. Approved product is "Kurez DR" by The Euclid Chemical Company, or as approved.

C. PREFORMED EXPANSION JOINT FILLER

1. Provide preformed asphalt expansion joint filler complying with ASTM D994.

D. REINFORCING MATERIALS

1. Reinforcing Bars
 - a. ASTM A615, including Supplementary Requirement S1, Grade 60, except stirrups and ties may be Grade 40 for ease of bending.
2. Wire Fabric
 - a. Welded Steel: ASTM A185.
 - b. Welded Deformed Steel: ASTM A497.
 - 1) The yield strength (of 60,000 psi or greater) shall be determined at a strain of 0.35 percent.
 - c. Wire fabric shall be provided in flat sheets only.
3. Tie Wire
 - a. Within 2 Inches of Exposed Concrete Surfaces: 16 gauge minimum soft annealed zinc coated steel.
 - b. Elsewhere: 16 gauge minimum, black annealed steel.

E. EXPANSION JOINT SEALANT

1. Polyurethane: Two-part meeting Federal Specification TT-S-00227E and ASTM C-920, Traffic Grade
 - a. Horizontal Joints: Self leveling grade.
 - 1) Type I, hardness, Shore A, 35-45.
 - 2) Class A, self-leveling.
 - b. Vertical Joints: Non-sag grade.
 - c. Non-staining.
 - d. Primer: Type required and recommended by sealant manufacturer.
 - e. Service Range: -40 degrees F to 180 degrees F.
 - f. Tackfree Time: 48 hours maximum.
 - g. Chemical curing.
 - h. Cure Time: 1/4 inch by 1/4 inch channel - 3-4 days.
 - i. Compression Set: 5 percent maximum.
 - j. Colors: To be selected from manufacturer's full line by Architect/Engineer.
 - k. Material: Sikaflex-2C SL/NS, manufactured by Sika Corporation, Lindhurst, NJ, or as approved.

F. BONDING AGENTS

1. Bonding agents shall be water soluble bonding agents or cement grout.

G. CONCRETE FINISHES

1. Pavements (Walks, Aprons, and Pads)
 - a. Immediately after floating, give a coarse scored textured finish by drawing a broom across the surface.
 - b. Scoring shall be transverse to direction of foot traffic.
 - c. Edge Treatment
 - 1) Walks, Aprons, and Flush Pads: Finish edges with 1/4 inch radius edging tool.
 - 2) Raised Pads: Edges shall have 3/4 inch chamfered edge.
2. Curbs
 - a. Provide a smooth and uniform finish on exposed surfaces.
 - b. Finish edges with edging tool.

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SECTION 02711

FOUNDATION DRAINAGE SYSTEMS

A. QUALITY ASSURANCE

1. Installer Qualifications: Engage an experienced Installer who has completed foundation drainage systems similar in material, design, and extent to that indicated for this Project and with a record of successful in-service performance.
2. Field Quality Control:
 - a. Testing: Test drain piping with water or visually check piping to ensure free flow before backfilling. Remove obstructions, replace damaged components, and repeat test until results are satisfactory.
 - 1) Place additional filtering material to depth of 6 inches around sides and top of drains after testing.

B. COORDINATION

1. Coordinate foundation drainage system installation with excavating, trenching, and backfilling.
2. Coordinate piping termination with storm drainage system.

C. PIPES AND FITTINGS

1. General: Include pipes, fittings, couplings, and joint materials.
2. Polyvinyl Chloride (PVC) Sewer Pipe and Fittings (Solid Pipe): ASTM D 3034, SDR 35, bell-and-spigot ends, for gasketed joints.
 - a. Gaskets: ASTM F 477, elastomeric seal.
3. Perforated, Polyvinyl Chloride (PVC) Sewer Pipe and Fittings: ASTM D 2729, bell-and-spigot ends, for loose joints.
4. Geotextile or Filter Fabric
 - a. Refer to requirements specified in Section 02200.

D. SPECIAL PIPE COUPLINGS

1. Description: Rubber or elastomeric sleeve and band assembly fabricated to match outside diameters of pipes to be joined.
 - a. Sleeve type and size shall be compatible with pipe materials being joined.

E. SOIL MATERIALS

1. Filtering Material: Refer to Section 02200.

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SECTION 02831

CHAIN LINK FENCES AND GATES

A. CHAIN LINK FENCING AND GATES

1. Fabric
 - a. Polyvinylchloride coating over galvanized steel chain link fence fabric conforming to ASTM A392, latest revision.
 - b. One-piece fabric, full height, size as indicated.
 - c. Mesh Size: 2 inches, except as noted otherwise.
 - d. Wire Diameter (Core): 9 gauge, except as noted otherwise.
 - e. Selvage

	Height	Selvage
1)	4 feet 0 inches - 6 feet 0 inches	Both edges knuckled
2)	Greater than 6 feet 0 inches	Bottom edge only knuckled
 - f. Warranty
 - 1) Minimum 20 year guarantee against failure resulting from rust or corrosion.
2. Line Posts
 - a. Shall be 2-1/2 inch polyvinylchloride coating over galvanized steel schedule 40 pipe. Spacing shall be 10 feet 0 inch maximum. All posts which do not have a barb arm attached at the top shall have a cap.
3. End, Corner, Pull, and Gate Posts
 - a. Shall be 3 inch polyvinylchloride coating over galvanized steel schedule 40 pipe. Gate posts for gates over 6 feet 0 inch wide shall be of a size as recommended by the gate manufacturer and approved by Electric Boat. All posts which do not have a barb arm attached at the top shall have a cap.
4. Post Settings
 - a. Posts shall be of sufficient length to allow for 36 inch settings into concrete footings. Diameter shall be 10 inch for 2 inch posts and 12 inch for 3 inch posts. Footings for posts over 3 inches shall be submitted for approval. Cover shall be 4 inch minimum. Tops shall be crowned to shed water. When ledge, rock, etc., is encountered, the posts shall be set in drilled holes at least 12 inches in depth and grouted with 5-Star Epoxy Grout or an approved equal. Special post settings shall be as indicated on the drawings, etc.
5. Brace Rail: Shall be 1-5/8 inch steel tubing.
6. Fittings
 - a. Shall be pressed steel galvanized and coated with polyvinylchloride.
7. Barbed Wire
 - a. Three strands of barbed wire shall be installed on extension arms, 45 degrees outward. Barbed wire shall consist of 4 point barbs spaced 3 inches apart on double strand twisted 12-1/2 gauge steel wire.
8. Top and Bottom Tension Wire
 - a. Shall be No. 7 gauge, steel, coil spring wire.
9. Gates
 - a. Frames shall be tubular welded construction. Member sizes, braces, hardware, etc., shall be of adequate design and strength to provide satisfactory operation of the gate and minimal deflection and sagging. All bolts shall be staked. Latches shall be padlocked type. Shop drawings shall be submitted for approval.
10. Truss Braces
 - a. Shall be securely fastened to posts by suitable connections and trusses from lines post back to post requiring bracing with 3/8 inch round rod having a turnbuckle adjustment. Each brace shall have an independent brace rail. Braces shall be installed as follows:
 - 1) Pull posts with two braces shall be provided for all heights where changes in horizontal or vertical alignment of ten (10) degrees or more occur.
 - 2) Corner posts shall have two (2) braces.
 - 3) End posts shall have one brace.
11. Material Finish
 - a. All material shall be galvanized coated with polyvinylchloride.

January 7, 2004

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