

State of Connecticut

Department of Transportation

SUPPLEMENTAL SPECIFICATIONS

TO

THE STANDARD SPECIFICATIONS

FOR

ROADS, BRIDGES AND INCIDENTAL CONSTRUCTION

FORM 816

2004

JULY 2014

July 2014

DIVISION I
GENERAL REQUIREMENTS AND COVENANTS

<u>SECTION</u>		<u>SPECIFICATION NUMBER</u>
1.01	Definition of Terms and Permissible Abbreviations	101
1.02	Proposal Requirements and Conditions	102
1.03	Award and Execution of Contract	103
1.05	Control of the Work	105
1.07	Legal Relations and Responsibilities	107
1.08	Prosecution and Progress	108
1.09	Measurement and Payment	109
1.10	Environmental Compliance	110
1.11	Claims	111
1.20	General Clauses for Facilities Construction	120

DIVISION II
CONSTRUCTION DETAILS

<u>SECTION</u>		<u>SPECIFICATION NUMBER</u>
2.02	Roadway Excavation, Formation of Embankment and Disposal of Surplus Material	202
2.05	Trench Excavation	205
2.12	Subbase	212
2.16	Pervious Structure Backfill	216
3.04	Processed Aggregate Base	304
4.01	Concrete Pavement	401
5.14	Prestressed Concrete Members	514
6.01	Concrete for Structures	601
6.03	Structural Steel	603
6.12	Concrete Cylinder Curing Box	612
6.51	Culverts	651
7.01	Drilled Shafts	701
7.02	Piles	702
7.06	Micropiles	706
8.22	Temporary Precast Concrete Barrier Curb	822
9.01	Bollard	901
9.10	Metal Beam Rail	910
9.18	Three-Cable Guide Railing (I-Beam Post) and Anchorages	918
9.22	Bituminous Concrete Sidewalk	
	Bituminous Concrete Driveway	922
9.44	Topsoil	944
9.49	Furnishing, Planting and Mulching Trees, Shrubs, Vines and Ground Cover Plants	949
9.75	Mobilization and Project Closeout	975
10.00	General Clauses for Highway Illumination and Traffic Signal Projects	1000
10.01	Trenching and Backfilling	1001
10.03	Light Standards	1003
10.09	Cast Iron Junction Box	1009
10.10	Concrete Handhole	1010
10.14	Cable in Duct	1014
10.19	Pre-Assembled Aerial Cable, Aerial Cable (3 No. 2)	1019
10.20	Wood Pole, Temporary Illumination Unit	1020
11.13	Control Cable	1113
12.10	Epoxy Resin Pavement Markings, Symbols and Legends	1210

July 2014

DIVISION III
MATERIALS SECTION

<u>SECTION</u>		<u>SPECIFICATION NUMBER</u>
M.03	Portland Cement Concrete	M03
M.06	Metals	M06
M.08	Drainage	M08
M.11	Masonry Facing, Cement and Dry Rubble Masonry, Brick, Mortar	M11
M.13	Roadside Development	M13
M.16	Traffic Control Signals	M16
M.17	Elastomeric Materials	M17
M.18	Signing	M18

July 2014
STANDARD SPECIFICATIONS
FOR
ROADS, BRIDGES AND INCIDENTAL CONSTRUCTION
FORM 816

ERRATA

<u>PG.</u>	<u>ARTICLE OR SUBARTICLE</u>	<u>LINE NO.</u>	<u>CORRECTION</u>	<u>REV. DATE</u>
i	Table of Contents	20	Insert "1.11 Claims".....	July10
iii	Table of Contents	10	Insert "7.01 Drilled Shafts".....	July14
iii	Table of Contents	15	Insert "7.06 Micropiles".....	July14
iv	Table of Contents	11	Change "Guild" to "Guide"	Jan05
v	Table of Contents	2	Change "Mobilization" to "Mobilization and Project Closeout".....	July14
12	1.01.03	31	Insert "AOEC – Area of Environmental Concern".....	Jan05
12	1.01.03	31	Insert "AWG – American Wire Gauge".....	Jan05
13	1.01.03	16	Insert "HASP – Health and Safety Plan".....	Jan05
13	1.01.03	29	Insert "PCC – Portland Cement Concrete".....	Jan05
14	1.01.03	25	Insert "VOC – Volatile Organic Compound".....	Jan05
14	1.01.03	26	Insert "WSA – Temporary Waste Stockpile Area".....	Jan05
32	1.05.01	38	Change "Connecticut General Statutes" to "CGS".....	Jan05
97	1.10.03-2	32	Change "D.E.P." to "DEEP".....	Jan14
97	1.10.03-2	39	Change "D.E.P," to "DEEP,".....	Jan14
98	1.10.03-2.1	13	Change "D.E.P." to "DEEP".....	Jan14
99	1.10.03-2.6	23	Change "D.E.P." to "DEEP".....	Jan14
100	1.10.03-2.9	32	Change "D.E.P." to "DEEP".....	Jan14
101	1.10.03-2.12	22	Change "D.E.P." to "DEEP".....	Jan14
102	1.10.04	26	Change "D.E.P." to "DEEP".....	Jan14
105	1.20	29	Change "Workmen and Equipment" to "Personnel and Equipment".....	Jan05
105	1.20	31	Delete "Completion of Construction Work and".....	Jan05
108	1.20-1.04.01	26	Change "othewise" to "otherwise".....	July07
110	1.20-1.05.02-2	17	Change "DEP" to "DEEP"	Jan14
122	1.20-1.06.08	3	Change "Certificate of Compliance" to "C.O.C.".....	July07
131	1.20-1.08.05	34	Change "Workmen and Equipment" to "Personnel and Equipment".....	Jan05
132	1.20-1.08.11	12	Change "Certificate of Compliance" to "C.O.C.".....	July07
133	1.20-1.08.13	7	Delete "Completion of Construction Work and".....	Jan05
133	1.20-1.08.13	9	Change "Certificate of Compliance" to "C.O.C.".....	July07
133	1.20-1.08.13	15	Change "Certificate of Compliance" to "C.O.C.".....	July07
133	1.20-1.08.13	20	Change "Certificate of Compliance" to "C.O.C.".....	July07
164	2.04.03-1	2	Change "6.01.03-10" to "6.01.03-6".....	Jan14
196	3.03.02	33	Change "Article M.03.01" to "Section M.03".....	Jan14
245	4.06.04	11	Change " Over weight (mass) Adjustments - " and replace with indented "Over weight (mass) Adjustments -" as a subsection of " 1. Bituminous Concrete Class () .".....	Jan05
256	5.01.02	22	Change "DEP" to "DEEP".....	Jan14
259	5.03.03	24	Change "Such requirements of Article 5.02.03 ... equally to this construction." to "All such plans prepared by the Contractor	

<u>PG.</u>	<u>ARTICLE OR SUBARTICLE</u>	<u>LINE NO.</u>	<u>CORRECTION</u>	<u>REV. DATE</u>
			shall be considered working drawings and shall be submitted with engineering calculations to the Engineer for review in accordance with the requirements of Article 1.05.02.".....	July10
262	5.06.02	26	Change "Article M.03.01" to "Section M.03".....	Jan14
262	5.06.02	27	Change "Article M.03.01" to "Section M.03".....	Jan14
265	5.07.02	19	Change "Subarticle M.03.01-11" to "Article M.03.09".....	Jan14
265	5.07.02	23	Change "Approved Products List for Geotextiles referred to in Subarticle M.08.01-26." to "Qualified Products List referred to in Subarticle M.08.01-19 Geotextiles".....	July14
270	5.08.02	4	Change "M.06.02-12" to "M.06.02-4 Welded Stud Shear Connectors".....	July10
271	5.09.02	39	Change "M.06.02-12" to "M.06.02-4 Welded Stud Shear Connectors".....	July10
272	5.13.02	22	Change "M.08.01-27" to "M.08.01-20 PVC Pipe or M.08.01-21 PVC Gravity Pipe".....	July13
378	6.52.02	2	Change "M.08.01-22" to "M.08.01-11 Reinforced Concrete Culvert End".....	July13
378	6.52.02	3	Change "M.08.01-23" to "M.08.01-6 Metal Culvert End".....	July13
404	7.05.02	11	Change "Article M.03.01" to "Section M.03".....	Jan14
416	7.51.02-(4)	7	Change "M.08.01-26" to "M.08.01-19 Geotextiles".....	July13
418	7.55.02	26	Change "M.08.01-26" to "M.08.01-19 Geotextiles".....	July13
420	8.11.02	37	Change "Article M.03.01" to "Section M.03".....	Jan14
420	8.11.02	38	Change "Article M.03.01" to "Subarticle M.03.08-2".....	Jan14
421	8.11.02	1	Change "Article M.03.01" to "Section M.03".....	Jan14
426	8.16.02	28	Change "Subarticle M.03.01-8" to "Article M.03.08".....	Jan14
428	8.18.02	10	Change "Subarticle M.03.01-11" to "Article M.03.09".....	Jan14
429	8.21.02-6	30	Change "M.03.01-11" to "Article M.03.09".....	Jan14
430	8.21.03-6	37	Change "M.03.01-11" to "Article M.03.09".....	Jan14
434	9.04.02	14	Change "Subarticle M.06.02-1" to "Article 6.03.02".....	July10
434	9.04.02	15	Change "M.06.02-9(d) for metal bridge rail (cast post—aluminum)" to "Malleable castings shall conform to the requirements of the specifications for malleable iron castings, ASTM A 47, Grade No. 32510 (22010). Ductile iron castings shall conform to the Specifications for Ductile Iron Castings, ASTM A 536, Grade 60-40-18 (414-276-18) unless otherwise specified. In addition to the specified test coupons, test specimens from parts integral with the castings, such as risers, shall be tested for castings having a weight (mass) of more than 1000 pounds (455 kilograms) to determine that the required quality is obtained in the castings in the finished condition.".....	July10
445	9.11.02	14	Change "Subarticle M.03.01-12" to "Article M.03.05".....	Jan14
452	9.14.02	2	Change "Subarticle M.06.02-8" to "ASTM A 53, Type E or S, Grade A, Schedule 40 Black Finish.".....	July10
452	9.14.02	4	Change "Subarticle M.06.02-9(d) except that the grade shall be 32510" to "the specifications for malleable iron castings, ASTM A 47, Grade No. 32510 (22010). Ductile iron castings shall conform to the Specifications for Ductile Iron Castings, ASTM A 536, Grade 60-40-18 (414-276-18)	

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			unless otherwise specified. In addition to the specified test coupons, test specimens from parts integral with the castings, such as risers, shall be tested for castings having a weight (mass) of more than 1000 pounds (455 kilograms) to determine that the required quality is obtained in the castings in the finished condition.”.....	July10
454	9.16.02	20	Change “Article M.03.01” to “Section M.03”.....	Jan14
459	9.21.02	9	Change “Article M.03.01” to “Section M.03”.....	Jan14
459	9.21.02	17	Change “Article M.03.01” to “Section M.03”.....	Jan14
464	9.24.02-1	19	Change “Article M.03.01” to “Section M.03”.....	Jan14
475	9.47.02-5	34	Change “Article M.03.01” to “Section M.03”.....	Jan14
496	9.70.01	37	Change “CDOT” to “ConnDOT”.....	Jan05
507	9.77.02	35	Change “M.18.09.01” to “M.18.09-1”.....	July14
508	9.78.02	32	Change “M.18.09.01” to “M.18.09-1”.....	July14
508	9.78.02	37	Delete the sentence “Retroreflective sheeting shall ... the requirements of Article M.18.09.01.”.....	July14
514	9.81.02	21	Change “M.18.09.01” to “M.18.09-1”.....	July14
514	9.81.03	24	Change “manufacturers” to “manufacturer's”.....	July14
517	10.00	21	Add “10.00.14—Maintenance of Illumination During Construction”.....	July14
518	10.00.03(2)	41	Change “pre-emotion” to “pre-emption”.....	July14
519	10.00.04	12	Capitalize “Section”.....	July14
519	10.00.04	18	Capitalize “Project”.....	July14
533	10.02.02	6	Change “Article M.03.01” to “Section M.03”.....	Jan14
544	10.11.02	5	Change “M.08.01-25 or M.08.01-27” to “M.08.01-20 or M.08.01-21”.....	July13
548	10.17.03	14	Change “6.01.03-21” to “6.01.03-10”.....	Jan14
552	11.03.03-1	18	Change “M.03.01-12” to “M.03.05”.....	Jan14
569	11.14.05	19	Change “Span Wire” to “Span Wire (Type)”.....	July12
576	12.01.02	40	Change “Subarticle M.03.01-12” to “Article M.03.05”.....	Jan14
577	12.01.03	7	Change “6.03.03-19” to “6.03.03-4 (f) High Strength Bolted Connections”.....	July10
577	12.01.03	23	Change “Article 6.03.03-15” to “Subarticle 6.03.03-4(c) Bearings”.....	July10
577	12.01.03	27	Change “Article 6.03.03-19 (c)(3)” to “Subarticle 6.03.03-4 (f) High Strength Bolted Connections Turn-of-Nut Installation Method”.....	July10
578	12.02.02	23	Change “M.03.01-12” to “M.03.05”.....	Jan14
580	12.02.03	16	Change “6.01.03-21” to “6.01.03-10”.....	Jan14
583	12.05.02	16	Change “M.18.09.01” to “M.18.09-1”.....	July14
583	12.05.02	17	Change “M.18.09.02” to “M.18.09-2”.....	July14
583	12.05.04	35	Change “12.05.040” to “12.05.04”.....	July14
587	12.08.02	40	Change “Section M.18.09.01” to “Subarticle M.18.09-1”.....	July14
604	18.00.02	7	Change “National Cooperative Highway Research Program (NCHRP)” to “NCHRP”.....	Jan05
604	18.02.02	36	Change “Approved Products List” to “Qualified Products List”.....	July14
609	18.07.02	30	Change “M18” to “M.18”.....	July14
705	M.09.02-2	18	Change “Article M.09.02(1)” to “Subarticle M.09.02-1”.....	July14

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708	M.09.02-5	5	Change "Article M.03.01" to "Section M.03".....	Jan14
708	M.09.02-6	40	Change "Article M.03.01-2" to "Subarticle M.03.01-2".....	July14
638	M.04.02	37	Change "Asphalt Institute's" to "AI's".....	Jan05
711	M.10.02-1	17	Change "Subarticle M.06.02-1(b)" to "Article M.06.02".....	July10
713	M.10.02-7	8	Change "Article M.03.01" to "Section M.03".....	Jan14
720	M.10.08-3	2	Change "Subarticle M.06.02-1(b)" to "Article M.06.02".....	July10
720	M.10.08-4	10	Change "Article M.03.01" to "Section M.03".....	Jan14
726	M.12.03	18	After "M.03.01" add "and M.03.02".....	Jan14
731	M.12.08-3	20	Change "Article M.06.01-1" to "Subarticle M.06.01-1".....	July14
748	M.14.01-3	42	Change "Article M.06.01-1" to "Subarticle M.06.01-1".....	July14
749	M.14.01-4	2	Change "Article M.08.01-5" to "Subarticle M.08.01-5".....	July14
749	M.14.01-7	22	Change "Article M.14.01-2" to "Subarticle M.14.01-2".....	July14
749	M.14.01-8	32	Change "Article M.03.01-12" to "Article M.03.05".....	Jan14
758	M.15.10	9	Change "Article M.15.09-1" to "Subarticle M.15.09-1".....	July14
759	M.15.15-4	23	Change "Article M.16.03.2" to "Subarticle M.16.03-2".....	July14
759	M.15.15-5	26	Change Article M.15.02.2" to "Subarticle M.15.02-2".....	July14
759	M.15.15-5	24	Change "Article M.03.01" to "Section M.03".....	Jan14
759	M.15.15-6	27	Change "Article M.03.01" to "Section M.03".....	Jan14
760	M.15.15-16	21	Change "non-fusible" to "fused".....	Jan05
828	Pay Items	29	Add "7.01, Furnishing Drilled Shaft Drilling Equipment, I.s. (I.s.)".....	July14
828	Pay Items	30	Add "7.01, Drilled Shaft (Diameter), I.f. (m).....	July14
828	Pay Items	31	Add "7.01, Drilled Shaft Earth Excavation (Diameter), I.f. (m)".....	July14
828	Pay Items	32	Add "7.01, Drilled Shaft Rock Excavation (Diameter), I.f. (m)".....	July14
828	Pay Items	33	Add "7.01, Obstructions, hr. (hr.)".....	July14
828	Pay Items	34	Add "7.01, Trial Drilled Shaft (Diameter), I.f. (m)".....	July14
828	Pay Items	35	Add "7.01, Exploration Test Boring, I.f. (m)".....	July14
828	Pay Items	36	Add "7.01, Permanent Casing (Diameter), I.f. (m)".....	July14
828	Pay Items	37	Add "7.01, Access Tubes, I.f. (m)".....	July14
829	Pay Items	4	Add "7.02, Dynamic Pile Driving Analysis (PDA) Test, ea. (ea.)".....	July13
829	Pay Items	5	Add "7.02, Pre-Augering of Piles, I.f. (m)".....	July13
829	Pay Items	13	Add "7.06, Micropiles, ea. (ea.)".....	July14
829	Pay Items	14	Add "7.06, Verification Test for Micropiles, ea. (ea.)".....	July14
829	Pay Items	15	Add "7.06, Proof Test for Micropiles, ea. (ea.)".....	July14
829	Pay Items	16	Add "7.06, Micropile Length Adjustment, I.f. (m)".....	July14
835	Pay Items	3	Change "Mobilization" to "Mobilization and Project Closeout".....	July14
837	Pay Items	24	Change "Span Wire" to "Span Wire (Type)".....	July12
845	Index	6	Add page 133 to "Acceptance of Project".....	Jan05
846	Index	13	Add page 107 to "Bids: Consideration of".....	Jan05
847	Index	28	Add page 132 to "Cleaning Up, Final".....	Jan05
849	Index	25	Add page 107 to "Consideration of Bids".....	Jan05
849	Index	39	Add page 108 to "Contract: Intent of".....	Jan05
850	Index	3	Add page 133 to "Contractor's: Responsibility, Termination of the".....	Jan05
850	Index	13	Add page 114 to "Cooperation by Contractor".....	Jan05

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850	Index	15	Add page 114 to "Coordination of Special Provisions, Plans, Supplemental Specifications and Standard Specifications and Other Contract Requirements".....	Jan05
850	Index	40	Add page 128 to "Cutting and Patching:".....	Jan05
852	Index	16	Add page 106 to "Examination of Plans, Specifications, Special Provisions and Site of Work".....	Jan05
852	Index	38	Insert "Facilities, Temporary...126".....	Jan05
853	Index	7	Add page 132 to "Final: Cleaning Up".....	Jan05
854	Index	35	Add page 115 to "Inspection".....	Jan05
855	Index	11	Add page 108 to "Intent of Contract".....	Jan05
855	Index	22	Add page 106 to "Knowledge of Applicable Laws".....	Jan05
855	Index	25	Add page 106 to "Laws: Knowledge of Applicable".....	Jan05
856	Index	27	Add page 120 to "Materials: Source of Supply and Quality"....	Jan05
856	Index	28	Add page 121 to "Materials: Storage of".....	Jan05
857	Index	33	Add page 133 to "Operation and Maintenance Manuals:".....	Jan05
857	Index	34	Change page 133 to 136 for "Equipment and Systems Maintenance Manual".....	Jan05
859	Index	2	Add page 131 to "Personnel and Equipment".....	Jan05
860	Index	6	Add page 114 to "Plans: Coordination of Special Provisions, Supplemental Specifications and Standard Specifications and Other Contract Requirements".....	Jan05
860	Index	7	Add page 106 to "Plans: Examination of".....	Jan05
860	Index	30	Change page 108 to 112 for "Product Data".....	Jan05
860	Index	31	Change page 108 to 112 for "Product Samples".....	Jan05
860	Index	32	Add page 124 to "Product Selection:".....	Jan05
861	Index	12	Add page 126 to "Prosecution of Work".....	Jan05
861	Index	38	Change page 115 to 135 for "Record Drawings".....	Jan05
863	Index	3	Add page 125 to "Sanitary Provisions".....	Jan05
863	Index	18	Insert "Services, Temporary...126".....	Jan05
863	Index	23	Add page 111 to "Shop Drawings".....	Jan05
864	Index	4	Add page 106 to "Site of Work, Examination of".....	Jan05
864	Index	12	Add page 120 to "Source of Supply and Quality".....	Jan05
864	Index	19	Add page 114 to "Special Provisions: Coordination of Plans, Supplemental Specifications and Standard Specifications and Other Contract Requirements".....	Jan05
864	Index	20	Add page 106 to "Special Provisions: Examination of".....	Jan05
864	Index	26	Add page 114 to "Specifications: Coordination of Plans, Special Provisions and Other Contract Requirements".....	Jan05
864	Index	27	Add page 106 to "Specifications: Examination of".....	Jan05
864	Index	43	Add page 121 to "Storage".....	Jan05
865	Index	27	Delete page 108 from "Submittals: Shop Drawings".....	Jan05
865	Index	45	Insert "Temporary Utilities, Services, and Facilities...126"....	Jan05
866	Index	2	Add page 133 to "Termination of Contractor's Responsibility".....	Jan05
866	Index	23	Insert "Training...137".....	Jan05
866	Index	45	Add page 133 to "Utility Services".....	Jan05
867	Index	8	Insert "Warranties...121".....	Jan05
867	Index	24	Add page 126 to "Work: Prosecution of".....	Jan05

**CONNECTICUT
SUPPLEMENTAL SPECIFICATION
SECTION 1.01
DEFINITIONS OF TERMS AND
PERMISSIBLE ABBREVIATIONS**

1.01.01 — Definitions:

After the end of the definition for “Plans” insert the following Subarticle:

- “ A. Standard Sheets – Standardized plans containing details approved by the Department and the FHWA, for construction of a given type on any project, included in contracts on an as-needed basis.”

After the definition for “Subcontractor” add the following definition:

“SUBSTANTIAL COMPLETION: The date at which the performance of all work on the Project has been completed except minor or incidental items, final cleanup, work required under a warranty, and repair of unacceptable work, and provided the Engineer has determined that:

- A. The Project is safe and convenient for use by the public, and
- B. All traffic lanes including all safety appurtenances are in their final configuration, and
- C. Failure to complete the work and repairs excepted above does not result in the deterioration of other completed work; and provided further, that the value of work remaining to be performed, repairs, and cleanup is less than one percent (1%) of the estimated final Contract amount, and
- D. If applicable a Certificate of Compliance has been issued.”

1.01.02 — Abbreviations, Publications, and Standards:

Delete the entire Article and replace with the following:

“ **1.01.02—Abbreviations, Publications and Standards:** Whenever one of the following abbreviations is used in the Contract, its meaning shall be interpreted as follows:

AA—Aluminum Association, Inc. (The)

AABC—Associated Air Balance Council

AAMA—American Architectural Manufacturers Association

AAPA—American Association of Port Authorities

AASHTO—American Association of State Highway and Transportation Officials:

Wherever reference is made to an AASHTO Standard Method of Test or Standard Specification, it refers by letter and number to the method or specification published by AASHTO in the "Standard Specifications for Transportation Materials and Methods of Sampling and Testing". The edition governing the work shall be in effect on the date the Contract was advertised for solicitation of bids shall govern.

ABMA—American Bearing Manufacturers Association
 ACGIH—American Council of Government Industrial Hygienists
 ACI—ACI International (American Concrete Institute)
 ADAAG—Americans with Disabilities Act (ADA) Accessibility Guidelines for Buildings and Facilities
 ADSC—The International Association of Foundation Drilling
 AF&PA—American Forest & Paper Association
 AGA—American Gas Association
 AGC—Associated General Contractors of America (The)
 AHA—American Hardboard Association
 AHAM—Association of Home Appliance Manufacturers
 AI—Asphalt Institute
 AIA—The American Institute of Architects (The)
 AISC—American Institute of Steel Construction
 AISI—American Iron and Steel Institute
 AITC—American Institute of Timber Construction
 A.L.I.—Automotive Lift Institute
 ALSC—American Lumber Standard Committee, Incorporated
 AMCA—Air Movement and Control Association International, Inc.
 ANLA—American Nursery and Landscape Association
 ANSI—American National Standards Institute
 AOAC—AOAC International
 AOSA—Association of Official Seed Analysts
 APA—APA-The Engineered Wood Association
 API—American Petroleum Institute
 AREMA—American Railway Engineering and Maintenance-of-Way Association
 ARI—Air-Conditioning & Refrigeration Institute
 ARTBA—American Road and Transportation Builders Association
 ASA—Acoustical Society of America
 ASC—Adhesive and Sealant Council
 ASCE—American Society of Civil Engineers
 ASHRAE—American Society of Heating, Refrigerating and Air-Conditioning Engineers
 ASME—ASME International (The American Society of Mechanical Engineers International)
 ASSE—American Society of Sanitary Engineering
 ASTM—American Society of Testing and Materials (ASTM International): Wherever reference is made to an ASTM specification, test method, or practice, it refers by letter, number, or both to standards published by ASTM International in the "ASTM Standards Source™ Database". The edition governing the work shall be in effect on the date the Contract was advertised for solicitation of bids shall govern.
 ATSSA—American Traffic Safety Services Association
 AWI—Architectural Woodwork Institute
 AWWA—American Wood-Preservers' Association
 AWPI—American Wood Preservers Institute
 AWS—American Welding Society: Wherever reference is made to an AWS materials specification, inspection methods, or welding procedures, it refers by section number to standards of the American Welding Society published in the applicable steel, or aluminum welding code. The edition governing the work shall be in effect on the date the Contract was advertised for solicitation of bids shall govern.

AWWA—American Water Works Association
 BHMA—Builders Hardware Manufacturers Association
 BIA—Brick Industry Association (The)
 BOCA—BOCA International, Inc.
 CBM—Certified Ballast Manufacturers Association
 CCRL—Cement and Concrete Reference Laboratory
 CDA—Copper Development Association (The)
 CGA—Compressed Gas Association
 Cisca—Ceilings and Interior Systems Construction Association
 CLFMI—Chain Link Fence Manufacturers Institute
 ConnDOT—Connecticut Department of Transportation
 CFR—Code of Federal Regulations
 CGS—Connecticut General Statutes
 CISPI—Cast Iron Soil Pipe Institute
 CRI—Carpet and Rug Institute (The)
 CRSI—Concrete Reinforcing Steel Institute
 CSI—Construction Specifications Institute (The)
 CSSB—Cedar Shake & Shingle Bureau
 CTI—Cooling Technology Institute
 DASMA—Door and Access Systems Manufacturers Association, International
 DEEP—Connecticut Department of Energy and Environmental Protection
 DHI—Door and Hardware Institute
 DOD—Department of Defense Military Specifications and Standards
~~DPUC—Department of Public Utility Control~~ see *PURA*
 EIA—Electronic Industries Alliance
 EPA—Environmental Protection Agency
 FAA—Federal Aviation Administration
 FCC—Federal Communications Commission
 FCICA—Floor Covering Installation Contractors Association
 FHWA—Federal Highway Administration
 FMG—FM Global
 FRA—Federal Railway Administration
 FS—Wherever reference is made to FS in the contract, it refers by number, letter, or both, to the latest standard or tentative standard of the Federal Specification Unit, General Services Administration, Federal Supply Service, as to materials, specifications, or methods of testing, whichever the case may be.
 FTA—Federal Transit Administration
 HPVA—Hardwood Plywood & Veneer Association
 GA—Gypsum Association
 GANA—Glass Association of North America
 GSA—General Services Administration
 HI—Hydraulics Institute
 HPVA—Hardwood Plywood & Veneer Association
 ICC—International Code Council
 ICC-ES—ICC Evaluation Service, Inc.
 ICEA—Insulated Cable Engineers Association, Inc.
 IEC—International Electrotechnical Commission
 IEEE—Institute of Electrical and Electronics Engineers, Inc. (The)
 IES—Illuminating Engineers Society

IESNA—Illuminating Engineering Society of North America
IGCC—Insulating Glass Certification Council
IGMA—Insulating Glass Manufacturers Alliance
IMSA—International Municipal Signal Association
IRI—HSB Industrial Risk Insurers
ISO—International Organization for Standardization
ITE—Institute of Traffic Engineers
KCMA—Kitchen Cabinet Manufacturers Association
LMA—Laminating Materials Association
LPI—Lightning Protection Institute
MBMA—Metal Building Manufacturers Association
MILSPEC—Military Specification and Standards
MMA—Monorail Manufacturers Association
MSHA—Mine Safety and Health Administration
MSS—Manufacturers Standardization Society of The Valve and Fittings the Valve Industry, Inc.
MUTCD—Manual on Uniform Traffic Control Devices
NAAMM—National Association of Architectural Metal Manufacturers
NADCA—National Air Duct Cleaners Association
NAIMA—North American Insulation Manufacturers Association (The)
NBFU—National Board of Fire Underwriters
NCHRP—National Cooperative Highway Research Program
NCMA—National Concrete Masonry Association
NCPI—National Clay Pipe Institute
NEBB—Natural Environmental Balancing Bureau
NEC—National Electrical Code
NECA—National Electrical Contractors Association
NEMA—National Electrical Manufacturers Association
NEPCOAT—North East Protective Coatings Committee
NESC—National Electrical Safety Code
NETA—InterNational Testing Association
NFPA—National Fire Protection Association
NFRC—National Fenestration Rating Council
NHLA—National Hardwood Lumber Association
NICET—National Institute for Certification in Engineering Technologies
NIOSH—National Institute of Occupational Safety and Health
NIST—National Institute of Standards and Technology
NLGA—National Lumber Grades Authority
NOAA—National Oceanic and Atmospheric Administration
NRCA—National Roofing Contractors Association
NSF—NSF International
NTMA—National Terrazzo and Mosaic Association, Inc.
OEO—Office of Equal Opportunity
OSHA—Occupational Safety and Health Administration
PCA—Portland Cement Association
PCI—Precast/Prestressed Concrete Institute
PDI—Plumbing & Drainage Institute
PTI—Post-Tensioning Institute
PURA—Public Utilities Regulatory Authority

RMA—Rubber Manufacturers Association
SAE—SAE International
SDI—Steel Deck Institute or
.....—Steel Door Institute
SFPA—Southern Forest Products Association
SJI—Steel Joist Institute
SMACNA—Sheet Metal and Air Conditioning Contractors National Association
SPIB—Southern Pine Inspection Bureau (The)
SPRI—Single Ply Roofing Institute
SSPC—Where reference is made to SSPC in the Contract, it refers by number, letter, or both, to the latest standard or tentative standard specification of The Society for Protective Coatings, Formerly the Steel Structures Painting Council, as to materials specifications, methods of testing, systems, procedures, inspection or other specification pertaining to any or all phases of cleaning or painting, whichever may apply.
SWRI—Sealant, Waterproofing, & Restoration Institute
TCA—Tile Council of America, Inc.
TIA—Telecommunications Industry Association
TIA/EIA—Telecommunications Industry Association/Electronics Industries Alliance
TPI—Truss Plate Institute, Inc.
TRB—Transportation Research Board
UFAS—Uniform Federal Accessibility Standards
UL—Underwriters Laboratories Inc.
USDA—United States Department of Agriculture
USGBC—U.S. Green Building Council
WCLIB—West Coast Lumber Inspection Bureau
WCSC—Window Covering Safety Council
WDMA—Window & Door Manufacturers Association
WWPA—Western Wood Products Association”

1.01.03 — Abbreviations and Terms:

Add the following abbreviations:

“**cu.dm** - Cubic Decimeter
cu.m - Cubic Meters
dm³ - Cubic Decimeter
m² - Square Meter
m³ - Cubic Meters
sq.m - Square Meter
Vert. M - Vertical Meter
vert.m - Vertical Meter”

**CONNECTICUT
SUPPLEMENTAL SPECIFICATION
SECTION 1.02
PROPOSAL REQUIREMENTS AND CONDITIONS**

1.02.01—Contract Bidding and Award

Replace the entire article with the following:

“1.02.01—Contract Bidding and Award: All bids for construction contracts must be submitted electronically. It is the responsibility of each bidder and all other interested parties to obtain all bidding related information and documents from the Department of Administrative Services (DAS) State Contracting Portal.

Connecticut Department of Transportation bidding and other information and documents which are obtained from any other source must not be submitted to the Department. Reproduced, reformatted or altered forms of documents are not authorized or acceptable.

For information about the bidding and award of Department construction contracts, consult the “State of Connecticut Department of Transportation Construction Contract Bidding and Award Manual,” available from the Division of Contracts. In order to be eligible for award of a Department construction contract, a bidder must follow the requirements of this Bid Manual, and all bidding and award matters regarding Department construction contracts shall be governed by the terms of the Bid Manual, unless treated otherwise in the Contract, including these Specifications.”

**CONNECTICUT
SUPPLEMENTAL SPECIFICATION
SECTION 1.03
AWARD AND EXECUTION OF THE CONTRACT**

Replace Article 1.03.07 in its entirety with the following:

1.03.07—Insurance:

Coverage shall be on a primary basis.

The Contractor shall carry and maintain at all times during the term of the Contract the insurance coverages required by this Article and any additional coverages(s) or higher minimum insurance coverage amount(s) required by the Special Provisions of the Contract.

If the Project includes work on or adjacent to railroad property additional insurance may be required as specified by the railroad. Please refer to the Special Provisions for any additional insurance requirements by the railroad.

1. Worker's Compensation Insurance: With respect to all operations the Contractor performs and all those performed for it by subcontractors, the Contractor shall carry, and require each subcontractor to carry, Workers' Compensation insurance as required by the laws of the State of Connecticut.

Employer's Liability insurance shall be provided in amounts not less than \$100,000 per accident for bodily injury by accident; \$100,000 policy limit by disease and \$100,000 per employee for bodily injury by disease. Each Workers' Compensation policy shall contain the U.S. Longshoreman's and Harbor Workers' Act endorsement when work is to be performed over or adjacent to navigable water.

2. Commercial General Liability Insurance: With respect to the operations the Contractor performs and also those performed for it by subcontractors, the Contractor shall carry, and require each subcontractor to carry, Commercial General Liability insurance, including Contractual Liability, Products and Completed Operations, Broad Form Property Damage and Independent Contractors.

Products and completed operations insurance for ongoing and completed operations shall be maintained for a period of one (1) year after the acceptance of the project by the Department in accordance with Article 1.08.14. See chart below for applicable minimum coverage amounts.

Contract Amount (\$)	Minimum Single Occurrence Amount (\$)	Minimum Annual Aggregate Amount (\$)
0-2,000,000	1,000,000	2,000,000
>2,000,001-10,000,000	2,000,000	4,000,000
>10,000,000	4,000,000	8,000,000

In Facilities construction projects, if underground work is to be undertaken, each policy shall have coverage for and exclusions removed for “Explosion, Collapse and Underground” (“XCU”).

3. Automobile Liability Insurance: The Contractor shall obtain automobile liability insurance covering the operation of all motor vehicles, including those hired or borrowed, that are used in connection with the Project for all damages arising out of: (1) bodily injury to or death of all persons and/or (2) injury to or destruction of property; in any one accident or occurrence. This policy shall not be subject to an annual aggregate limitation. See chart above for applicable minimum coverage amounts.

4. Owner’s and Contractor’s Protective Liability Insurance for and in the Name of the State: With respect to the Contractor’s Project operations and also those of its subcontractors, the Contractor shall carry, for and on behalf of the State for each accident or occurrence resulting in damages from (1) bodily injury to or death of persons and/or (2) injury to or destruction of property. See chart below for applicable minimum coverage amounts.

Contract Amount (\$)	Minimum Single Occurrence Amount (\$)	Minimum Annual Aggregate Amount (\$)
0 - 20 Million	1,000,000	1,000,000
20 Million - 50 Million	2,000,000	2,000,000
> 50 Million	4,000,000	4,000,000

5. Railroad Protective Liability Insurance: When the Contract involves work within fifty (50) feet of the railroad right-of-way or State-owned rail property, with respect to Project operations and also those of its subcontractors, the Contractor shall carry Railroad Protective Liability Insurance providing coverage of at least \$2,000,000 for each accident or occurrence resulting in damages from (1) bodily injury to or death of all persons and/or (2) injury to or destruction of property, and subject to that limit per accident or occurrence, an aggregate coverage of at least \$6,000,000 for all damages during the policy period, and with all entities falling within any of the following listed categories named as insured parties: (i) the owner of the railroad right-of-way, (ii) the owner of any railcar licensed or permitted to travel within that affected portion of railroad right-of-way, and (iii) the operator of any railcar licensed or permitted to travel within that affected portion of the railroad right-of-way, and with the State, if not falling within any of the above-listed categories, also named as an insured party.

6. Blasting: When explosives are to be used in the Project, the Commercial General Liability insurance policy shall include XCU coverage, in the same limits as the per occurrence policy limits.

7. Protection and Indemnity Insurance for Marine Construction Operations in Navigable Waters:

If a vessel of any kind will be involved in Project work, the Contractor shall obtain the following additional insurance coverage:

- A.** Protection and Indemnity Coverage of at least \$300,000 per vessel or equal to at least the value of hull and machinery, whichever is greater.
- B.** If there is any limitation or exclusion with regard to crew and employees under the protection and indemnity form, the Contractor must obtain and keep in effect throughout the Project a workers' compensation policy, including coverage for operations under admiralty jurisdiction, with a limit of liability of at least \$300,000 per accident or a limit equal to at least the value of the hull and machinery, whichever is greater, or for any amount otherwise required by statute.

8. Builder's Risk Insurance: For Facilities construction projects, the Contractor shall maintain comprehensive replacement cost builder's risk (completed value) insurance providing coverage for the entire work at the Project site, including all fixtures, machinery and equipment, any heating, cooling and constituting a permanent part of the building and shall cover portions of work located away from the site, but intended for use at the site. If it is determined that all or a portion of the project is located within an area designated as a Special Flood Hazard Area, the Contractor shall maintain flood insurance (no less than \$10,000,000 sublimit). The State of Connecticut shall be named as Loss Payee. Equipment breakdown coverage may be sub limited to 50% of the project cost.

9. Architects and Engineer's Professional Liability Insurance for Structural Engineer: If required, limits will be specified in Article 1.03.07 of the Special Provisions of the Contract or Article 1.05.02.

10. Umbrella Liability Insurance: The Contractor may satisfy the minimum limits required for Commercial General Liability and Automobile Liability Insurance using Umbrella Liability Insurance. In the event that the Contractor obtains Umbrella Liability Insurance to meet the minimum coverage requirements for Commercial General Liability or Automobile Liability Insurance coverage, the Umbrella Liability Insurance policy shall have an annual aggregate at a limit not less than twice the single occurrence and must specifically endorse the State of Connecticut as an additional insured. Specifically for Bridge Projects with a low bid equal to or higher than \$80,000,000, the Umbrella Liability Insurance policy must have a minimum limit of at least \$25,000,000.

11. Certificate of Insurance: Before the Contract is executed, the Contractor must provide to the Department a certificate of insurance acceptable to the Commissioner and executed by an insurance company or companies satisfactory to the State of Connecticut for the insurance coverage(s) required by this Article and the Special

Provisions of the Contract. The Contractor shall maintain the required insurance coverage during the entire term of the Contract. The certificate of insurance must clearly include the name of the insured and identify the project for which it is being issued.

12. Copies of Policies: The Contractor shall provide, within five (5) business days, a copy or copies of all applicable insurance policies when requested by the State. In providing said policies, the Contractor may redact provisions of the policy that are proprietary. This provision shall survive the expiration or termination of the Contract.

13. Sovereign Immunity: The Contractor may not assert the defense of sovereign immunity in the adjustment of claims or in the defense of any claim or suit brought against the Contractor or the State, unless the State, in writing, requests that the Contractor do so or consents to its doing.

14. Contractor Assumes Costs: The Contractor shall assume and pay all costs and billings for premiums, deductibles, self-insured retentions and audit charges earned and payable under the required insurance.

15. State Named as Additional Insured: The State must be named as an additional insured party for the Commercial General Liability and Automobile Liability insurance policies required by this Article and the Special Provisions to the Contract, and any Umbrella Liability Insurance, as applicable, obtained in accordance with this Article. Each policy shall waive right of recovery (waiver of subrogation) against the State of Connecticut.

16. Termination or Change of Insurance:

A. The Contractor shall notify the Department of any cancelation of insurance carrier or change to the required insurance coverage by submitting a new insurance certificate to the Department immediately following said cancelation or change in required coverage.

B. It is the responsibility of the Contractor to maintain evidence of a current insurance coverage with the Department for the duration of contract. It is the responsibility of the Contractor to file with the Department all renewals and new certificates of insurance issued due to changes in policy terms or changes in insurance carriers prior to the expiration dates on the forms already on file with the Department.

17. Duration of Coverage. The Contractor shall keep all the required insurance in continuous effect until the date that the Department designates for the termination of the Contractor's responsibility, as defined by Article 1.08.14.

18. Compensation: There shall be no direct compensation allowed the Contractor on account of any premium or other charge necessary to obtain and keep in effect any insurance or bonds in connection with the Project, but the cost thereof shall be considered included in the general cost of the Project work.

**CONNECTICUT
SUPPLEMENTAL SPECIFICATION
SECTION 1.05
CONTROL OF THE WORK**

1.05.08–Vacant:

Replace with the following:

“1.05.08—SCHEDULES AND REPORTS:

When a project coordinator is not required by the Contract the following shall apply:

Baseline Bar Chart Construction Schedule: Within 20 calendar days after contract award the Contractor shall develop a comprehensive bar chart as a baseline schedule for the project. The bar chart schedule shall be submitted to the Engineer for approval and shall be based on the following guidelines:

1. The bar chart schedule shall contain a list of activities that represents the major activities of the project. At a minimum, this list should include a breakdown by individual structure or stage, including major components of each. The bar chart schedule shall contain sufficient detail to describe the progression of the work in a comprehensive manner. As a guide, 10 to 15 bar chart activities should be provided for each \$1 million of contract value. The following list is provided as an example only and is not meant to be all-inclusive or all-applicable:

General Activities Applicable to all projects

Project Constraints

- Winter shutdowns
- Environmental permits/application time of year restrictions
- Milestones
- Third Party approvals
- Long lead time items (procurement and fabrication of major elements)
- Adjacent Projects or work by others

Award

Notice to Proceed

Signing (Construction, temporary, permanent by location)

Mobilization

Permits as required

Field Office

Utility Relocations

Submittals/shop drawings/working drawings/product data

Construction of Waste Stock pile area

Clearing and Grubbing

Earthwork (Borrow, earth ex, rock ex etc.)

Traffic control items (including illumination and signalization)

Pavement markings

Roadway Construction (Breakdown into components)

Drainage (Breakdown into components)

Culverts
Plantings (including turf establishment)
Semi-final inspection
Final Cleanup

As required the following may supplement the activities listed above for the specific project types indicated:

a. For bridges and other structures, include major components such as abutments, wingwalls, piers, decks and retaining walls; further breakdown by footings, wall sections, parapets etc.

Temporary Earth Retention Systems
Cofferdam and Dewatering
Structure Excavation
Piles/test piles
Temporary Structures
Removal of Superstructure
Bearing Pads
Structural Steel (Breakdown by fabrication, delivery, installation, painting etc.)
Bridge deck

b. Multiple location projects such as traffic signal, incident management, lighting, planting and guiderail projects will be broken down first by location and then by operation. Other major activities of these types of projects should include, but are not limited to:

Installation of anchors
Driving posts
Foundations
Trenching and Backfilling
Installation of Span poles/mast arms
Installation of luminaries
Installation of cameras
Installation of VMS
Hanging heads
Sawcut loops
Energizing equipment

c. Facility Projects – Facilities construction shall reflect the same breakdown of the project as the schedule of values:

Division 2 – Existing Conditions
Division 3 – Concrete
Division 4 – Masonry
Division 5 – Metals
Division 6 – Wood, Plastic, and Composites
Division 7 – Thermal and Moisture Protection
Division 8 – Openings

Division 9 – Finishes
Division 10 – Specialties
Division 11 – Equipment
Division 12 - Furnishings
Division 13 – Special Construction
Division 14 – Conveying Equipment
Division 21 – Fire Suppression
Division 22 – Plumbing
Division 23 – Heating, Ventilating, and Air Conditioning
Division 26 – Electrical
Division 27 – Communications
Division 28 – Electronic Safety and Security
Division 31 – Earthwork
Division 32 – Exterior Improvements
Division 33 - Utilities

2. If the Engineer determines that additional detail is necessary, the Contractor shall provide it.
3. Each activity shall have a separate schedule bar. The schedule timeline shall be broken into weekly time periods with a vertical line to identify the first working day of each week.
4. The bar chart schedule shall show relationships among activities. The critical path for the Project shall be clearly defined on the schedule. The schedule shall show milestones for major elements of work, and shall be prepared on a sheet, or series of sheets of sufficient width to show data for the entire construction period.
5. If scheduling software is used to create the bar chart schedule, related reports such as a predecessor and successor report, a sort by total float, and a sort by early start shall also be submitted.
6. Project activities shall be scheduled to demonstrate that the construction completion date for the Project will occur prior to expiration of the Contract time. In addition, the schedule shall demonstrate conformance with any other dates stipulated in the Contract.
7. The Contractor is responsible to inform its subcontractor(s) and supplier(s) of the project schedule and any relevant updates.
8. There will be no direct payment for furnishing schedules, the cost thereof shall be considered as included in the general cost of the work.
9. For projects without a Mobilization item, 5% of the contract value will be withheld until such time as the Baseline Schedule is approved.

Monthly Updates: No later than the 10th day of each month, unless directed otherwise by the Engineer, the Contractor shall deliver to the Engineer three copies of the schedule to show the work actually accomplished during the preceding month, the actual time spent on each activity, and the estimated time needed to complete any activity which has been started but not completed. Each time bar shall indicate, in 10% increments, the estimated percentage of that activity which remains to be completed. As the Project progresses, the Contractor shall place a contrasting mark in each bar to indicate the actual percentage of the activity that has been completed.

The monthly update shall include revisions of the schedule necessitated by revisions to the Project directed by the Engineer (including, but not limited to extra work), during the month preceding the update. Similarly, any changes of the schedule required due to changes in the Contractor's planning or progress shall also be included. The Engineer reserves the right to reject any such revisions. If the schedule revisions extend the contract completion date, due to extra or added work or delays beyond the control of the Contractor, the Contractor shall submit a request in writing for an extension of time in accordance with Article 1.08.08. This request shall be supported by an analysis of the schedules submitted previously.

Any schedule revisions shall be identified and explained in a cover letter accompanying the monthly update. The letter shall also describe in general terms the progress of the Project since the last schedule update and shall identify any items of special interest.

If the Contractor fails to provide monthly schedule updates, the Engineer has the right to hold 10% of the monthly estimated payment, or \$5,000, whichever is less, until such time as an update has been provided in accordance with this provision.

Biweekly Schedules: Each week, the Contractor shall submit to the Engineer a two week look-ahead schedule. This short-term schedule may be handwritten but shall clearly indicate all work planned for the following two week period.

Recovery Schedules: If the updated schedule indicates that the Project has fallen behind schedule, the Contractor shall either submit a time extension request in accordance with 1.08.08 or immediately institute steps acceptable to the Engineer to improve its progress of the Project. In such a case, the Contractor shall submit a recovery plan, as may be deemed necessary by the Engineer, to demonstrate the manner in which an acceptable rate of progress will be regained.”

1.05.12–Payrolls:

Replace the first paragraph with the following:

“For each week of the Project from the first week during which an employee of the Contractor does Project work to which prevailing wage requirements apply, until the last week on which such an employee does such work, the Contractor shall furnish to the Engineer certified copies of payrolls showing (a) the names of the employees who worked on the Project and whose work is subject to prevailing wage requirements, (b) the specific days and hours and numbers of hours that each such employee worked on the Project, and (c) the amount of money paid to each such employee for Project work. Each such payroll shall include the statement(s) of compliance with prevailing wage laws required by the State of Connecticut and, if applicable, by the Federal government.

Said payrolls must contain all information required by Connecticut General Statutes Section 31-53 (as it may be revised). For contracts subject to Federal prevailing wage requirements, each payroll shall also contain the information required by the Davis Bacon and Related Acts (DBR). All of the payroll requirements in this Article shall also apply to the work of any subcontractor or other party that performs work on the Project site, and the Contractor shall be responsible for ensuring that each such party meets said requirements.”

1.05.15–Markings for Underground Facilities:

Replace the beginning of the first sentence with the following:

“In conformance with Sections 16-345 through 16-359 of the Regulations of the PURA state statutes, the Contractor is responsible for notifying ‘Call Before You Dig’ ...”

After Article 1.05.16–Dimensions and Measurements, add the following article:

“1.05.17 - WELDING

The Contractor shall ensure that all welding of materials permanently incorporated into the work, and welding of materials used temporarily during construction of the work is performed in accordance with the following codes:

- American Welding Society (AWS) Structural Welding Code – Steel – ANSI/AWS D1.1: Miscellaneous steel items that are statically loaded including but not limited to columns, and floor beams in buildings, railings, sign supports, cofferdams, tubular items, and modifications to existing statically loaded structures.
- AWS Structural Welding Code – Aluminum – AWS D1.2/D1.2M: Any aluminum structure or member including but not limited to brackets, light standards, and poles.
- AWS Structural Welding Code – Sheet Steel – AWS D1.3/D1.3M: Sheet steel and cold-formed members 0.18 in.(4.6 mm) or less in thickness used as, but not limited, to decking and stay-in-place forms.
- AWS Structural Welding Code – Reinforcing Steel – AWS D1.4/D1.4M: Steel material used in the reinforcement of cast-in-place or pre-cast Portland cement concrete elements including but not limited to bridge decks, catch basin components, walls, beams, deck units, and girders.
- AASHTO/AWS – Bridge Welding Code, AASHTO/AWS D1.5/D1.5M: Steel highway bridges and other dynamically loaded steel structures. Also includes sign supports, and any other fracture critical structure.

The edition governing the work shall be in effect on the date the Contract was advertised for solicitation of bids.

The Contractor is responsible to provide a Certified Welding Inspector in accordance with the above noted codes. The cost for this service is included in the general cost of the work.

All welders shall be certified by the Engineer in accordance with Section 6.03.”

**CONNECTICUT
SUPPLEMENTAL SPECIFICATION
SECTION 1.07
LEGAL RELATIONS AND RESPONSIBILITIES**

1.07.05 – Load Restrictions

Delete the entire article and replace with the following:

“1.07.05 – Load Restrictions

(a) Vehicle Weights: This subarticle will apply to travel both on existing pavements and pavements under construction. The Contractor shall comply with all legal load restrictions as to vehicle size, the gross weight of vehicles, and the axle weight of vehicles while hauling materials. Throughout the duration of the contract, the Contractor shall take precautions to ensure existing and newly installed roadway structures and appurtenances are not damaged by construction vehicles or operations.

Unless otherwise noted in contract specifications or plans, on and off road equipment of the Contractor, either loaded or unloaded, will not be allowed to travel across any bridge or on any highway when such a vehicle exceeds the statutory limit or posted limit of such bridge or highway. Should such movement of equipment become necessary the Contractor shall apply for a permit from the Department for such travel, as provided in the Connecticut General Statutes (CGS). The movement of any such vehicles within the project limits or detour routes shall be submitted to the Engineer for project record. Such permit or submittal will not excuse the Contractor from liability for damage to the highway caused by its equipment.

The Contractor is subject to fines, assessments and other penalties that may be levied as a result of violations by its employees or agents of the legal restrictions as to vehicle size and weight.

(b) Storage of Construction Materials/Equipment on Structures: Storage is determined to be non-operating equipment or material. The Contractor shall not exceed the statutory limit or posted limit for either an existing or new structure when storing materials and/or construction equipment. When a structure is not posted, then the maximum weight of equipment or materials stored in each 12 foot wide travel lane of any given span shall be limited to 750 pounds per linear foot combined with a 20,000 pound concentrated load located anywhere within the subject lane. If anticipated storage of equipment or material exceeds the above provision, then the Contractor shall submit his proposal of storage supported by calculations stamped by a Professional Engineer registered in the State of Connecticut, to the Engineer for approval 14 days prior to the storage operation. Operations related to structural steel demolition or erection shall follow the guidelines under Section 6.03. All other submittals shall include a detailed description of the material/equipment to be stored, the quantity of storage if it is stockpiled materials, the storage location, gross weight with supporting calculations if applicable, anticipated duration of storage and any environmental safety, or traffic protection that may be required. Storage location on the structure shall be clearly defined in the field. If structures are in a state of staged construction or demolition, additional structural analysis may be required prior to authorization of storage.”

1.07.18 – Use of State Property

After Subarticle (h) add the following sentence:

“Gore areas are not available for disposal of surplus material.”

**CONNECTICUT
SUPPLEMENTAL SPECIFICATION
SECTION 1.08
PROSECUTION AND PROGRESS**

1.08.01 – Transfer of Work or Contract:

Replace the last paragraph with the following paragraphs:

“ The Contractor shall not sublet, sell, transfer, assign, or otherwise dispose of the Contract or any portion thereof, or of the work provided for therein, or of its right, title, or interest therein, to any individual or entity without the written consent of the Commissioner. No payment will be made for such work until written consent is provided by the Commissioner.

The Contractor shall pay the subcontractor for work performed within thirty (30) days after the Contractor receives payment for the work performed by the subcontractor. Withholding retainage by the Contractor, subcontractor or lower tier subcontractors is not allowed.

Payment for work that has been performed by a subcontractor does not eliminate the Contractor’s responsibilities for all the work as defined in Article 1.07.12, “Contractor’s Responsibility for Work.”

Payment for work that has been performed by a subcontractor also does not release the subcontractor from its responsibility for maintenance and other periods of subcontractor responsibility specified for the subcontractor’s items of work. Failure of a subcontractor to meet its maintenance, warranty or defective work responsibilities may result in administrative action on future Department contracts.

For any dispute regarding prompt payment, the alternate dispute resolution provisions of this article shall apply.

The above requirements are also applicable to all sub-tier subcontractors and the above provisions shall be made a part of all subcontract agreements.

Failure of the Contractor to comply with the provisions of this section may result in a finding that the Contractor is nonresponsible as a bidder for a Department contract.”

1.08.07 – Determination of Contract Time:

Replace the fifth paragraph with the following:

“ The total elapsed time in calendar days, computed as described above, from the commencement date specified in the Engineer's "Notice to Proceed" to the “Substantial Completion” date specified in the Engineer's "Notice of Substantial Completion" shall be considered as the time used in the performance of the Contract work.”

1.08.09 – Failure to Complete Work on Time:

Replace the second paragraph with the following:

“ If the last day of the initial Contract time or the initial Contract date determined for

Substantial Completion is before December 1 in the given year, liquidated damages as specified in the Contract shall be assessed against the Contractor per calendar day (including any days during a winter shutdown period) from that day until the date on which the Project is substantially completed.”

1.08.12—Final Inspection:

Replace the first paragraph with the following:

“ If the Engineer determines that the work may be substantially complete, a Semi Final Inspection will be held as soon as practical. After the Semi Final Inspection is held and the Engineer determines that the requirements for Substantial Completion have been satisfied the Engineer will prepare a “Notice of Substantial Completion”.

When the Contractor has completed all work listed in the “Notice of Substantial Completion” the Contractor shall prepare a written notice requesting a Final Inspection and a “Certificate of Acceptance of Work”. The Engineer will hold an Inspection of the Project as soon as practical after the Engineer determines that the Project may be completed. If the Engineer deems the Project complete, said inspection shall constitute the Final Inspection, and the Engineer will notify the Contractor in writing that the Final Inspection has been performed.”

1.08.13 – Acceptance of Work and Termination of the Contractor’s Responsibility:

Replace the only paragraph with the following:

“ The Contractor’s responsibility for non-administrative Project work will be considered terminated when the final inspection has been held, any required additional work and final cleaning-up have been completed, all final operation and maintenance manuals have been submitted, and all of the Contractor’s equipment and construction signs have been removed from the Project site. When these requirements have been met to the satisfaction of the Engineer, the Commissioner will accept the work by certifying in writing to the Contractor that the non-administrative Project work has been completed.”

**CONNECTICUT
SUPPLEMENTAL SPECIFICATION
SECTION 1.09
MEASUREMENT AND PAYMENT**

1.09.04 – Extra and Cost-Plus Work

Delete existing subarticle (e) and replace with the following:

“(e) Administrative Expense: When extra work on a cost-plus basis is performed by an authorized subcontractor, the Department will pay the Contractor an additional 7.5% for that work; such payment will be in addition to the percentage payments described in (a), (b), (c) and (d) above, as a reimbursement for the Contractor's administrative expense in connection with such work. Approval of such additional payments will be given only after the Contractor provides to the Engineer receipted invoices for all relevant costs.”

1.09.06 – Partial Payments:

In the first paragraph under A. Monthly and Semi-monthly Estimates:, delete the second, third and fourth sentences and replace the remainder of subarticle (1) with the following:

“Retainage will not be held.

Exceptions may be made as follows:

- (a) When not in conflict with the interests of the State, the Contractor may request, and the Engineer may make, semi-monthly estimates for payment.
- (b) If, in the judgment of the Assistant District Engineer, the Project is not proceeding in accordance with the Contract the Engineer may decline to make a payment estimate.
- (c) If the total value of the Project work complete since the last estimate amounts to less than \$2,500 the Engineer also may decline to make a payment estimate.”

Replace the first paragraph of subarticle B. Payment for Stored Materials: with the following:

“B. Payment for Stored Materials: Non-perishable materials that are required for Project construction and that the Contractor has produced or purchased specifically for incorporation into the Project, but which have not yet been so incorporated, may be included in a payment estimate if

- (i) the materials meet all applicable Contract specifications,
- (ii) the materials have been delivered to the Project site or to another location approved by the Engineer, and
- (iii) the Contractor has submitted to the Engineer, as evidence of the Contractor's purchase of the materials, either a copy of a receipted bill for same or a Certificate of Title to the materials, in the form approved by the Department, duly-executed by the Contractor and Vendor.

The Engineer will decide at what fair and appropriate fraction of the applicable Contract price such materials may be included in a payment estimate.”

1.09.07 – Final Payment:

Replace the entire article with the following:

“1.09.07 – Final Payment: When the Commissioner has accepted the Project in accordance with Article 1.08.14, the Engineer will prepare a final payment estimate.”

**CONNECTICUT
SUPPLEMENTAL SPECIFICATION
SECTION 1.10
ENVIRONMENTAL COMPLIANCE**

Add the following Article:

"1.10.08 – VEHICLE EMISSIONS

All motor vehicles and/or construction equipment (both on-highway and non-road) shall comply with all pertinent State and Federal regulations relative to exhaust emission controls and safety.

The Contractor shall establish staging zones for vehicles that are waiting to load or unload at the contract area. Such zones shall be located where the emissions from the vehicles will have minimum impact on abutters and the general public.

Idling of delivery trucks, dump trucks, and other equipment shall not be permitted in excess of 3 minutes during periods of non-activity except as allowed by the Regulations of Connecticut State Agencies Section 22a-174-18(b)(3)(c):

No mobile source engine shall be allowed "to operate for more than three (3) consecutive minutes when the mobile source is not in motion, except as follows:

- (i) When a mobile source is forced to remain motionless because of traffic conditions or mechanical difficulties over which the operator has no control,
- (ii) When it is necessary to operate defrosting, heating or cooling equipment to ensure the safety or health of the driver or passengers,
- (iii) When it is necessary to operate auxiliary equipment that is located in or on the mobile source to accomplish the intended use of the mobile source,
- (iv) To bring the mobile source to the manufacturer's recommended operating temperature,
- (v) When the outdoor temperature is below twenty degrees Fahrenheit (20 degrees F) [negative seven degrees Celsius (-7 degrees C)],
- (vi) When the mobile source is undergoing maintenance that requires such mobile source be operated for more than three (3) consecutive minutes, or
- (vii) When a mobile source is in queue to be inspected by U.S. military personnel prior to gaining access to a U.S. military installation."

All work shall be conducted to ensure that no harmful effects are caused to adjacent sensitive receptors. Sensitive receptors include but are not limited to hospitals, schools, daycare facilities, elderly housing and convalescent facilities. Engine exhaust shall be located away from fresh air intakes, air conditioners, and windows.

A Vehicle Emissions Mitigation plan will be required for areas where extensive work will be performed within (less than 50 feet (15 meters)) to sensitive receptors. No work will proceed until a sequence of construction and a Vehicle Emissions Mitigation plan is submitted in writing to the Engineer for review and all comments are addressed in a manner acceptable to the Engineer. The mitigation plan must address the control of vehicle emissions from all vehicles and construction equipment.

Any costs associated with this "Vehicle Emissions" article shall be included in the general cost of the Contract. In addition, there shall be no time granted to the contractor for compliance with this notice. The contractor's compliance with this notice and any associated regulations shall not be grounds for claims as outlined in Section 1.11 – "Claims."

**CONNECTICUT
SUPPLEMENTAL SPECIFICATION
SECTION 1.11
CLAIMS**

Add the following Section:

**SECTION 1.11
CLAIMS**

1.11.01 – General

1.11.02 – Notice of Claim

1.11.03 – Record Keeping

1.11.04 – Claim Compensation

1.11.05 – Required Claim Documentation

1.11.06 – Auditing of Claims

1.11.01 – General: When filing a formal claim under Section 4-61 (referred to as “Section 4-61” below) of the C.G.S. (as revised), either as a lawsuit in the Superior Court or as a demand for arbitration, the Contractor must follow the procedures and comply with the requirements set forth in this Section of the Specifications. This Section does not, unless so specified, govern informal claims for additional compensation which the Contractor may bring before the Department. The Contractor should understand, however, that the Department may need, before the Department can resolve such a claim, the same kinds of documentation and other substantiation that it requires under this Section. It is the intent of the Department to compensate the Contractor for actual increased costs caused by or arising from acts or omissions on the part of the Department that violate legal or contractual duties owed to the Contractor by the Department.

1.11.02 – Notice of Claim: Whenever the Contractor intends to file a formal claim against the Department under Section 4-61, seeking compensation for additional costs, the Contractor shall notify the Commissioner in writing (in strict compliance with Section 4-61) of the details of said claim. Such written notice shall contain all pertinent information described in Article 1.11.05 below.

Once formal notice of a claim under C.G.S. Section 4-61 (b) (as revised) has been given to the Commissioner, the claimant may not change the claim in any way, in either concept or monetary amount, (1) without filing a new notice of claim and demand for arbitration to reflect any such change and (2) without the minimum period of six months after filing of the new demand commencing again and running before any hearing on the merits of the claim may be held. The only exception to this limitation will be for damages that continue to accrue after submission of the notice, in ways described and anticipated in the notice.

1.11.03 – Record Keeping: The Contractor shall keep daily records of all costs incurred in connection with its construction-related activities on behalf of the Department. These daily records shall identify each aspect of the Project affected by

matters related to any claim for additional compensation that the Contractor has filed, intends to file, or has reason to believe that it may file against the Department; the specific Project locations where Project work has been so affected; the number of people working on the affected aspects of the Project at the pertinent time(s); and the types and number of pieces of equipment on the Project site at the pertinent time(s). If possible, any potential or anticipated effect on the Project's progress or schedule which may result in a claim by the Contractor should also be noted contemporaneously with the cause of the effect, or as soon thereafter as possible.

1.11.04 – Claim Compensation: The payment of any claim, or any portion thereof, that is deemed valid by the Engineer shall be made in accordance with the following provisions of this Article:

(a) Compensable Items: The liability of the Department for claims will be limited to the following specifically-identified items of cost, insofar as they have not otherwise been paid for by the Department, and insofar as they were caused solely by the actions or omissions of the Department or its agents (except that with regard to payment for extra work, the Department will pay to the Contractor the mark-ups provided for in Article 1.04.05.):

- (1) Additional Project-site labor expenses.
- (2) Additional costs for materials.
- (3) Additional, unabsorbed Project-site overhead (**e.g.**, for mobilization and demobilization).
- (4) Additional costs for active equipment.
- (5) For each day of Project delay or suspension caused solely by actions or omissions of the Department, either
 - (i) an additional ten percent (10%) of the total amount of the costs identified in Subarticles (1) through (4) above; except that if the delay or suspension period prevented the Contractor from incurring enough Project costs under Subarticles (1) through (4) during that period to require a payment by the Department that would be greater than the payment described in subparagraph (ii) below, then the payment for affected home office overhead and profit shall instead be made in the following *per diem* amount:
 - (ii) six percent (6%) of the original total Contract amount divided by the original number of days of Contract time.

Payment under either (i) or (ii) hereof shall be deemed to be complete and mutually-satisfactory compensation for any unabsorbed home office overhead and any profit related to the period of delay or suspension.

- (6) Additional equipment costs. Only actual equipment costs shall be used in the calculation of any compensation to be made in response to claims for additional Project compensation. Actual equipment costs shall be based upon records kept in the normal course of business and in accordance with generally-accepted accounting principles. Under no circumstances shall Blue Book or other guide or rental rates be used for this purpose (unless the Contractor had to rent the equipment from an unrelated party, in which case the actual rental charges paid by the Contractor, so long as they are reasonable, shall be used). Idle equipment, for instance, shall be paid for based only on its actual cost to the Contractor.

- (7) Subcontractor costs limited to, and determined in accordance with, Subarticles (1), (2), (3), (4), and (5) above and applicable statutory and case law. Such subcontractor costs may be paid for by the Department only (a) in the context of an informal claims settlement or (b) if the Contractor has itself paid or legally-assumed, present unconditional liability for those subcontractor costs.

(b) Non-Compensable Items: The Department will have no liability for the following specifically-identified non-compensable items:

- (1) Profit, in excess of that provided for herein.
- (2) Loss of anticipated profit.
- (3) Loss of bidding opportunities.
- (4) Reduction of bidding capacity.
- (5) Home office overhead in excess of that provided for in Article 1.11.04(a)(5) hereof.
- (6) Attorneys fees, claims preparation expenses, or other costs of claims proceedings or resolution.
- (7) Any other consequential or indirect expenses or costs, such as tort damages, or any other form of expense or damages not provided for in these Specifications or elsewhere in the Contract.

1.11.05 – Required Claim Documentation: All claims shall be submitted in writing to the Commissioner, and shall be sufficient in detail to enable the Engineer to ascertain the basis and the amount of each claim, and to investigate and evaluate each claim in detail. As a minimum, the Contractor must provide the following information for each and every claim and sub-claim asserted:

- (a) A detailed factual statement of the claim, with all dates, locations and items of work pertinent to the claim.
- (b) A statement of whether each requested additional amount of compensation or extension of time is based on provisions of the Contract or on an alleged breach of the Contract. Each supporting or breached Contract provision and a statement of the reasons why each such provision supports the claim, must be specifically identified or explained.
- (c) Excerpts from manuals or other texts which are standard in the industry, if available, that support the Contractor's claim.
- (d) The details of the circumstances that gave rise to the claim.
- (e) The date(s) on which any and all events resulting in the claim occurred, and the date(s) on which conditions resulting in the claim first became evident to the Contractor.
- (f) Specific identification of any pertinent document, and detailed description of the substance of any material oral communication, relating to the substance of such claim.
- (g) If an extension of time is sought, the specific dates and number of days for which it is sought, and the basis or bases for the extension sought. A critical path method, bar chart, or other type of graphical schedule that supports the extension must be submitted.
- (h) When submitting any claim over \$50,000, the Contractor shall certify in writing, under oath and in accordance with the formalities required by the contract, as to the following:
 - (1) That supporting data is accurate and complete to the Contractors best

- knowledge and belief;
- (2) That the amount of the dispute and the dispute itself accurately reflects what the Contractor in good faith believes to be the Departments liability;
 - (3) The certification shall be executed by:
 - a. If the Contractor is an individual, the certification shall be executed by that individual.
 - b. If the Contractor is not an individual, the certification shall be executed by a senior company official in charge at the Contractor's plant or location involved or an officer or general partner of the Contractor having overall responsibility for the conduct of the Contractors affairs.

1.11.06 – Auditing of Claims: All claims filed against the Department shall be subject to audit by the Department or its agents at any time following the filing of such claim. The Contractor and its subcontractors and suppliers shall cooperate fully with the Department's auditors. Failure of the Contractor, its subcontractors, or its suppliers to maintain and retain sufficient records to allow the Department or its agents to fully evaluate the claim shall constitute a waiver of any portion of such claim that cannot be verified by specific, adequate, contemporaneous records, and shall bar recovery on any claim or any portion of a claim for which such verification is not produced. Without limiting the foregoing requirements, and as a minimum, the Contractor shall make available to the Department and its agents the following documents in connection with any claim that the Contractor submits:

- (1) Daily time sheets and foreman's daily reports.
- (2) Union agreements, if any.
- (3) Insurance, welfare, and benefits records.
- (4) Payroll register.
- (5) Earnings records.
- (6) Payroll tax returns.
- (7) Records of property tax payments.
- (8) Material invoices, purchase orders, and all material and supply acquisition contracts.
- (9) Materials cost distribution worksheets.
- (10) Equipment records (list of company equipment, rates, etc.).
- (11) Vendor rental agreements
- (12) Subcontractor invoices to the Contractor, and the Contractor's certificates of payments to subcontractors.
- (13) Subcontractor payment certificates.
- (14) Canceled checks (payroll and vendors).
- (15) Job cost reports.
- (16) Job payroll ledger.
- (17) General ledger, general journal (if used), and all subsidiary ledgers and journals, together with all supporting documentation pertinent to entries made in these ledgers and journals.
- (18) Cash disbursements journals.
- (19) Financial statements for all years reflecting the operations on the Project.
- (20) Income tax returns for all years reflecting the operations on the Project.
- (21) Depreciation records on all company equipment, whether such records are maintained by the company involved, its accountant, or others.

- (22) If a source other than depreciation records is used to develop costs for the Contractor's internal purposes in establishing the actual cost of owning and operating equipment, all such other source documents.
- (23) All documents which reflect the Contractor's actual profit and overhead during the years that the Project was being performed, and for each of the five years prior to the commencement of the Project.
- (24) All documents related to the preparation of the Contractor's bid, including the final calculations on which the bid was based.
- (25) All documents which relate to the claim or to any sub-claim, together with all documents that support the amount of damages as to each claim or sub-claim.
- (26) Worksheets used to prepare the claim, which indicate the cost components of each item of the claim, including but not limited to the pertinent costs of labor, benefits and insurance, materials, equipment, and subcontractors' damages, as well as all documents which establish the relevant time periods, individuals involved, and the Project hours and the rates for the individuals.
- (27) The name, function, and pertinent activity of each Contractor's or subcontractor's official, or employee involved in or knowledgeable about events that give rise to, or facts that relate to, the claim.
- (28) The amount(s) of additional compensation sought and a break-down of the amount(s) into the categories specified as payable under Article 1.11.04 above.
- (29) The name, function, and pertinent activity of each Department official, employee or agent involved in or knowledgeable about events that give rise to, or facts that relate to, the claim.

**CONNECTICUT
SUPPLEMENTAL SPECIFICATION
SECTION 1.20
GENERAL CLAUSES FOR FACILITIES CONSTRUCTION**

1.20-1.00 – General:

Delete the last sentence of the first paragraph and replace with the following:

“Facilities Construction is defined as the type of construction that requires the issuance of a Certificate of Compliance (C.O.C.) by the State Building Inspector or his authorized representative at the completion of a project, and includes site work considered ancillary to this type of construction.”

Add the following article:

“1.20-1.01.01—Definitions:

OWNER: Where used herein, it is synonymous with Department or State.”

1.20-1.02.04 – Examination of Plans, Specifications, Special Provisions and Site of Work:

Delete the first sentence of the first paragraph and replace with the following:

“CSI-formatted specifications are organized into Divisions and Sections based on the CSI’s “MasterFormat” numbering system.”

1.20-1.02.13 – Knowledge of Applicable Laws:

Delete Items 1 through 9 in their entirety and replace with the following:

1. “The 2003 International Building Code with the State Building Code, including latest Connecticut Supplement and Amendments.
2. The 2003 International Plumbing Code.
3. The 2003 International Mechanical Code.
4. The 2003 International Existing Building Code.
5. The 2009 International Energy Conservation Code.
6. The 2011 NFPA 70 National Electrical Code.
7. The 2003 ICC/ANSI A117.1.
8. The Fire Safety Code, including latest Connecticut Supplement and Amendments.
9. The 2003 International Fire Code.
10. The 2003 NFPA 1 Uniform Fire Code.

11. The 2003 NFPA 101 Life Safety Code.”

Add the following as the new last paragraph:

“All work to be performed by the Contractor shall comply with the “Americans with Disabilities Act Accessibility Guidelines.””

1.20-1.03.01 – Consideration of Bids:

Delete the entire article and replace with the following:

“The apparent low bidder shall submit to the Manager of Contracts a Schedule of Values within 14 days after bid opening. Any other Contractor that the Department may subsequently designate as the apparent lowest bidder shall make the aforesaid submission within 14 days from the date on which the Department notifies said Contractor that it has become the apparent lowest bidder. If, however, the Department deems it necessary for such a subsequently designated Contractor to make said submission within a shorter period of time, the Contractor shall make the submission within the time designated by the Department.

The total in the Schedule of Values shall equal the bid dollar amount for the Major Lump Sum Item (MLSI).

The Schedule of Values shall be divided into “Line Items” listed separately for each CSI Section of the Special Provisions. An additional line item for “Mobilization” shall be incorporated into the Schedule of Values; however, this item may not exceed 7.5% of the value of the MLSI. The “Mobilization” line item will also include costs associated with “General Conditions” and “Insurance/Bonding.” An additional line item for “Project Closeout” shall be incorporated into the Schedule of Values; however, this item must be at least 2.5% of the value of the MLSI. Where requested by the Department, the Contractor shall break down the line items further into more specific line items.

In the event that this Contract is terminated or a portion of this Contract is deleted for any reason or in any way allowable by law under this Contract after the apparent low bidder has been awarded the Contract, the Schedule of Values will not be used for estimating payment due the Contractor for work completed prior to such termination of the Contract or deletion of work thereunder. In the case of Contract termination, payment shall be made in accordance with Article 1.05.14.”

1.20-1.05.02--Shop Drawings, Product Data, Product Samples and Quality Assurance Submittals:

Delete the last sentence of the first paragraph and replace with the following:

“All facsimiles or other electronic documents from the Contractor shall be followed by an

official transmittal.”

Delete the third paragraph and replace with the following:

“The Contractor shall number each submittal consecutively: When resubmitting a “Revise and Resubmit” or “Rejected” submittal, the Contractor shall label the transmittal with the original submittal number followed by a letter to designate the additional submission. All submittals shall be numbered conforming to the following examples:”

In column B of line 001, line 001a, and line 001b of the table in subsection 1, replace “07511” with “075110.”

Add the following to the end of the first paragraph of subsection 2:

“The Department reserves the right to return partial submittals unreviewed to the Contractor.”

Revise the third paragraph of subsection 2 to read:

“The Contractor shall allow at least 60 calendar days for review of any submittal requiring approval by FAA, FTA, any railroad, DEEP, U.S. Coast Guard, Army Corps of Engineers, or any other outside agency.”

Delete the third and fourth paragraphs of subsection 3 and replace with the following:

“The Designer will not review submittals and the Engineer will not process payment estimates until the initial submittal schedule has been provided. Any delays in construction due to the Contractor's failure to provide a submittal schedule shall be the responsibility of the Contractor.

The Contractor must update its submittal schedule at least once a month, and distribute and post each updated schedule in the manner described above. The Engineer reserves the right not to process payment estimates without a recently updated submittal schedule on file.”

Replace the first sentence of the first paragraph of subsection 4 with the following:

“Shop Drawings consist of fabrication and installation drawings, roughing-in and setting drawings, schedules, patterns, templates and similar drawings, and wiring diagrams showing field-installed wiring, including power, signal, and control wiring.”

Replace the second paragraph of subsection 4 with the following:

“Shop drawings shall include the following information: Contract number, Project

description, number and title of the drawing, date of drawing, revision number, name of Contractor and subcontractor submitting drawings, dimensions, identification of products, shopwork manufacturing instructions, design calculations, statement of compliance with Contractual standards, notation of dimensions established by field measurement, relationship to adjoining construction clearly indicated, seal and signature of a professional engineer if specified, and any other information required by individual Contract provisions.”

Replace the first sentence of the first paragraph of subsection 5 with the following:

“Product data consist of printed information such as manufacturer’s product specifications, manufacturer’s installation instructions, manufacturer’s catalog cuts, standard color charts, wiring diagrams showing factory-installed wiring, printed performance curves, operational range diagrams, and mill reports.”

Replace the first sentence of the first paragraph of subsection 7 with the following:

“Quality assurance submittals consist of qualification data, design data, certifications, manufacturer’s instructions, manufacturer’s field reports, test reports, Material Safety Data Sheets (MSDSs), and other quality assurance information required by individual Contract provisions.”

1.20-1.05.04—Coordination of Special Provisions, Plans, Supplemental Specifications and Standard Specifications and Other Contract Requirements:

Delete the first and second paragraphs and replace with the following:

“Industry Standards: Each entity engaged in construction of the Contract shall be familiar with industry standards applicable to that entity's construction activities. If printed standards have been established by organizations referenced in Article 1.01.02 or in the Contract, the Contractor shall obtain copies of said standards directly from the publication source.

Unless the Special Provisions include more stringent requirements, applicable construction industry standards have the same force and effect as if bound or copied directly into the Special Provisions to the extent referenced. Such standards are made a part of the Contract by reference.”

Add the following article:

1.20-1.05.08—Schedules and Reports:

Daily Construction Reports: The Contractor shall assist the Engineer in the preparation of a daily construction report, by ensuring that each of the Contractor’s

employees and subcontractors working on the Project site on a given day signs the Engineer's sign-in sheet for that day; and by keeping and providing to the Engineer its own daily list of employees and subcontractors who worked on the Project site on that day.

Add the following article:

1.20-1.05.23—Requests for Information (RFIs):

The Contractor shall forward all RFIs to the Engineer in writing (facsimile or other electronic document) for review. The Engineer will forward the RFI to the Designer for review. Upon receipt of an RFI, the Designer will attempt to determine if additional information is required from the Contractor to respond to the RFI, and request said information from the Engineer.

All other RFIs will be responded to within 10 calendar days of receipt by the Designer.

1.20-1.05.24—Project Meetings:

Delete the third paragraph under subsection 1.

Delete the second paragraph under subsection 2 and replace with the following:

“The meeting participants shall review progress of other construction activities and preparations for the particular activity under consideration, including requirements of Contract documents, related requests for interpretations, related construction orders, purchases, deliveries, submittals, review of mockups, possible conflicts, compatibility problems, time schedules, weather limitations, manufacturer's written recommendations, warranty requirements, compatibility of materials, acceptability of substrates, temporary facilities and controls, space and access limitations, regulations of authorities having jurisdiction, testing and inspecting requirements, installation procedures coordination with other work, required performance results, protection of adjacent work, and protection of construction and personnel.”

Delete the second, third and fourth paragraph under subsection 3 and replace with the following:

“The Contractor shall provide the Engineer with a detailed agenda for the proposed meeting, specifying what topics will be covered. In addition to representatives of the Engineer, each subcontractor, supplier or other entity concerned with current progress or involved in planning, coordination or performance of future activities shall attend these meetings. All participants at the meeting shall be familiar with the Project and authorized to conclude matters relating to the Project.

At each progress meeting, the participants shall (1) review items of significance that could affect progress; (2) discuss topics appropriate to the current status of the Project;

(3) review progress since the last meeting; (4) determine whether each activity is on time, ahead of schedule, or behind schedule, in relation to the Contractor's Construction Schedule; (5) determine how to expedite any Project work that may be behind schedule; (6) discuss whether or not schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract time; and (7) review the present and future needs of each entity represented at the meeting, including such items as interface requirements, time, sequences, deliveries, off-site fabrication problems, access, site utilization, temporary facilities and controls, hours of work, hazards and risks, housekeeping, quality and work standards, status of correction of deficient items, field observations, requests for interpretations, status of proposal requests, pending changes, status of construction orders, and documentation of information for payment requests. The Engineer will distribute copies of minutes of the meeting to the Designer and the Contractor. The Contractor shall distribute copies to parties who were or should have been at the meeting.”

Delete article 1.20-1.05.25—Schedules and Reports in its entirety

1.20-1.06.08—Warranties:

Delete the eighth and ninth paragraph and replace with the following:

“The Contractor shall:

(a) Bind warranties in heavy-duty, commercial-quality, durable 3-ring vinyl-covered loose-leaf binders, thick enough to accommodate the contents, and sized to receive 8 1/2-inch x 11-inch paper (216-millimeter x 279-millimeter) paper.

(b) Identify the binder’s contents on the binder’s front and spine with the typed or printed title “WARRANTIES,” the Project title or name, and the name of the Contractor.

(c) Provide a heavy paper divider with a tab for each separate warranty.

(d) Mark the tab to identify the related product or installation.

(e) Provide a typed description of the product or installation, including the name of the product, and the name, address and telephone number of the Contractor or pertinent subcontractor.

(f) Furnish to the Department a written warranty for all Project work accompanied by a cover letter with the following contents:

[Addressed to:]

Commissioner of Transportation
Department of Transportation
P.O. Box 317546
Newington, Connecticut 06131-7546

Project Title and Number

[We] hereby warrant all materials and workmanship for all work performed under this Contract for a period of one (1) year from [date of issuance of C.O.C.] against failures of

workmanship and materials in accordance with the Contract. Furthermore, as a condition of this warranty, [we] agree to have in place all insurance coverage identified in the Contract for the performance of any warranty work.

[Signature:] [Name of authorized signatory]
[Title]

(g) Submit to the Engineer, upon completion of installation of materials or assemblies that are required to have either a flame-rating or a fire-endurance hourly rating, a detailed letter certifying that the required rating has been attained.

Upon determination by the Engineer that Project work covered by a warranty has failed, the Contractor shall replace or rebuild the work to an acceptable condition complying with Contract requirements. The Contractor is responsible for the cost of replacing or rebuilding defective construction or components and those which may have needed to be damaged or removed in order to cure the defective work including costs of material, equipment, labor, and material disposal, regardless of whether or not the State has benefited from use of the work through a portion of its anticipated useful service life. The Contractor shall respond to the Project Site when Project work covered by a warranty has failed within 3 calendar days, unless in the Engineer's opinion said failure is deemed to be an emergency, in which case the Contractor shall respond to the Project Site as directed by the Engineer."

1.20-1.08.03—Prosecution of Work:

Under subsection '3. Cutting and Patching,' delete the heading 'B. Protection of Structural Elements' and replace with the following:

"B. Protection:"

Move the existing first and second paragraphs to under the following subparagraph:

"1. Structural Elements:"

Add the following after the first paragraph under B:

"2. Operational Elements: The Contractor shall not cut and patch operating elements and related components in a manner that results in their reducing their capacity to perform as intended or that results in increased maintenance or decreased operational life or safety.

3. Miscellaneous Elements: The Contractor shall not cut and patch miscellaneous elements or related components in a manner that could change their load-carrying capacity, that results reducing their capacity to perform as intended, or that results in increased maintenance or decreased operational life or safety."

Add the following after subsection 3:

“4. Selective Demolition:

A. Definitions:

Remove: The Contractor shall detach materials from existing construction and legally dispose or recycle them off-site, unless indicated to be removed and salvaged or removed and reinstalled. Except for materials indicated to be reused, salvaged, reinstalled, or otherwise indicated to remain Engineer's property, demolished materials shall become Contractor's property and shall be removed from the Project Site.

Remove and Salvage: The Contractor shall detach materials from existing construction and deliver them to Engineer. The Engineer reserves the right to identify other materials for salvage during the course of demolition.

Remove and Reinstall: The Contractor shall detach materials from existing construction, prepare them for reuse, and reinstall them where indicated.

Existing to Remain: Existing materials of construction that are not to be removed and that are not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled.

B. Approval Process:

The Contractor shall submit pre-demolition photographs to the Engineer prior to the commencement of Project work to show existing conditions of adjoining construction and site improvements, including finish surfaces, that might be misconstrued as damage caused by selective demolition operations.

Well in advance of performing any selective demolition on the Project, the Contractor shall submit to the Engineer a proposal describing the procedures that the Contractor intends to use for same.

The Contractor shall include the following information, as applicable, in its proposal: (1) detailed sequence of selective demolition and removal work with starting and ending dates for each activity while ensuring that the Engineer's on-site operations are not disrupted; (2) interruption of utility services; (3) coordination for shutoff, capping, and continuation of utility services; (4) use of elevators and stairs; (5) locations of temporary partitions and means of egress; (6) coordination of Engineer's continuing occupancy of portions of existing building and of Engineer's partial occupancy of completed Project work; and (7) means of protection for items to remain and items in path of waste removal from building.

The Contractor shall comply with (1) governing EPA notification regulations before beginning selective demolition; (2) hauling and disposal regulations of authorities having jurisdiction; (3) ANSI A10.6; and (4) NFPA 241.

The Engineer will conduct a Pre-Demolition Meeting at the Project site in accordance with Article 1.20-1.05.24. Said meeting will review the methods and procedures related to selective demolition including, but not limited to, the following: (1) an inspection and discussion of the condition of construction to be selectively demolished; (2) a review of the structural load limitations of the existing structure; (3) a review and finalization of the selective demolition schedule and a verification of the availability of materials, demolition personnel, equipment, and facilities needed to make progress and avoid delays; (4) a review of requirements of Project work performed by other trades that rely on substrates exposed by selective demolition operations; and (5) a review of areas where existing construction is to remain and requires protection.

C. Repair Materials:

The Contractor shall comply with Article 1.20-1.08.03 subsection 3E for repair materials and shall comply with material and installation requirements specified in other Contract provisions.

D. Examination:

The Contractor shall (1) verify that utilities have been disconnected and capped; (2) survey existing conditions and correlate with requirements indicated to determine extent of selective demolition required; (3) inventory and record the condition of items to be removed and reinstalled and items to be removed and salvaged; (4) investigate and measure the nature and extent of unanticipated mechanical, electrical, or structural elements that conflict with intended function or design and submit a written report to Engineer; and (5) perform surveys as the Project work progresses to detect hazards resulting from selective demolition activities.

E. Utility Services:

The Contractor shall (1) maintain existing utility services indicated to remain and protect them against damage during selective demolition operations; (2) not interrupt existing utilities serving occupied or operating facilities unless authorized in writing by the Engineer; (3) provide temporary services during interruptions to existing utilities, as acceptable to Engineer; (4) provide at least 3 calendar days' notice to the Engineer if shutdown of service is required during changeover; and (5) locate, identify, disconnect, and seal or cap off indicated utilities serving areas to be selectively demolished. The Contractor shall arrange to shut off indicated utilities with utility companies. If utility services are required to be removed, relocated, or abandoned, before proceeding with selective demolition the Contractor shall provide temporary utilities that bypass area of selective demolition and that maintain continuity of service to other parts of building.

The Contractor shall cut off pipe or conduit in walls or partitions to be removed and shall cap, valve, or plug and seal remaining portion of pipe or conduit after bypassing.

The Contractor shall refer to other Contract provisions for shutting off, disconnecting, removing, and sealing or capping utilities. The Contractor shall not start selective demolition work until utility disconnecting and sealing have been completed and verified by the Engineer in writing.

F. Preparation:

The Contractor shall conduct selective demolition and debris-removal operations to ensure minimum interference with adjacent occupied and used facilities on the Project site. The Contractor shall not disrupt the Owner's operations without the Engineer's permission. The Contractor shall protect existing site improvements, appurtenances, and landscaping to remain.

The Contractor shall provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain. The Contractor shall provide temporary weather protection, during interval between selective demolition of existing construction on exterior surfaces and new construction, to prevent water leakage and damage to structure and interior areas. The Contractor shall protect walls, ceilings, floors, and other existing finish work that are to remain or that are exposed during selective demolition operations. The Contractor shall cover and protect furniture, furnishings, and equipment that have not been removed.

The Contractor shall provide temporary enclosures for protection of existing building and construction, in progress and completed, from exposure, foul weather, other construction operations, and similar activities. The Contractor shall provide temporary weathertight enclosure for building exterior. Where heating is needed and permanent enclosure is not complete, the Contractor shall provide insulated temporary enclosures and shall coordinate enclosure with ventilating and material drying or curing requirements to avoid dangerous conditions and effects.

The Contractor shall erect and maintain dustproof partitions and temporary enclosures to limit dust and dirt migration and to separate areas from fumes and noise.

The Contractor shall provide and maintain interior and exterior shoring, bracing, or structural support to preserve stability and prevent movement, settlement, or collapse of construction to remain, and to prevent unexpected or uncontrolled movement or collapse of construction being demolished. The Contractor shall strengthen or add new supports when required during progress of selective demolition.

G. Pollution Controls:

The Contractor shall comply with governing regulations pertaining to environmental protection.

The Contractor shall not use water when it may create a hazardous or objectionable condition such as ice, flooding, or pollution.

The Contractor shall remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas. The Contractor shall remove debris from elevated portions of building by chute, hoist, or other device that will convey debris to grade level in a controlled descent.

The Contractor shall clean adjacent structures and improvements of dust, dirt, and debris caused by selective demolition operations. The Contractor shall return adjacent areas to condition existing before selective demolition operations began.

H. Performance:

The Contractor shall not use explosives for demolition purposes.

The Contractor shall demolish and remove existing construction only to the extent required by new construction and as indicated. The Contractor shall (1) proceed with selective demolition systematically; (2) neatly cut openings and holes plumb, square, and true to dimensions required; (3) use cutting methods least likely to damage remaining or adjoining construction; (4) use hand tools or small power tools designed for sawing or grinding, not hammering and chopping, to minimize disturbance of adjacent surfaces; (5) temporarily cover openings to remain; (6) cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces; (7) not use cutting torches until work area is cleared of flammable materials; (8) verify condition and contents of concealed spaces such as duct and pipe interiors before starting flame-cutting operations; (9) maintain fire watch and portable fire-suppression devices during flame-cutting operations; (10) maintain adequate ventilation when using cutting torches; (11) remove decayed, vermin-infested, or otherwise dangerous or unsuitable materials and promptly dispose of off-site; (12) remove structural framing members and lower to ground by method suitable to avoid free fall and to prevent ground impact or dust generation; (13) locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing; and (14) dispose of demolished items and materials promptly.

The Contractor shall comply with the Engineer's requirements for using and protecting walkways, building entries, and other building facilities during selective demolition operations.

The Contractor shall demolish and remove foundations and other below-grade structures completely unless otherwise indicated on the plans. The Contractor shall fill below-grade areas and voids resulting from demolition of structures with granular fill materials. Prior to placement of fill materials, the Contractor shall ensure that the areas

to be filled are free of standing water, frost, frozen material, trash, and debris. After fill placement and compaction, grade surface to meet adjacent contours and provide flow to surface drainage structures. Backfilling and grading related to demolition is included in the Major Lump Sum Item (MLSI) for the Project. There will be no separate payment for this backfilling and grading.

The Contractor shall (1) demolish concrete in sections; (2) cut concrete at junctures with construction to remain to the depth shown on the Contract plans and at regular intervals using power-driven saw; and (3) remove concrete between saw cuts.

The Contractor shall (1) demolish masonry in small sections; (2) cut masonry at junctures with construction to remain using power-driven saw; and (3) remove masonry between saw cuts.

The Contractor shall (1) saw-cut perimeter of concrete slabs-on-grade to be demolished as shown on the Contract plans; and (2) break up and remove concrete slabs-on-grade.

The Contractor shall (1) remove floor coverings and adhesive according to recommendations in RFCI-WP and its Addendum; and (2) remove residual adhesive and prepare substrate for new floor coverings by one of the methods recommended by RFCI.

The Contractor shall (1) only remove existing roofing in one day to the extent that it can be covered by new roofing; and (2) refer to other Contract provisions for new roofing requirements.

The Contractor shall remove air conditioning equipment without releasing refrigerants.

I. Reuse of Building Elements:

The Contractor shall not demolish building elements beyond what is indicated on the plans without the Engineer's approval.

J. Removed and Salvaged Materials:

Unless otherwise directed by the Engineer, the Contractor shall (1) store materials in a secure area until delivery to the owner; (2) transport materials to the owner's storage area off-site; and (3) protect materials from damage during transport and storage.

K. Removed and Reinstalled Materials:

Unless otherwise directed by the Engineer, the Contractor shall (1) clean and repair materials to functional condition adequate for intended reuse; (2) paint equipment to match the color of new equipment; (3) protect materials from damage during transport and storage; and (4) reinstall items in locations indicated complying with installation

requirements for new materials and equipment and providing connections, supports, and miscellaneous materials necessary to make item functional for use indicated.

L. Existing Materials to Remain:

The Contractor shall protect construction indicated to remain against damage and soiling during selective demolition.

The Contractor shall drain piping and cap or plug piping with the same or a compatible piping material for piping to be abandoned in place.

The Contractor shall cap or plug ducts with the same or a compatible ductwork material for ducts to be abandoned in place.

The Contractor shall cut and remove concealed conduits and wiring to be abandoned in place 2-inches (50-mm) below the surface of the adjacent construction, cap the conduit end, and patch the surface to match the existing finish. The Contractor shall cut existing conduits installed in concrete slabs to be abandoned in place flush with the top of the slab and fill conduit end with a minimum of 4-inches (100-mm) of concrete.

M. Patching and Repairing:

The Contractor shall comply with Article 1.20-1.08.03 subsection 3H for patching and repairing damage to adjacent construction caused by selective demolition operations.

N. Disposal of Demolished Materials:

The Contractor shall (1) not allow demolished materials to accumulate or be sold on the Project Site; (2) not burn demolished materials on the Project Site; and (3) promptly and legally dispose or recycle demolished materials off the Project Site.”

1.20-1.08.05—Personnel and Equipment:

Replace “FM with “FMG” in subsection (a)

Add the following article:

“1.20-1.08.12—Semi-Final and Final Inspections:

1. Semi-Final Inspection: Before requesting the Semi-Final Inspection, the Contractor shall show 100% completion for all Project work claimed as complete. The Contractor shall submit final test/adjust/balance records including the final air and water balance report. For all incomplete Project work, the Contractor shall prepare its own “Punch List” of the incomplete items and reasons the work is not complete. The Contractor shall submit final test/adjust/balance records including the final air and water balance report.

On receipt of a Contractor request for inspection, the Engineer will proceed with inspection or notify the Contractor of unfulfilled requirements. The Engineer will prepare a "Punch List" of unfilled, substandard, or incomplete items. During this inspection, the Contractor shall have all technicians necessary to demonstrate the complete operation of all systems on-site. Examples of such systems include, but are not limited to, the following: boiler, HVAC, fire alarm, and building automation. The Engineer will advise the Contractor of the construction that must be completed or corrected before the issuance of the C.O.C. Results of the completed inspection will form the basis of requirements for the Final Inspection. The Engineer reserves the right to issue the C.O.C. after the Semi-Final Inspection if there are no Building Code or Fire Code compliance issues or any major "Punch List" items.

2. Final Inspection: Before requesting Final Inspection for issuance of the C.O.C., the Contractor shall: (1) submit specific warranties, maintenance service agreements, final certifications and similar documents; (2) submit Record Drawings, Record Specifications, operations and maintenance manuals, final project photographs, property surveys, and similar final record information; (3) deliver spare parts; (4) make final changeover of permanent locks and deliver the keys to the Engineer; (5) complete start-up testing of systems; (6) train the owner's operation and maintenance personnel; (7) discontinue or change over and remove temporary facilities from the Project Site, along with construction tools, mock-ups, and similar elements; (8) complete final cleaning requirements, including touch-up painting; (9) touch-up and otherwise repair and restore marred exposed finishes to eliminate visual defects; (10) submit a certified copy of the Engineer's "Punch List" of items to be completed or corrected, stating that each item has been completed or otherwise resolved for acceptance, and the list has been endorsed and dated by the Engineer; (11) submit final meter readings for utilities, a measured record of stored fuel, and similar data as of the date of Final Inspection, or when the Engineer took possession of and responsibility for corresponding elements of the Project work; and (12) install permanent electrical service. The Contractor shall install permanent electrical service prior to Semi-Final Inspection if requested by the Engineer, or if necessary for the Engineer or Contractor to perform testing of building and other related systems and equipment to certify acceptance and completion of Project work. The Contractor shall submit all outstanding items or unacceptable submissions from the Semi-Final Inspection, or other outstanding items required for submittal, prior to the Final Inspection.

On receipt of a Contractor request for inspection, the Engineer will proceed with inspection and notify the Contractor of unfulfilled requirements."

1.20-1.08.13—Termination of the Contractor's Responsibility:

Add subsection 3 as follows:

"3. Insurance Coverage: The Contractor shall have in place all insurance coverage identified in Article 1.03.07 for the performance of any warranty work."

1.20-1.08.14—Acceptance of Project:

Add the following to subsection 2 under the heading “Equipment and Systems Maintenance Manual:”

“(j) Copies of maintenance agreements with service agent name and telephone number.”

Add the following paragraph in subsection 3 after the second paragraph:

“The Contractor shall provide a syllabus prior to the training to ensure that the appropriate owner’s operation and maintenance personnel are in attendance.”

Delete the last paragraph and replace with the following:

“ The Contractor shall submit to the Engineer for approval, a qualified commercial videographer to videotape the training sessions. The videographer shall be a firm or an individual of established reputation that has been regularly engaged as a professional videographer for not less than 3 years.

The Contractor shall video record each training session and provide said video in DVD format to the Engineer for the owner’s future use.”

Add the following section:

“1.20-1.09.06—Partial Payments:

With each payment request under the MLSI, the Contractor shall submit AIA Form G702 (Application and Certificate of Payment) and Form G703 (Continuation Sheet). The Contractor is not required to obtain the Architect’s signature on Form G702. Once approved by the Engineer, the Forms G702 and G703 become the basis of payment under the MLSI.”

Add the following section:

“1.20-9.75.04—Method of Measurement:

Mobilization as defined in Article 1.20-1.03.01 will be paid in the manner described hereinafter; however, the determination of the total contract price earned shall not include the amount of mobilization earned during the period covered by the current monthly estimate – but shall include amounts previously earned and certified for payment:

1. When the first payment estimate is made, 25 percent of the “Mobilization” line item will be certified for payment.

2. When the Baseline Schedule, as specified under Section 1.05.08, is accepted, 50 percent of the "Mobilization" line item, minus any previous payments, will be certified for payment.

3. When 10 percent of the total original contract price is earned and the Baseline Schedule, as specified under Section 1.05.08, is accepted, 75 percent of the "Mobilization" line item, minus any previous payments, will be certified for payment.

4. When 30 percent of the total original contract price is earned and the Baseline Schedule, as specified under Section 1.05.08, is accepted, 100 percent of the "Mobilization" line item, minus any previous payments, will be certified for payment.

Project Closeout as defined in Article 1.20-1.03.01 shall include demobilization of plant and equipment, completion of all physical work, and administrative closeout items necessary to satisfy all Contract requirements. Project Closeout will be paid in the manner described hereinafter:

1. When the non-administrative project completion requirements (as specified under Article 1.08.13) and the administrative completion requirements (as specified under Article 1.08.14) have been satisfied, 100 percent of the "Project Closeout" line item will be certified for payment."

**CONNECTICUT
SUPPLEMENTAL SPECIFICATION
SECTION 2.02
ROADWAY EXCAVATION, FORMATION OF
EMBANKMENT AND DISPOSAL OF
SURPLUS MATERIAL**

2.02.01 – Description:

In the first sentence, insert “, swales” between “channels” and “and other miscellaneous construction to the ...”

2.02.04 – Method of Measurement:

In the second to last Paragraph, replace the last sentence with the following:
“Bituminous parking areas are considered as bituminous concrete pavement.”

**CONNECTICUT
SUPPLEMENTAL SPECIFICATION
SECTION 2.05
TRENCH EXCAVATION**

2.05.01--Description:

In Paragraph 2, delete the only sentence and replace with the following:

- 2) The removal of stormwater drainage structures, stormwater pipes and appurtenances beyond the limits of the roadway and structure excavation.

In Sub article 2, Rock in Trench, delete the only sentence and replace with the following:

- (2) Rock, insofar as it applies to trench excavation, shall be defined as rock in definite ledge formation, boulders, or portions of boulders, cement masonry structures, concrete structures, reinforced concrete pipe, Portland cement concrete pavement or base, of 1/2 cubic yard (0.5 cubic meters) or more in volume, removed as indicated or directed from within the payment lines for trench excavation.

2.05.05 -Basis of Payment

In Paragraph 13, delete the entire sentence "There will be no direct payment for the plugging of existing pipes....." and replace with the following:

" There will be no direct Payment for the plugging of existing pipes, removal and disposal of metal or plastic pipes or for the breaking up of floors in drainage structures being abandoned. The cost shall be included in the contract unit prices of the drainage and excavation items."

**CONNECTICUT
SUPPLEMENTAL SPECIFICATION
SECTION 2.12
SUBBASE**

2.12.02 – Materials:

Delete the second sentence:

“Grading ‘B’ shall be used.”

**CONNECTICUT
SUPPLEMENTAL SPECIFICATION
SECTION 2.16
PERVIOUS STRUCTURE BACKFILL**

2.16.01 - Description:

Add the following sentence after the only sentence:

“This item shall also consist of furnishing and placing crushed stone or gravel in permeable material bags at the inlet ends of weep holes in structures to the dimensions indicated on the plans or as ordered by the Engineer.”

2.16.02 – Materials:

Add the following paragraph after the only sentence:

“ The materials for bagged stone shall conform to the following requirements:

1. The crushed stone or gravel shall conform to the grading requirements of Article M.01.01 for No. 3 or No. 4 coarse aggregate or a mixture of both.
2. The bag shall be of permeable material sized to contain 1 c.f. (0.03 cu.m) of loosely packed granular material.”

2.16.03 - Construction Methods:

Add the following paragraph at the end of the section:

“ Where weep holes are installed, bagged stone shall be placed around the inlet end of each weep hole, to prevent movement of the pervious material into the weep hole. Approximately 1 c.f. (0.03 cu.m) of crushed stone or gravel shall be enclosed in each of the permeable material bags. All bags shall then be securely tied at the neck with cord or wire so that the enclosed material is contained loosely. The filled bags shall be stacked at the weep holes to the dimensions shown on the plans or as directed by the Engineer. The bags shall be unbroken at the time pervious material is placed around them, and bags which are broken or burst prior to or during the placing of the pervious material shall be replaced at the Contractor’s expense.”

2.16.04 - Method of Measurement:

Add the following paragraph after the only paragraph:

“ There will be no direct payment for bagged stone, but the cost thereof shall be included in the cost of the work for “Pervious Structure Backfill.””

**CONNECTICUT
SUPPLEMENTAL SPECIFICATION
SECTION 3.04
PROCESSED AGGREGATE BASE**

Delete the entire Section and replace with the following:

3.04.01--Description: The base shall consist of a foundation constructed on the prepared subbase or subgrade in accordance with these specifications and in conformity with the lines, grades, compacted thickness and typical cross-section as shown on the plans.

3.04.02--Materials: All materials for this work shall conform to the requirements of Article M.05.01.

3.04.03--Construction Methods: Only one type of coarse aggregate shall be used on a project unless otherwise permitted by the Engineer.

Prior to placing the processed aggregate base, the prepared subbase or subgrade shall be maintained true to line and grade, for a minimum distance of 200 feet (60 meters) in advance of the work. None of the aggregate courses shall be placed more than 500 feet (150 meters) ahead of the compaction and binding operation on that particular course.

The processed aggregate base shall be spread uniformly by a method approved by the Engineer. The thickness of each course shall not be more than 4 inches (100 millimeters) after compaction, unless otherwise ordered.

After the aggregate is spread, it shall be thoroughly compacted and bound by use of equipment specifically manufactured for that purpose. Rollers shall deliver a ground pressure of not less than 300 pounds per lineal inch (52.5 newtons/millimeter) of contact width and shall have a weight (mass) not less than 10 tons (9100 kilograms). Vibratory units shall have a static weight (mass) of not less than 4 tons (3650 kilograms). Water may be used during the compaction and binding operation and shall be applied from an approved watering device. The compacting and binding operation shall begin at the outside edges, overlapping the shoulders for a distance of not less than 6 inches (150 millimeters) and progress towards the middle, parallel with the centerline of the pavement. The work shall cover the entire surface of the course with uniform overlapping of each preceding track or pass. Areas of super-elevation and special cross slope shall be compacted by beginning at the lowest edge and proceeding towards the higher edge, unless otherwise directed by the Engineer. The compacting and binding operation shall be continued until the voids in the aggregates have been reduced to provide a firm and uniform surface satisfactory to the Engineer. The amount of compactive effort shall in no case shall be less than four (4) complete passes of the compacting and binding operations. All aggregate shall be completely compacted and bound at the end of each day's work or when traffic is to be permitted to operate on the

road. The dry density of each layer of processed aggregate base after compaction shall not be less than 95 percent of the dry density for that material when tested in accordance with AASHTO T180, Method D.

Should the subbase or subgrade material become churned up or mixed with the processed aggregate base at any time, the Contractor shall, without additional compensation remove the mixture. The Contractor shall add new subbase material, if required, and reshape and recompact the subbase in accordance with the requirements of Article 2.12.03. New aggregate material shall be added, compacted and bound, as hereinbefore specified, to match the surrounding surface.

Any surface irregularities which develop during, or after work on each course, shall be corrected by loosening material already in place and removing or adding aggregate as required. The entire area, including the surrounding surface, shall be re-compact and rebound until it is brought to a firm and uniform surface satisfactory to the Engineer.

3.04.04--Method of Measurement: Processed Aggregate Base will be measured horizontally in-place after final grading and compaction. Materials placed beyond the horizontal limits indicated on the plans will not be measured for payment.

The total thickness shall be as indicated on the plans, or as ordered by the Engineer and within a tolerance of minus three-fourths of an inch ($-\frac{3}{4}$ ") to plus one-half inch ($+\frac{1}{2}$ ") (-19 millimeters to +13 millimeters).

Measurements to determine the thickness will be taken by the Engineer at intervals of 500 feet (150 meters) or less, along lanes, and shall be considered representative of the lane. For the purpose of these measurements, a shoulder will be considered a lane.

If a thickness measurement is taken and found deficient, the Engineer will take such additional measurements as he considers necessary to determine the longitudinal limits of the deficiency. Areas not within allowable tolerances shall be corrected, as ordered by the Engineer, without additional compensation to the Contractor.

3.04.05--Basis of Payment: This work will be paid for at the contract unit price per cubic yard for "Processed Aggregate Base", complete in place, which price shall include all materials, tools, equipment and work incidental thereto.

Pay Item	Pay Unit
Processed Aggregate Base	c.y. (cu. m)

**CONNECTICUT
SUPPLEMENTAL SPECIFICATION
SECTION 4.01
CONCRETE PAVEMENT**

4.01.03-A. Composition:

Change the beginning of the first sentence as follows:

“The composition of the concrete shall be in accordance with the requirements of Section M.03 - Portland Cement Concrete, as well as the applicable ...”

Add the following new paragraph before the last paragraph:

“The temperature of the concrete at the time of placement shall not be less than 60° F (15.5° C) or greater than 90° F (32° C). For pumped concrete, the temperature shall be determined at the placement end of the pump line. The temperature of the concrete shall be determined in accordance with ASTM C1064.”

4.01.03-E. Hauling Units:

1. Truck mixers and truck agitators:

Change the end of the only sentence as follows:

“... the requirements of Subarticle 6.01.03-3, ‘Transportation and Delivery of Concrete.’”

4.01.03-F. Placing Concrete:

6. Joints:

(e) Load Transfer Devices:

Change the only sentence as follows:

“Load transfer devices shall conform to the requirements of Article M.03.08.”

7. Curing:

(a) Liquid Membrane-Forming Cure:

Change the first sentence as follows:

“The liquid curing compound shall conform to Subarticle M.03.04-3.”

(b) Moist Curing:

Change the end of the first sentence as follows:

“... moist mats of the size and quality specified in Subarticle M.03.04-2.”

(c) Cover Sheet Curing:

Change the end of the first sentence as follows:

“... paper or polyethylene cover sheets conforming to Subarticle M.03.04-4.”

**CONNECTICUT
SUPPLEMENTAL SPECIFICATION
SECTION 5.14
PRESTRESSED CONCRETE MEMBERS**

5.14.03 – Construction Methods:

2. Prestressing:

Change the outline level of “Final Stressing of Straight Strands:” and “Final Stressing of Draped Strands:” and their subsections as follows:

- “ **A. Final Stressing of Straight Strands:**
 - (1) Single-strand tensioning:**
 - (2) Multiple-strand tensioning:**
- B. Final Stressing of Draped Strands:**
 - (1) Partial stressing and subsequent strains:**
 - (2) Final stressing in draped position:”**

5. Finishing: Deck Units:

Change the first sentence as follows:

“Deck units in structures that will have a bituminous concrete wearing surface shall be given a float finish on the top surface as specified in Subarticle 6.01.03-10.”

9. Joining Deck Units:

Change the end of the last sentence of the first paragraph as follows:

“... shall be filled with non-shrink grout conforming to the requirements of Article M.03.05.”

12. Inspection:

Change the beginning of the first sentence as follows:

“The provisions of Subarticle 6.03.03-3 (Shop Fabrication), (a) Notification shall apply to the steel items, ...”

16: Methods and Equipment:

Change the last sentence as follows:

“The results of this investigation, including computations, shall be submitted to the Engineer.”

**CONNECTICUT
SUPPLEMENTAL SPECIFICATION
SECTION 6.01
CONCRETE FOR STRUCTURES**

Delete the entire Section and replace it with the following:

**SECTION 6.01
CONCRETE FOR STRUCTURES**

- 6.01.01—Description**
- 6.01.02—Materials**
- 6.01.03—Construction Methods**
- 6.01.04—Method of Measurement**
- 6.01.05—Basis of Payment**

6.01.01—Description: This item shall include concrete for use in bridges and culverts, walls, catch basins, drop inlets and other incidental construction as required. The concrete shall be composed of Portland cement, pozzolans, fine and coarse aggregate, admixtures and water, prepared and constructed in accordance with these specifications, at the locations and of the form dimensions and class shown on the plans, or as directed by the Engineer.

The use of concrete from dry batch or central mixed plants is permitted for all concrete mixtures.

6.01.02—Materials: The materials for this work shall conform to the requirements of Section M.03.

6.01.03—Construction Methods:

1. Falsework and Forms: Falsework is considered to be any temporary structure which supports structural elements of concrete, steel, masonry or other material during the construction or erection. Forms are considered to be the enclosures or panels which contain the fluid concrete and withstand the forces due to its placement and consolidation. Forms may in turn be supported on falsework.

This work shall consist of the construction and removal of falsework and forms that are designed by the Contractor in the execution of the work, and whose failure to perform properly could adversely affect the character of the Contract work or endanger the safety of adjacent facilities, property, or the public. Falsework and forms shall be mortar tight and of sufficient rigidity and strength to safely support all loads imposed and to produce in the finished structure the lines and grades indicated in the Contract documents. Forms shall also impart the required surface texture and rustication and shall not detract from the uniformity of color of the formed surfaces. Forms shall be of wood, steel or other material approved by the Engineer.

- (a) **Design:** The design of falsework and formwork shall conform to the *AASHTO Guide Design Specifications for Bridge Temporary Works*, or to other established and generally accepted design codes such as ACI Standard *ACI 347 Recommended Practice for Concrete Formwork* or specific form or falsework manufacturer specifications. When other than new or undamaged materials are used, appropriate reductions in allowable stresses, and decreases in resistance factors or imposed loads shall be used for design.
- (b) **Loads:** The design of the falsework and forms shall be based on load factors specified in the *AASHTO LRFD Bridge Design Specifications* and all applicable load combinations shall be investigated. The design load for falsework shall consist of the sum of appropriate dead and live vertical loads and any horizontal loads.

As a minimum, dead loads shall include the weight (mass) of the falsework and all construction material to be supported. The combined unit weight (density) of concrete, reinforcing and pre-stressing steel and forms that is supported shall be assumed to be not less than:

1. Normal-weight (normal-density) concrete: 0.16 kip/ft³ (2560 kg/m³)
2. Lightweight (low-density) concrete: 0.13 kip/ft³ (2080 kg/m³)

Live loads shall consist of the actual weight (mass) of any equipment to be supported, applied as concentrated loads at the points of contact and a uniform load of not less than 0.02 kip/ft² (0.001 MPa) applied over the area supported, plus 0.075 kip/ft (1.10 N/mm) applied at the outside edge of deck overhangs.

The horizontal load used for the design of the falsework bracing system shall be the sum of the horizontal loads due to equipment; construction sequence including unbalanced hydrostatic forces from fluid concrete and traffic control devices; stream flow, when applicable; and an allowance for wind. However, in no case shall the horizontal load to be resisted in any direction be less than two percent (2%) of the total dead load.

For post-tensioned structures, the falsework shall also be designed to support any increase in or redistribution of loads caused by tensioning of the structure. Loads imposed by falsework onto existing, new, or partially completed structures shall not exceed those permitted in 6.01.03-12, "Application of Loads."

- (c) **Working Drawings:** The working drawings for falsework and formwork shall be prepared in accordance with Article 1.05.02 whenever the falsework or formwork exceeds 14.0 feet (4300 mm) in height or whenever vehicular, marine, or pedestrian traffic may travel under or adjacent to the falsework or formwork. Working drawings shall include the sequence, method and rate of placement of the concrete.

Manufacturer catalog cuts or written installation procedures shall be provided for any clips, braces, hangers or other manufactured parts used with the formwork or falsework.

(d) Construction: Forms and falsework shall be built true to lines and grades, shall be strong, stable, firm, mortar-tight and adequately braced or tied, or both. They shall be designed and constructed to withstand all loads and pressures including those imposed by plastic concrete, taking full account of the stresses due to the rate of placement, effect of vibration and conditions brought about by construction methods. Forms and falsework shall be constructed to compensate for variations in camber of supporting members and allow for deflections.

Falsework and formwork shall be chamfered at all sharp corners, unless otherwise ordered or permitted, and shall be given a slight bevel or draft in the case of projections to ensure satisfactory removal. Materials for falsework and formwork and their supports, ties and bracing, shall be of the type, quality and strength to achieve the structural requirements. Form material in contact with concrete shall provide the finished concrete surface smoothness as specified in 6.01.03-10, "Finishing Concrete Surfaces," and have a uniform appearance.

Falsework and formwork shall be treated with form oil or other release agent approved by the Engineer before the reinforcing steel is placed, or self-releasing forms approved by the Engineer may be used. Release agents which will adhere to or discolor the concrete shall not be used.

Falsework and formwork for concrete surfaces exposed to view shall produce a smooth surface of uniform texture, free of voids, indentations, protrusions and bulges. Panels lining falsework and formwork shall be arranged so that the joint lines form a symmetrical pattern conforming to the general lines of the structure. The same type of form-lining material shall be used throughout each element of a structure. Falsework and formwork shall be sufficiently rigid so that the undulation of the concrete surface shall not exceed 1/4 inch (6 mm) when checked with a 4 foot (1200 mm) straightedge or template.

For non-exposed surfaces the falsework and formwork shall be sufficiently rigid so that the undulation of the concrete surface shall not exceed 1/2 inch (13 mm) when checked with a 4 foot (1200 mm) straightedge or template.

Metal ties and anchors to hold the falsework and formwork in alignment and location shall be so constructed that the metal work can be removed to a depth of at least 2 inches (50 mm) from the concrete surface without damage to the concrete. All cavities resulting from the removal of metal ties shall be filled after removal of forms with cement mortar of the same proportions used in the body of the work or other materials approved by the Engineer, and the surface finished smooth and even, and if exposed in the finished work, shall conform to the texture and color of adjacent surfaces. With permission of the Engineer, the Contractor need not remove from the underneath side of bridge decks portions of metal devices used to support reinforcing steel providing such devices are of material, or are adequately coated with material, that will not rust or corrode. When coated reinforcing steel is required, all metal ties, anchorages, or spreaders that remain in the concrete shall be of corrosion-resistant material or coated with a dielectric material.

Forms shall be clean and clear of all debris. For narrow walls and columns where the bottom of the form is inaccessible, an access opening will be allowed in the form and falsework for cleaning out extraneous material.

- (e) **Date of Completion:** The year in which the superstructure is completed in its entirety shall be cast in at least two (2) places as shown on the plans unless otherwise ordered by the Engineer. The date shall be placed in diagonally opposite ends of the bridge parapets or as designated by the Engineer. The reverse molds for the date shall be furnished by the Contractor.
- (f) **Bridge Decks:** After erection of beams and prior to placing falsework and forms, the Contractor shall take elevations along the top of the beam at the points shown on the plans or as directed by the Engineer. The Contractor shall calculate the haunch depths and provide them to the Engineer a minimum of seven (7) days prior to installing the falsework and forms. The Contractor shall also provide calculations for the setting of the overhang brackets based on the final beam deflection. These calculations shall be based on the final proposed deck grade and parapet elevations.

Falsework or formwork for deck forms on girder bridges shall be supported directly on the girders so that there will be no appreciable differential settlement during placing of the concrete. Girders shall be either braced and tied to resist any forces that would cause rotation or torsion in the girders caused by the placing of concrete for diaphragms or decks, or shown to be adequate for those effects. Unless specifically permitted, welding of falsework support brackets or braces to structural steel members or reinforcing steel shall not be allowed.

- (g) **Stay-In-Place Metal Forms for Bridge Decks:** These forms may be used if shown in the Contract or approved by the Engineer. Prior to the use of such forms and before fabricating any material, the Contractor shall submit working drawings to the Engineer for review in accordance with Article 1.05.02, Working Drawings. These drawings shall include the proposed method of form construction, erection plans including placement plans, attachment details, weld procedure(s), material lists, material designation, gage of all materials, and the details of corrugation. Also, copies of the form design computations shall be submitted with the working drawings. Any changes necessary to accommodate stay-in-place forms, if approved, shall be at no cost to the Department.

The metal forms shall be designed on the basis of the dead load of the form, reinforcement and the plastic concrete, including the additional weight (mass) of concrete [considered to be equivalent to the weight (mass) imposed by an additional concrete thickness equal to three percent (3%) of the proposed deck thickness, but not to exceed 0.3 inches (8 mm)] due to the deflection of the metal forms, plus 50 pounds per square foot (2.40 kilopascals) for construction loads. The allowable stress in the corrugated form and the accessories shall not be greater than 0.725 times the yield strength of the furnished material and the allowable stress shall not exceed 36,000 psi (250 megapascals). The span for design and deflection shall be the clear distance between edges of the beams or girders less 2 inches (50 mm) and shall be measured parallel to the form flutes. The maximum deflection under the weight (mass) of plastic concrete, reinforcement, and forms shall not exceed 1/180 of the form span or 0.5 inches (13 mm), whichever is less. In no case shall the loading

used to estimate this deflection be less than 120 pounds per square foot (586 kilograms per square meter). The permissible form camber shall be based on the actual dead load condition. Camber shall not be used to compensate for deflection in excess of the foregoing limits. The form support angles shall be designed as a cantilever with horizontal leg not more than 3 inches (75 mm).

No stay-in-place metal forms shall be placed over or be directly supported by the top flanges of beams or girders. The form supporting steel angles may be supported by or attached to the top flanges.

Stay-in-place metal forms shall not be used in bays where longitudinal slab construction joints are located, under cantilevered slabs such as the overhang outside of fascia members, and bridges over a salt-laden body of water with a clearance of less than 15 feet (4.5 m) above mean high water level.

Welding to the top flanges of steel beams and girders is not permitted in the areas where the top flanges are in tension, or as indicated on the plans. Alternate installation procedures shall be submitted addressing this condition.

Drilling of holes in pre-stressed concrete beams or the use of power-actuated tools on the pre-stressed concrete beams for fastening of the form supports to the pre-stressed concrete beams will not be permitted. Welding of the reinforcing steel to the pre-stressed units is not permitted.

All edges of openings cut for drains, pipes, and similar appurtenances shall be independently supported around the entire periphery of the opening.

All fabricated stay-in-place metal forms shall be unloaded, stored at the Project site at least 4 inches (100 mm) above the ground on platforms, skids or other suitable supports and shall be protected against corrosion and damage and handled in such a manner as to preclude damage to the forms. Damaged material shall be replaced at no additional cost to the State.

Any exposed form or form support metal where the galvanized coating has been damaged, shall be thoroughly cleaned, wire brushed, then coated with two (2) coats of Zinc Dust – Zinc Oxide primer, FS No. TT-P-641d, Type II or another product acceptable to the Engineer.

The forms shall be installed from the topside in accordance with the manufacturer's recommended installation procedures. The form supports shall ensure that the forms retain their correct dimensions and positions during use at all times. Form supports shall provide vertical adjustment to maintain design slab thickness at the crest of corrugation, to compensate for variations in camber of beams and girders and to allow for deflections. Stay-in-place metal forms shall have a minimum depth of the form valley equal to 2 inches (50 mm). The forms shall have closed tapered ends. Lightweight filler material shall be used in the form valleys.

All field cutting shall be done with a steel cutting saw or shears including the cutting of supports, closures and cutouts. Flame cutting of forms is not permitted.

All welding shall be performed by Department certified welders in accordance with the "Welding" Subarticle in Section 6.03. Welding of forms to supports is not permitted.

The steel form supports shall be placed in direct contact with the flange of stringer or floor beam flanges and attached by bolts, clips, welding where permitted, or other approved means. Form sheets shall not be permitted to rest directly on the top of the stringer or floor beam flanges. The forms shall be securely fastened to form supports with self-drilling fasteners and shall have a minimum bearing length of 1 inch (25 mm) at each end. In the areas where the form sheets lap, the form sheets shall be securely fastened to one another by fasteners at a maximum spacing of 18 inches (450 mm). The ends of the form sheets shall be securely attached to the support angles with fasteners at a maximum spacing of 18 inches (450 mm), or two (2) corrugation widths, whichever is less.

The depth of the concrete slab shall be as shown on the plans and the corrugated forms shall be placed so that the top of the corrugation will coincide with the bottom of the deck slab. No part of the forms or their supports shall protrude into the slab. All reinforcement in the bottom reinforcement mat shall have a minimum concrete cover of 1 inch (25 mm) unless noted otherwise on the plans.

The completed stay-in-place metal form system shall be sufficiently tight to prevent leakage of mortar. Where forms or their installation are unsatisfactory in the opinion of the Engineer, either before or during placement of the concrete, the Contractor shall correct the defects before proceeding with the work.

- (h) Construction Joints:** Construction joints other than those shown on the plans will not be permitted without prior approval of the Engineer. In joining fresh concrete to concrete that has already set, the work already in place shall have all loose and foreign material removed, and the surface roughened and thoroughly drenched with water.

All reinforcing steel shall extend continuously through joints. Where unplanned construction joints may be needed, they shall be constructed as directed by the Engineer.

- (i) Expansion and Contraction Joints:** Expansion and contraction joints shall be constructed at the locations and in accordance with the details specified in the Contract documents. The forming of joint openings shall be dimensioned in accordance with the joint manufacturer's design requirements. Joints include open joints, filled joints, joints sealed with sealants, joints reinforced with steel armor plates or shapes, paraffin coated joints, and joints with combinations of these features.

For mechanical joint systems, the concrete shall be placed in such a manner that does not interfere with the movement of the joint.

Open joints shall be placed at locations designated on the plans and shall be formed by the insertion and subsequent removal of templates of wood, metal or other suitable material. The templates shall be so constructed that their removal may be readily accomplished without damage to the work.

Filled joints shall be made with joint filler, the materials for which shall conform to the requirements of the plans and of these specifications.

- (j) **Pipes, Conduits and Utility Installations:** The Contractor shall coordinate the installation of pipes, conduits and utilities as shown on the plans and in conformance with the Contract documents or as directed by the Engineer. The openings accommodating such pipe, conduit and utility installations shall be incorporated into the formwork by the Contractor.
- (k) **Anchorage:** Anchor bolts and systems shall be set to the requirements of the plans and Contract documents. Anchor bolts and systems shall be clean and free of dirt, moisture or other foreign materials at the time of installation. The anchor bolts and systems shall be installed prior to placing concrete.

With the Engineer's approval, the Contractor may install anchorages after placement and setting of the concrete or in formed holes. The anchorages shall be installed into drilled or formed holes having a diameter and a depth suitable to receive the bolts in accordance with the grout manufacturer's requirements. Such holes shall be located to avoid damage to the existing reinforcement. All holes shall be perpendicular to the plane surface. The Contractor shall take every precaution necessary to prevent damage to the concrete due to freezing of water or grout in anchor bolt holes.

- (l) **Ornament or Reverse Moulds:** Ornamental work, when so noted on the plans, shall be formed by the use of reverse moulds. These moulds shall be produced by a qualified manufacturer approved by the Engineer. They shall be built in accordance with the general dimensions and appearance shown on the plans. The Contractor shall submit all detailed drawings, models, or carvings for review by the Engineer before the moulds are made.

The Contractor shall be responsible for their condition at all times, and shall be required to remove and replace any damaged or defective moulds at no additional cost to the State.

The surfaces of the moulds shall be given a coating of form release agent to prevent the adherence of concrete. Any material which will adhere to or discolor the concrete shall not be used.

Form Liners, if required, shall be installed per the Contract Special Provisions.

- (m) **Removal of Falsework and Forms:** The Contractor shall consider the location and character of the structure, the weather, the materials used in the mix, and other conditions influencing the early strength of the concrete when removing forms and falsework. Methods of removal likely to cause damage to the concrete surface shall not be used.

Supports shall be removed in such a manner as to permit the structure to uniformly and gradually take the stresses due to its own weight. For structures of two (2) or more spans, the sequence of falsework release shall be as specified in the Contract documents or as approved by the Engineer.

Removal shall be controlled by field-cured cylinder tests. The removal shall not begin until the concrete has achieved seventy-five percent (75%) of the design compressive strength. To facilitate finishing, side forms carrying no load may be removed after twenty-four (24) hours with the permission of the Engineer, but the curing process must be continued for seven (7) days.

When the results of field-cured cylinder tests are unavailable, the following periods, exclusive of days when the temperature drops below 40°F (5°C), may govern the removal of forms:

Form Removal Requirements	
Structure Element	Minimum Time Period
Arch Centers, centering under beams, pier caps, and unsupported elements	14 days
Slabs on grade, Abutments and Walls	24 hours
Columns	2 days
Bridge Decks	28 days

The Contractor may submit alternate methods to determine the in-place strength of the concrete for removal of forms and falsework, for review and approval by the Engineer.

2. Protection from Environmental Conditions: The concrete shall be protected from damage due to weather or other environmental conditions during placing and curing periods. In-place concrete that has been damaged by weather conditions shall be either repaired to an acceptable condition or removed and replaced as determined by the Engineer.

(a) Rain Protection: The placement of concrete shall not commence or continue unless adequate protection satisfactory to the Engineer is provided by the Contractor.

(b) Hot Weather Protection: When the ambient air temperature is above 90°F (32°C), the forms, which will come in contact with the mix shall be cooled to below 90°F (32°C) for a minimum of one (1) hour prior to and one (1) hour after completion of the concrete placement by means of a water spray or other methods satisfactory to the Engineer.

(c) Cold Weather Protection: When there is a probability of ambient air temperature below 40°F (5°C) during placement and curing, a Cold-Weather Concreting Plan shall be submitted to the Engineer for review and comment. The Plan shall detail the methods and equipment, including temperature measuring devices, that will be used to ensure that the required concrete and air temperatures are maintained.

1. Placement: The forms, reinforcing steel, steel beam flanges, and other surfaces which will come in contact with the mix shall be heated to a minimum of 40°F (5°C), by methods satisfactory to the Engineer, for a minimum of one (1) hour prior to, and maintained throughout, concrete placement.

2. Curing: For the first six (6) days, considered the initial cure period, the concrete shall be maintained at a temperature of not less than 45°F (7°C) and the air temperature surrounding the structure shall be maintained at a temperature of not less than 60°F (16°C). When the concrete mix includes pozzolans or slag, the initial cure period shall be increased to ten (10) days. After the initial cure period, the air surrounding the structure shall be maintained above 40° F (5°C) for an additional eight (8) days. If external heating is employed, the heat shall be applied and withdrawn gradually and uniformly so that no part of the concrete surface is heated to more than 90°F (32°C) or caused to change temperature by more than 20°F (11°C) in eight (8) hours. The Engineer may reduce or increase the amount of time that the structure must be protected or heated based on an indication of in-place concrete strength acceptable to the Engineer.

(d) Additional Requirements for Bridge Decks: Prior to the application of curing materials, all the concrete placed on bridge decks shall be protected from damage due to rapid evaporation by methods acceptable to the Engineer. During periods of low humidity (less than 60% relative humidity), sustained winds of 25 mph (40 kph) or more, or ambient air temperatures greater than 80°F (25°C) the Contractor shall provide written details of additional measures to be taken during placement and curing.

Protection may include increasing the humidity of the surrounding air with fog sprayers and employing wind-breaks or sun-shades. Additional actions may include reduction of the temperature of the concrete prior to placement, scheduling placement during cooler times of days or nights, or a combination of these actions.

(e) Concrete Exposed to Salt Water: No Construction joints shall be formed between the levels of extreme low water and extreme high water or the upper limit of wave action as determined by the Engineer.

3. Transportation and Delivery of Concrete: All material delivered to the Project shall be supplied by a producer qualified in accordance with Section M.03. The producer shall have sufficient plant capacity and trucks to ensure continuous delivery at the rate required to prevent the formation of cold joints.

(a) Material Documentation: All vendors producing concrete must have their weigh scales and mixing plant automated to provide a detailed ticket. Delivery tickets must include the following information:

1. State of Connecticut printed on ticket
2. Name of producer, identification of plant
3. Date and time of day
4. Type of material
5. Cubic yards (cubic meters) of material loaded into truck
6. Project number, purchase order number, name of Contractor (if Contractor other than producer)
7. Truck number for specific identification of truck
8. Individual aggregate, cement, water weights (masses) and any admixtures shall be printed on plant tickets
9. Water/cement ratio, and
10. Additional water allowance in gallons (liters) based on water/cement ratio for mix

A State inspector may be present to monitor batching and weighing operations.

The Contractor shall notify the Engineer immediately if, during the production day, there is a malfunction of the recording system in the automated plant or weigh scales.

Manually written tickets containing all required information may be allowed for up to one (1) hour after malfunction provided they are signed by an authorized representative of the producer.

- (b) Transportation of Mixture:** Trucks delivering concrete shall be qualified in accordance with Section M.03.

If the concrete mix arrives at the Project with a slump lower than allowed by specification, water may be considered as a means to temper concrete to bring the slump back to within specification. This tempering may only be done prior to discharge with the permission of the Engineer. The quantity of water in gallons (liters) added to the concrete cannot exceed the allowance shown on the delivery ticket.

The concrete shall be completely discharged into the forms within one and one-half (1-1/2) hours from the batch time stamped on the delivery ticket. This time may be extended if the measured temperature of the concrete is below 90°F (32°C). This time may also be reduced if the temperature of the concrete is over 90°F (32°C).

Rejected concrete shall be disposed of by the Contractor at no cost to the State.

The addition of chemical admixtures or air entrainment admixtures at the Project site, to increase the workability or to alter the time of set, will only be permitted if prior approval has been granted by the Engineer. The addition of air entrainment admixtures at the Project site will only be permitted by the producer's quality control staff. The Contractor is responsible for follow-up quality control testing to verify compliance with the Specifications.

- 4. Acceptance Testing and Test Specimens:** The Contractor shall furnish the facilities and concrete required for sampling, transport to the testing location in the field, performing field testing and for casting sample cylinders for compressive-strength determinations. The Department will furnish personnel for sampling and casting Acceptance specimens and the number of specimens required will be determined by the Engineer. The equipment for the Department's testing is provided for elsewhere in the Contract.

- (a) Temperature, Air Content and Slump:** Field testing in accordance with AASHTO T-23, "Making and Curing Concrete Test Specimens in the Field" will be performed at the point of placement and at a frequency determined by the Engineer.

English Units

Standard Mix Class	Air Content	Slump	Concrete Temperature
A (3300 psi)	6.0 +/- 1.5%	4" +/- 1"	60°-90°F
C (3300 psi)			
F (4400 psi)			
Modified Standards ¹	6.0 +/- 1.5% ²	4" +/- 1" ²	
Special Provision Mix ³	As specified	As specified	
¹ Modifications to Standard Mixes, including mixes placed by pumping, shall be reviewed by the Engineer prior to use. These include but are not limited to the use of chemical admixtures such as high range water reducing (HRWR) admixtures and the use of coarse aggregate sizes for that class not specified in M.03.			
² If the <u>only</u> modification is the addition of HRWR, the maximum allowable slump shall be 7 inches.			
³ All concrete mixes with a mix design strength not shown in the table must be approved by the Engineer on a case-by-case basis. Limits on the plastic properties and strength requirements of these mixes are listed in the Specifications.			

Metric Units

Standard Mix Class	Air Content	Slump	Concrete Temperature
A (23MPa)	6.0 +/- 1.5%	100 mm +/- 25mm	15.5°-32°C
C (23 MPa)			
F (30 MPa)			
Modified Standards ¹	6.0 +/- 1.5% ²	100mm +/- 25mm ²	
Special Provision Mix ³	As specified	As specified	
¹ Modifications to Standard Mixes, including mixes placed by pumping, shall be reviewed by the Engineer prior to use. These include but are not limited to the use of chemical admixtures such as high range water reducing (HRWR) admixtures and the use of coarse aggregate sizes for that class not specified in M.03.			
² If the <u>only</u> modification is the addition of HRWR, the maximum allowable slump shall be 175 mm.			
³ All concrete mixes with a mix design strength not shown in the table must be approved by the Engineer on a case-by-case basis. Limits on the plastic properties and strength requirements of these mixes are listed in the Specifications.			

- (b) Acceptance Testing and Compressive Strength Specimens:** Concrete samples are to be taken at the point of placement into the forms or molds. Representatives of the Engineer will sample the mix.

The Contractor shall provide and maintain facilities on the Project site, acceptable to the Engineer, for sampling, transporting the initial sample, casting, safe storage and initial curing of the concrete test specimens as required by AASHTO T-23. This shall include but not be limited to a sampling receptacle, a means of transport of the initial concrete sample from the location of the concrete placement to the testing location, a level and

protected area of adequate size to perform testing, and a specimen storage container capable of maintaining the temperature and moisture requirements for initial curing of Acceptance specimens. The distance from the location of concrete placement to the location of testing and initial curing shall be 100 feet (30 m) or less, unless otherwise approved by the Engineer.

The specimen storage container described in this section is in addition to the concrete cylinder curing box provided for elsewhere in the Contract documents.

After initial curing, the test specimens will be transported by Department personnel and stored in the concrete cylinder curing box until they can be transported to the Division of Materials Testing for strength evaluation.

- (c) Sampling Procedure for Pumping:** It is the responsibility of the Contractor to provide concrete that meets required specifications at the point of placement.

Samples of concrete shall be taken at the discharge end of the pump at the point of placement with the exception of underwater concrete. The Contractor may submit an alternate location to provide a sample from the discharge end of the pump with verification showing that the characteristics of the mix will not be altered from that which would have been attained at the point of placement. The Engineer will review the documentation and other extenuating circumstances when evaluating the request.

In the case of underwater concrete the Contractor shall submit the proposed sampling location with the submittals required in 6.01.03-6(f).

- (d) Additional field testing:** Additional field testing such as density and yield measurements may be required at the time of placement as determined by the Engineer.

5. Progression Cylinders and Compressive Strength Specimens: Progression Cylinders outlined in this section are field cured compressive strength specimens taken for information related to when a structure or segment of a structure can be loaded or put into service, adequacy of curing and protection of concrete in the structure, or when formwork or shoring may be removed from the structure. The information produced from strength results of Progression Cylinders will not be considered for acceptance of the concrete.

The personnel, equipment, and molds for sampling, casting, curing and testing of Progression Cylinders shall be furnished by the Contractor at no expense to the Department.

Sampling, casting, and field curing of the specimens shall be performed in accordance with AASHTO T23 by an ACI Concrete Field Testing Technician Grade 1 or higher and will be witnessed by a representative of the Department.

The sample shall be taken at the point of placement into the forms or molds from one (1) or more of the same truck loads that an Acceptance sample is taken from.

A minimum of two (2) cylinder results will be used to determine in-place strength.

Compression testing shall be performed in accordance with AASHTO T-22 by personnel approved by the Engineer.

A Certified Test Report in accordance with Article 1.06.07 shall be provided to the Engineer reporting the Progression Cylinder test results. A copy of the results of the compressive strength testing shall be provided to the Engineer at least twenty-four (24) hours prior to any Project activity that the results may control.

6. Handling and Placing Concrete: Concrete shall be handled, placed, and consolidated by methods acceptable to the Engineer that will not segregate the mix and shall result in a dense homogeneous concrete. The methods used shall not cause displacement of reinforcing steel or other materials to be embedded in the concrete. Concrete shall not be placed until the forms and all materials have been inspected by the Engineer. All mortar from previous placements, debris, and foreign material shall be removed from the forms and steel prior to commencing placement. The forms and subgrade shall be thoroughly moistened with water immediately before concrete is placed. All water that has ponded within the forms shall also be removed. Temporary form spreader devices shall not be left in place.

All laitance or unsound material shall be removed before placing substructure concrete onto the surface of any concrete placed underwater.

Placement of concrete for each section of the structure shall be performed continuously between construction or expansion joints as shown on the plans. The delivery rate, placing sequence and methods shall be such that fresh concrete is always placed and consolidated against previously placed concrete before initial set has occurred. The temperature of the concrete mixture during placement shall be maintained between 60°F (16°C) and 90°F (32°C). During and after placement of concrete, care shall be taken not to damage the concrete or break the bond with reinforcing steel. Platforms for workers and equipment shall not be supported directly on any reinforcing steel. Forces that may damage the concrete shall not be applied to the forms or reinforcing steel.

(a) Sequence of Placement: The sequence of placement shall be in accordance with the Contract documents or as permitted by the Engineer.

Concrete for integral horizontal members, such as caps, slabs, or footings shall not be placed until the concrete for the columns, substructure, culvert walls and similar vertical members has achieved sufficient strength as stated in 6.01.03-1(m).

The concrete in arches shall be placed in such a manner as to load the formwork uniformly and symmetrically.

The base slab or footings of cast-in-place box culverts shall reach sufficient strength before the remainder of the culvert is constructed.

(b) Placement Methods: The Contractor shall notify the Engineer at least twenty-four (24) hours in advance of intention to place concrete.

Vibrators shall not be used to shift the fresh concrete horizontally. Vibrators shall be adequate to consolidate the concrete and integrate it with the previous lift.

The rate of concrete placement must not produce loadings that exceed those considered in the design of the forms.

The use of chutes and pipes for conveying concrete into the forms must be reviewed by the Engineer. Chutes shall be clean, lined with smooth watertight material and, when steep slopes are involved, shall be equipped with baffles or reverses. When the discharge must be intermittent, a hopper or other device for regulating the discharge shall be provided.

Aluminum shall not be permanently incorporated into the concrete unless otherwise specified.

When placing operations involve dropping the concrete more than 5 feet (1500 mm), the Contractor shall take action to prevent segregation of the mix and spattering of mortar on steel and forms above the elevation of the lift being placed. This restriction shall not apply to cast-in-place pilings.

When using stay-in-place forms, concrete shall not be dropped more than 3 feet (1000 mm) above the top of the forms, and the concrete shall be discharged directly over the beams or girders.

- (c) **Pumping:** The Contractor shall use equipment specifically manufactured to pump concrete mixes and that meets the needs of the specific concrete placement.
- (d) **Consolidation:** Unless otherwise specified, all concrete, except concrete placed under water, shall be sufficiently consolidated by mechanical vibration immediately after placement.

The Contractor shall provide a sufficient number of commercially available mechanical immersion type vibrators to properly consolidate the concrete immediately after it is placed in the forms unless external form vibrators are used. The Contractor shall have an adequate number of operable vibrators available in case of breakdown.

External form vibrators may be used if submitted prior to concrete placement and reviewed by the Engineer.

Vibration shall not be applied directly to the reinforcement or hardened concrete. Special care shall be taken in placing and consolidating concrete around ornamental moulds, form liners and other embedded items. The vibrator shall not touch these items at any time.

- (e) **Additional Requirements for Bridge Decks:** At least fifteen (15) days before the erection of the screed rails, the Contractor shall submit screed erection plans, grades and sequence of concrete placement and proposed rate of placing concrete for review by the Engineer. These plans shall include details of equipment to be

used in the placement and finishing of the concrete, including the number and type of personnel who will be engaged in placing the concrete. The screed equipment shall be a commercially available vibratory system. The use of wooden screeds is prohibited.

When setting screed rails for mechanical finishing, the Contractor shall take into consideration and make proper allowances for the deflection of the bridge superstructure due to all operations.

Screed and runway supports shall not be located on any stay-in-place metal form sheets, form supports or reinforcing steel. The Contractor shall operate the mechanical screed at least twenty-four (24) hours prior to actual placement of the concrete to verify deck survey and equipment operations to the satisfaction of the Engineer.

Concrete shall be deposited in a uniform manner across the entire width being placed, and only two (2) passes of the transverse screed will be permitted over a given deck area, unless otherwise allowed by the Engineer.

If the Contractor proposes to place concrete outside of daylight hours, an adequate lighting system must be provided.

Concrete shall be deposited in accordance with the placement sequence as noted on the plans. If no sequence is indicated, the Contractor shall provide a placement sequence to the Engineer for review. The placement sequence shall proceed in such a manner that the total deflection or settlement of supporting members, and final finishing of the surface will occur before initial set of the concrete takes place.

At construction joints, concrete shall not be placed against the previously placed concrete for at least twelve (12) hours unless otherwise allowed by the Engineer.

- (f) Underwater Placement:** Concrete may only be placed under water within a cofferdam unless otherwise specified in the documents or otherwise allowed by the Engineer. Placement shall begin following inspection and acceptance of the depth and character of the foundation material by the Engineer.

Underwater concrete mixes are considered non-standard designs and shall be submitted to the Engineer for approval. Typically a minimum of ten percent (10%) additional cement than comparable non-underwater mixes will be required.

Underwater concrete shall be placed continuously with the surface of the concrete kept as horizontal as practical. To ensure thorough bonding, each succeeding layer shall be placed before the preceding layer has taken initial set. For large concrete placements, more than one (1) tremie or pump shall be used to ensure compliance with this requirement.

Mass concrete placement requirements, outlined in 6.01.03-6(g), do not apply to underwater concrete.

To prevent segregation, underwater concrete shall be placed in a compact mass, in its final position, by means of a tremie, concrete pump, or other approved method and shall not be disturbed. Still water shall be maintained at the point of deposit. Cofferdams shall be vented during the placement and curing of the concrete to equalize the hydrostatic pressure and thus prevent flow of water through the concrete.

If a tremie is used, the method of depositing the concrete shall be detailed in a working drawing submitted to the Engineer for review. The tube shall have watertight couplings and shall permit the free movement of the discharge end over the area of the work.

(g) Mass concrete placement: Mass concrete placement shall be defined as any placement, excluding underwater concrete placement, in which the concrete being cast has dimensions of 5 feet (1500 mm) or greater in each of three (3) different directions. For placements with a circular cross-section, a mass concrete placement shall be defined as any placement that has a diameter of 6 feet (1800 mm) or greater and a height of 5 feet (1500 mm) or greater. For all mass concrete placements, the mix temperature shall not exceed 85°F (30°C) as measured at point of discharge into the forms.

Any special concrete mix design proposed by the Contractor to meet the above temperature requirements shall be submitted to the Engineer for review.

7. Finishing Plastic Concrete: Unless otherwise specified in the Contract documents, after concrete has been consolidated and prior to final curing, all surfaces of concrete that are not placed against forms shall be struck-off to the planned elevation or slope. The surface shall be finished by floating with an acceptable tool. While the concrete is still in a workable state, all construction and expansion joints shall be tooled with an edger. Joint filler shall be left exposed. For requirements on float finish, refer to 6.01.03-10, "Finishing Concrete Surfaces."

After completion of the placing and finishing operation and for at least twelve (12) hours after the concrete has set, the Contractor shall not operate any equipment in the immediate vicinity of the freshly placed concrete if, in the opinion of the Engineer, it could cause excessive vibration, movement or deflection of the forms.

The addition of water to the surface of the concrete to assist in finishing operations will not be permitted.

(a) Bridge Decks: After the concrete has been consolidated and brought to the proper elevation by the screed machine, it shall be finished by use of a suitable float. The Contractor shall not disturb the fresh concrete after it has been finished. All finishing work, including the application of the fog spray and placement of the curing mats, shall be performed from work bridges supported above the deck surface. A work bridge shall be made available to the Engineer for inspection of the concrete work.

Surfaces that are to be covered with a waterproofing membrane shall be finished to a smooth surface, free of mortar ridges and other projections and in accordance with the membrane manufacturer's recommendations.

Unless otherwise noted in the Contract, the concrete wearing surfaces shall be given a skid-resistant texture by dragging, brooming, tining, or by a combination of these methods. These methods shall be done after floating and at such time and in such manner that the desired texture will be achieved while minimizing displacement of the larger aggregate particles.

1. Dragging: The surface shall be finished by dragging a seamless strip of damp burlap over the surface. The burlap to be dragged shall consist of sufficient layers and have sufficient length in contact with the concrete to slightly groove the surface. The burlap shall be drawn longitudinally along the surface in a slow manner so as to leave an even texture. The burlap shall be kept damp, clean, and free of particles of hardened concrete. The Contractor may propose an alternate material for the Engineer's consideration.
2. Tining: Tining shall be in a transverse direction using a wire broom, comb, or float having a single row of tines or fins. The tining grooves shall be between 1/16 inch (1.5 mm) and 3/16 inch (5 mm) wide and between 1/8 inch (3 mm) and 3/16 inch (5 mm) deep, spaced 1/2 inch (12.5 mm) to 3/4 inch (20 mm) on centers. Tining shall be discontinued 12 inches (300 mm) from the curb line on bridge decks. The area adjacent to the curbs shall be given a light broom finish longitudinally. As an alternative, tining may be achieved using a machine designed specifically for tining or grooving concrete pavements.

The transverse grooving shall be performed when the grooves can be formed to a maximum depth of 3/16 inch (5 mm) with relative ease and without the walls of the grooves closing in on each other. The tining shall be aligned so as to prevent overlapping of grooves in any two (2) successive transverse passes. The Contractor shall measure the depth of the grooves in the presence of the Engineer with an appropriate device to ensure compliance.

(b) Surface Testing and Correction: The completed surface shall be constructed in accordance with grades and cross slopes shown on the plans. The entire surface shall be checked by the Contractor in the presence of the Engineer, with an acceptable 10 foot (3 meter) straightedge.

1. The surface shall not vary more than +/- 1/8 inch (3 mm) in 10 feet (3 m) for decks which will not be covered with an overlay.
2. The surface shall not vary more than +/- 1/4 inch (6 mm) in 10 feet (3 m) for decks which will be covered with an overlay.

Variances greater than these, which, in the opinion of the Engineer, may adversely affect the riding qualities of the surface shall be corrected, and this shall be done at the expense of the Contractor. The Contractor shall submit a corrective procedure to the Engineer for review and approval. The procedure shall correct such irregularities by methods such as, but not limited to, concrete planing or grooving.

8. Bearing Surfaces: Concrete surfaces under metallic masonry plates and elastomeric bearings shall have a float finish. After the concrete has set, the area which will be in contact with the masonry plate shall be ground as necessary to provide full and even bearing. The finished surface shall not vary from a straightedge laid on the surface in any direction within the limits of the masonry plate by more than 0.0625 inches (1.5 mm). Surfaces which fail to conform shall be ground or filled until acceptable to the Engineer.

9. Curing Concrete: All newly placed concrete shall be cured so as to prevent loss of water by use of the methods specified. The Engineer may request that the Contractor furnish a curing plan.

The duration of the initial and final curing period in total shall continue uninterrupted for a minimum of seven (7) days.

(a) Curing Methods:

1. Forms-In-Place Method: Formed surfaces of concrete may be cured by retaining the forms in place without loosening. During periods of hot weather, water shall be applied to the forms until the Engineer determines that it is no longer required.
2. Water Method: Exposed concrete surfaces shall be kept continuously wet by ponding, spraying, or covering with materials that are kept continuously and thoroughly wet. Such materials may consist of cotton mats, multiple layers of burlap, or other approved materials that do not discolor or otherwise damage the concrete.
3. Waterproof Cover Method: This method shall consist of covering exposed surfaces with a waterproof sheet material to prevent moisture loss from the concrete. The concrete shall be wet at the time the cover is installed. The sheets shall be of the widest practicable width and adjacent sheets shall overlap a minimum of 6.0 inches (150 mm) to form a waterproof cover of the entire concrete surface and shall be adequately secured. Broken or damaged sheets shall be immediately repaired and the concrete shall be remoistened.

(b) Additional Requirements for Bridge Decks:

1. Curing Plan: The Contractor shall submit to the Engineer, at least fourteen (14) days prior to the placement of concrete for the bridge deck, a detailed curing plan that describes the following:
 - A. the initial and final curing durations,
 - B. equipment and materials to be used for curing concrete and monitoring concrete temperature, and
 - C. proposed primary and secondary water and heat sources

2. Initial Curing Period: A water fog spray shall be used by the Contractor from the time of initial placement until the final curing period begins. The amount of fog spray shall be strictly controlled so that accumulations of standing or flowing water on the surface of the concrete shall not occur.

Should atmospheric conditions render the use of fog spray impractical, the Contractor shall request approval from the Engineer to use a curing compound that meets the requirements of Section M.03 in lieu of a fog spray. The application shall be in accordance with the manufacturer's recommendation and be compatible with the membrane waterproofing.

3. Final Curing: After completion of finishing and as soon as any bleed water has dissipated and the concrete reaches sufficient strength to avoid marring, the Final curing period shall begin and the entire concrete surface shall be covered with water-retaining materials such as cotton mats, multiple layers of burlap, or other materials approved by the Engineer. Materials used shall be kept saturated by means of an acceptable sprinkler or wetting system.

The Contractor may cover the wet water-retaining material with a suitable polyethylene film to minimize evaporation during the curing period. The use of the polyethylene film does not relieve the Contractor from maintaining saturation of the curing materials.

4. Temperature Monitoring: The internal temperature of the concrete shall be monitored with a calibrated continuous recording thermometer for a minimum of seven (7) days. The air temperature at the concrete surface or the air temperature between the concrete surface and its protective covering shall be monitored with a minimum of one (1) recording thermometer.

The number and placement of the thermometers will be determined by the Engineer. A minimum of two (2) thermometers per concrete placement shall be provided by the Contractor.

The following types of thermometers shall be used to monitor curing temperatures:

- A. Continuously Recording Thermometer: The thermometer shall be capable of continuously recording temperatures within a range of -4 °F to 122 °F (-20°C to 50°C) for a minimum of twenty-four (24) hours.
- B. Maximum–Minimum Recording Thermometer: For all placements, the thermometer shall be capable of recording maximum and minimum temperatures in a range of -4 °F to 122 °F (-20°C to 50°C).

10. Finishing Concrete Surfaces: Any minor repairs due to fins, bulges, offsets and irregular projections shall be performed immediately following the removal of forms. For areas of newly placed concrete that are honeycombed or segregated the Contractor shall provide a written corrective procedure for review by the Engineer prior to the work being performed. Construction and expansion joints in the completed work shall be left

carefully tooled and free of mortar and concrete. The joint filler shall be left exposed for its full length with clean and true edges.

The cavities produced by form ties and all other holes, broken corners or edges, and other defects shall be cleaned, saturated with water, pointed and trued with a mortar conforming to M.11.04. Cement similar in color to the exposed surface being repaired shall be added to the mortar. Mortar used in pointing shall be used within one (1) hour of mixing. The concrete shall be finished as defined below if required and the cure continued as previously specified in "Curing Concrete."

Finishing work shall not interrupt the curing period unless permitted by the Engineer. The curing period may be extended to provide the minimum total number of days required.

Concrete surface finishes shall be classified as follows:

- (a) Float Finish:** This finish shall be achieved by placing an excess of material in the form and removing or striking off of such excess forcing the coarse aggregate below the mortar surface. Concave surfaces in which water will be retained will not be allowed. After the concrete has been struck off, the surface shall be thoroughly worked and floated. Before this last finish has set, the surface shall be lightly stripped with a fine brush to remove the surface cement film, leaving a fine-grained, smooth, but sanded texture. Curing, as specified elsewhere, shall follow. Any surfaces that will support appurtenances such as light standards, railing, or fences shall be finished in accordance with 6.01.03-8, "Bearing Surfaces."
- (b) Rubbed Finish:** The initial rubbing shall only be allowed within three (3) days after placement. The entire surface shall be thoroughly wet with a brush and rubbed with a No. 16 Carborundum Stone or an abrasive of equal quality, bringing the surface to a paste. The rubbing shall be continued sufficiently to remove all form marks and projections, producing a smooth, dense surface without pits or irregularities. The paste formed by the rubbing may be finished by stripping with a clean brush, or it may be spread uniformly over the surface and allowed to re-set. If all or portions of the rubbed surface are unacceptable to the Engineer or a rubbed finish is not provided within three (3) days after removal of forms, the Contractor will be directed to provide a grout clean down finish.
- (c) Grout Clean-Down Finish:** As soon as all cavities have been filled as required elsewhere and the cement mortar has set sufficiently, grout clean-down shall be performed. All burrs, unevenness, laitance, including that in air holes, and any other material which will adversely affect the bond of the grout to the concrete, shall be removed by acceptable methods. This cleaning shall be done from the top or uppermost part of the surface to be finished to the bottom.

A mixture of a fine aggregate and Portland cement shall be thoroughly blended while dry. The proportions shall be such that when mixed with the proper amount of water, the color will match that of the concrete to be finished. Water shall be added to this mixture in an amount which will bring the grout to a workable thick paint-like consistency.

The surface to be treated shall be thoroughly wetted with a sufficient amount of water to prevent the absorption of water from the grout. Grout shall then be applied to the wetted surface before setting of the grout occurs. Grout which has set shall not be re-tempered and shall be disposed of by the Contractor at no cost to the State.

The grout shall be uniformly applied over the entire surface, completely filling all air bubbles and holes. Immediately after applying the grout, the surface shall be floated with a suitable float, scouring the surface vigorously. While the grout is still plastic, all excess grout shall be removed.

After the final rubbing is completed and the surface has dried, it shall be rubbed to remove loose powder and shall be left free from all unsound patches, paste, powder, and objectionable marks. Wetting, application and removal of excess grout shall be completed in one (1) work shift.

All finished surfaces shall be cured for a minimum of twenty-four (24) hours. Horizontal surfaces shall have a float finish and vertical exposed surfaces shall have a rubbed finish. A grout clean down finish may be substituted for a rubbed finish as noted in this section or as directed by the Engineer

11. Mortar, Grout, Epoxy and Joint Seal

- (a) **Mortar and Grout:** This work consists of the making and placing of mortar and grout. At least forty-eight (48) hours prior to the planned use, a copy of the installation instructions and MSDS sheet(s) shall be provided to the Engineer for review and concurrence of their applicability and for verification of proper hole sizes in concrete structures. Such uses include mortar for filling under masonry plates, mortar used to fill voids and repair surface defects, grout used to fill sleeves for anchor bolts, and mortar and grout for other such uses where required or approved.

Concrete areas to be in contact with the mortar or grout shall be cleaned of all loose or foreign material that would in any way prevent bond, and the concrete surfaces shall be flushed with water and allowed to dry until no free-standing water is present.

The mortar or grout shall completely fill and shall be tightly packed into recesses and holes, on surfaces, under structural members, and at other locations specified. After placing, all surfaces of mortar or grout shall be cured as previously specified in 6.01.03-9(a)-2 "Curing Concrete – Water Method," for a period of not less than three (3) days.

- (b) **Epoxy:** The epoxy shall be prepared and placed in accordance with the manufacturer's directions and with the equipment prescribed by the manufacturer. Instructions furnished by the supplier for the safe storage, mixing, handling and

application of the epoxy shall be followed. Contents of damaged or previously opened containers shall not be used.

- (c) **Joint Seal:** This work consists of sealing joints where shown on the plans or as otherwise directed by the Engineer.

Before placement of the sealing material, the joints shall be thoroughly cleaned of all scale, loose concrete, dirt, dust or other foreign matter. Projections of concrete into the joint space shall be removed. The joint shall be clean and dry before the sealing compound is applied.

The joint sealant shall be prepared and placed in accordance with the manufacturer's directions and with the equipment prescribed by the manufacturer. The sealing compound shall be flush with, or not more than 1/8 inch (3 mm) above the adjacent surface of concrete, cutting off all excess compounds after the application. The joints shall be sealed in a neat and workmanlike manner and when the work is completed, the joints shall effectively seal against infiltration of moisture and water.

The Contractor shall arrange for, and have present at the commencement of the joint-sealing operation, a technically competent manufacturer's representative knowledgeable in the methods of installation of the sealant. The Contractor shall also arrange to have the representative present at such other times as the Engineer may request.

- (d) Closed Cell Elastomer:** The closed cell elastomer shall be of the thickness, size and type specified and installed as shown on the plans and shall be in accordance with Section M.03.

12. Application of Loads: Loads shall not be applied to concrete structures until the concrete has attained sufficient strength and, when applicable, sufficient pre-stressing and post tensioning has been completed, so that damage will not occur. The means to determine when the concrete has attained sufficient strength shall be the use of Progression cylinders as defined elsewhere in this specification, or other means approved in advance by the Engineer.

- (a) Earth Loads:** The placement of backfill shall not begin until the concrete is cured and has reached at least eighty percent (80%) of its specified strength unless otherwise permitted by the Engineer. The sequence of placing backfill around structures shall minimize overturning or sliding forces and flexural stresses in the concrete.
- (b) Construction Loads:** Light materials and equipment may be hand carried onto bridge decks only after the concrete has been in place at least twenty-four (24) hours providing curing is not interfered with and the surface texture is not damaged.

Prior to the concrete achieving its specified compressive strength, any other live or dead loads imposed on existing, new, or partially completed portions of structures, shall not exceed the reduced load carrying capacity of the structure, or portion of structure. The Contractor may be required to submit calculations to the Engineer

that verify these requirements are being met. The compressive strength of concrete ($f'c$) to be used in computing the load-carrying capacity shall be the smaller of the actual field compressive strength at the time of loading or the specified design strength of the concrete. The means to determine the actual field compressive strength shall be approved by the Engineer.

For post-tensioned structures, no live or dead loads shall be allowed on any span until the steel for that span has been tensioned.

- (c) **Loading of Completed Elements:** Precast concrete or steel girders shall not be placed on substructure elements until the substructure concrete has attained eighty-five percent (85%) of its specified strength.

No load shall be allowed on mortar or grout that has been in place less than seventy-two (72) hours.

- (d) **Traffic Loads:** The concrete deck will not be opened to traffic until at least fourteen (14) days after the last placement of deck concrete and until such concrete has attained its specified strength.

13. Dispute Resolution: The basis of any dispute resolution is side-by-side and quality control testing by the Contractor or the Contractor's representative. The Contractor and Engineer should perform independent testing on the material to reasonably establish the true characteristics of the material at the time of delivery. Absent of Contractor QC testing, the Engineer's test results will apply to the quantity of concrete represented by the sample, not to exceed 75 cubic yards (60 cubic meters).

- (a) **Air Content:** Contractor QC Testing must be performed by personnel qualified by The American Concrete Institute as an ACI Concrete Field Testing Technician Grade 1 or higher and performed in accordance with AASHTO T-23. If the Contractor's test results vary from those of the Engineer, the Contractor shall immediately notify the Engineer of the difference and work cooperatively to determine the reasonable cause and recognize the valid test. Should there be agreement, the result of the valid test will be used for acceptance and adjustment purposes for that lot of material. Should there not be an agreement as to the valid test, an additional set of tests should be performed. Results of all valid tests on the same lot may be averaged and used for acceptance and adjustment purposes. Should the Contractor wish to perform additional QC testing on subsequent material, the lot sizes may be adjusted to the amount of material included in that specific delivery. Any such QC testing must be witnessed and agreed to by the Engineer.

- (b) **Compressive Strength:** Contractor QC testing for compressive strength must be performed in accordance with AASHTO T-22 by personnel approved by the Engineer. Samples used to dispute the Engineer's test results must be made simultaneously and from the same batch of concrete. Should the Contractor wish to pursue a dispute resolution with regard to compressive strength, the Contractor shall submit in writing to the Engineer all test results, control charts, or other documentation that may be useful in determining if the specific lot(s) of material met the Contract specifications. The Engineer will consider the submittal and may average specific test results on the disputed lot(s) for acceptance and adjustment purposes. Destructive testing of any kind on the placed concrete structure will not be allowed.

6.01.04—Method of Measurement: This work will be measured for payment as follows:

1. Concrete: The quantity of concrete will be the actual volume in cubic yards (cubic meters) of the specified class or classes, with the exception of underwater concrete, completed and accepted within the neat lines as shown on the plans or as ordered by the Engineer.

When concrete is placed against bedrock, a maximum of 6 additional inches (150 additional millimeters) beyond the neat lines can be measured for payment.

No deduction will be made for panels, form liners, reinforcing bars, structural steel shapes or for pile heads. There will be no deduction made for the volume occupied by culvert and drainage pipes, scuppers, weep holes, public utility structures or any other opening, unless the surface area of any such single opening is 9 square feet (1 square meter) or more.

In the case of culverts or drainage pipes, the computation of the surface area will be based on the nominal diameter of the pipe, disregarding the thickness of the shell.

Miscellaneous materials necessary for completion of the work such as felt, mortar, grout, epoxy, joint seal, paraffin coating and closed cell elastomer will not be measured for payment.

Incidental work such as forming for anchor bolts, utilities, keyways, and sampling and testing will not be measured for payment.

2. Underwater Concrete: When underwater concrete is used, it will be measured by the volume in cubic yards (cubic meters) within the actual horizontal limits of the cofferdam and between the elevations established by the Engineer.

3. Joint Filler: This material will be measured by the area in square feet (square meters) of the joint filler, of the type and thickness specified, actually installed and accepted.

6.01.05—Basis of Payment: Payment for this work will be made as follows:

1. Concrete: Progress payments may be allowed for completed major labor elements of work such as forming, placing and curing. Prior to placement, the Contractor shall submit a proposed schedule of values for review and approval by the Engineer.

Payment for any lot of concrete allowed to remain in place will be adjusted when the field and laboratory testing of the material is completed. The quantity of concrete in each lot will be a maximum of 75 cubic yards (60 cubic meters). Payment for each lot of concrete will be adjusted based on the results of the Acceptance testing performed by the Engineer.

The following pay factors apply for Standard and Modified Standard Mix classes with regard to entrained air content:

Air Pay Factors

Measured air (%)		Pay factor (%)
4.5 to 7.5		1.00 (100)
4.3 and 4.4	7.6 and 7.7	0.98 (98)
4.1 and 4.2	7.8 and 7.9	0.96 (96)
3.9 and 4.0	8.0 and 8.1	0.94 (94)
3.7 and 3.8	8.2 and 8.3	0.92 (92)
3.5 and 3.6	8.4 and 8.5	0.90 (90)
Concrete lots with less than 3.5% or greater than 8.5% entrained air will be rejected.		

The following pay factors apply for Standard and Modified Standard Mix classes with regard to compressive strength:

Strength Pay Factors

Compressive Strength (%)	Pay factor (%)
95 or greater	1.00 (100)
90 to 94.9	0.95 (95)
85 to 89.9	0.90 (90)
Concrete lots with less than 85% specified strength will be rejected.	

The payment adjustment value for entrained air and 28-day strength for any lot of concrete that is allowed to remain in-place is determined using the formulas below. An index price of \$400.00 per c.y. (cu.m) shall be used to calculate each adjustment. The total adjustment value will be the sum of each individual adjustment value and will be deducted from the payment for the appropriate item.

English Units:	Metric Units:
Adjustment (air) = (1 - air pay factor) x \$400/c.y. x lot size (c.y.)	Adjustment (air) = (1 - air pay factor) x \$400/cu.m x lot size (cu.m)
Adjustment (strength) = (1 - strength pay factor) x \$400/c.y. x lot size (c.y.)	Adjustment (strength) = (1 - strength pay factor) x \$400/cu.m x lot size (cu.m)
Total Adjustment = Adjustment (air) + Adjustment (strength)	

The Contractor shall request permission from the Engineer to remove and replace a lot(s) of concrete to avoid a negatively adjusted payment. Any replacement material will be sampled, tested and evaluated in accordance with this specification.

No direct payment will be made for any labor, equipment or materials used during the sampling and testing of the concrete for Progression or Acceptance. The cost shall be considered as included in the general cost of the work or as stated elsewhere in the Contract. The work of transporting the concrete test specimens, after initial curing, for Acceptance testing will be performed by the Department without expense to the Contractor.

This material will be paid for at the Contract unit price per cubic yard (cubic meter) less any adjustments, for the specified class or classes, complete in place, which price shall include all materials, equipment, tools, labor and work incidental thereto, including heating, all admixtures, joint sealer, roofing felt and closed cell elastomer, and any miscellaneous materials such as metal flashing and metal used in expansion joints and bearings.

2. Underwater Concrete: When this class of concrete is used, it will be paid for at the Contract unit price per cubic yard (cubic meter) for "Underwater Concrete," complete in place, which price shall include all materials, equipment, tools, labor and work incidental thereto.

3. Joint Filler: Expansion joint filler will be paid for at the Contract unit price per square foot (square meter) for "Joint Filler for Bridges" of the type and thickness specified, complete in place, which price shall include all materials, equipment, tools, labor and work incidental thereto.

<u>Pay Item</u>	<u>Pay Unit</u>
Concrete (Class A, C, F)	c.y. (cu.m)
Underwater Concrete	c.y. (cu.m)
Joint Filler for Bridges (Thickness and Type)	s.f. (s.m.)

**CONNECTICUT
SUPPLEMENTAL SPECIFICATION
SECTION 6.03
STRUCTURAL STEEL**

Delete the entire section and replace it with the following:

**SECTION 6.03
STRUCTURAL STEEL**

Description: Work under this item shall consist of furnishing, fabricating, transporting, storing, handling and erecting of structural steel of the type and size designated, as shown on the plans, as directed by the Engineer and in accordance with these specifications.

All work except as stated in the following paragraph shall conform to the requirements of the AASHTO LRFD Bridge Construction Specifications and the ANSI/AASHTO/AWS D1.5 – Bridge Welding Code.

All work subject to railroad loading shall conform to AREMA and the ANSI/AASHTO/AWS D1.5 – Bridge Welding Code.

Materials: The materials for this work shall conform to the requirements of Section M.06.

Materials for this work shall be stored off the ground before, during, and after fabrication. It shall be kept free from dirt, grease and other contaminants and shall be reasonably protected from corrosion. In addition, weathering steel shall be stored as to allow free drainage and promote the development of the oxide coating and a uniform appearance.

Construction Methods:

1. Pre-qualification:

(a) Fabricators producing material for Department projects under this item are required to have as a minimum, an active AISC Certification for Simple Steel Bridges. For fabrication of material for use on bridges other than un-spliced rolled beam bridges, AISC Major Steel Bridge Certification is required. If so noted on the plans, additional AISC endorsement for fabrication of fracture critical members is also required.

(b) Field Welders: Prior to working on material for Department projects under this specification, all field welders, field welding operators, and field tackers must possess a valid welder certification card issued by the Department's Division of Materials Testing. If such person has not been engaged in welding operations on a Department project or

project acceptable to the Department within a period of six months, or if he cannot produce an approved welding certificate dated within the previous twelve months from a welding agency acceptable to the Engineer, he shall be required to re-qualify through examination. The Engineer may require re-qualification of anyone whose quality of work he questions.

2. Submittals:

(a) Shop Drawings: Prior to any fabrication, the Contractor shall submit shop drawings in accordance with Article 1.05.02-3 to the Engineer for review and approval. Shop drawings shall include a cambering procedure and diagram. In the case of trusses, the Contractor is responsible for calculation of the camber (lengthening and shortening) of all truss members.

(b) Shop Schedule: The Contractor shall submit a detailed shop fabrication schedule to the Engineer for review within 30 days of the notice to proceed unless otherwise agreed to by the Engineer. At a minimum the schedule shall include the start date, milestone dates, and completion date. Any significant changes shall be brought to the attention of the Engineer immediately.

(c) Welding Procedures: Prior to start of fabrication, all weld procedures shall be submitted to the Engineer for review and approval.

(d) Working Drawings for Falsework and Erection of Structural Steel: Prior to erecting any steel fabricated under this specification, the Contractor shall submit drawings and supporting calculations, including erection stresses, in accordance with Article 1.05.02-2 to the Engineer. The design of temporary supports and falsework shall conform to the *AASHTO Specifications*, the *AASHTO Guide Design Specifications for Bridge Temporary Works* or any other standard acceptable to the Engineer. Falsework shall be of sufficient rigidity and strength to safely support all loads imposed and to produce in the finished structure the lines and grades indicated in the contract documents. The submittal shall include at a minimum:

- Title block with contract number, project identification number (PIN), town, and structure number and name.
- Plan of the work area showing support structures, roads, railroad tracks, Federal and State regulated areas as depicted on the plans, utilities or any other information relative to erection.
- A detailed narrative describing the erection sequence for main members and secondary members (cross frames, diaphragms, lateral bracing, portals, etc.), noting use of holding cranes or temporary supports, falsework, or bents.
- Delivery location of each girder.
- Location of each crane for each pick.
- Capacity chart for each crane and boom length used in the work.
- The capacity of the crane and of all lifting and connecting devices shall be adequate for the total pick load including spreaders and other materials. In the area of railroads and navigable waterways, the capacity shall be as required by Amtrak, Metro North, U.S. Coast Guard or other regulatory authorities. No picks shall be

allowed over vehicular or pedestrian traffic unless otherwise noted on the plans or permitted by the Engineer.

- Pick point location(s) on each member.
- Lifting weight of each member (including clamps, spreader beams, etc.)
- Lift and setting radius for each pick (or maximum lift radius).
- Description of lifting devices or other connecting equipment.
- Girder tie-down details or other method of stabilizing erected girders.
- Bolting requirements, including the minimum number of bolts and erection pins required to stabilize members during the erection sequence.
- Blocking details for stabilizing members supported on expansion bearings and on bearings that do not limit movement in the transverse direction.
- The method and location for temporary supports for field spliced or curved girders, including shoring, false work, holding cranes, guys, etc. The Engineer will review, but not approve details of temporary supports. The design, erection, and stability of these supports shall be the sole responsibility of the Contractor.
- Offsets necessary to adjust expansion bearings during erection to provide for temperature variance and dead load rotation.

The following notes shall be placed on the Erection Drawings:

- Cranes shall be operated in accordance with the Connecticut Department of Public Safety regulations.
- The Contractor shall be responsible for verifying the weight of each lift and for insuring the stability of each member during all phases of erection.
- Members shall be subject to only light drifting to align holes. Any drifting that results in distortion of the member or damage to the holes will be cause for rejection of the member.
- Field reaming of holes shall not be performed unless required by the Contract Drawing or approved by the Engineer.

The Contractor shall submit these documents to the Engineer at least 60 calendar days in advance of their proposed use. If the proposed method of erection requires additional members or modifications to the existing members of the structure, such additions and modifications shall be made by the Contractor at no expense to the State.

3. Shop Fabrication: Unless otherwise shown on the plans or indicated in the Special Provisions, Structural Steel shall be fabricated in accordance with the AASHTO LRFD Bridge Construction Specifications, amended as follows:

(a) Notification: The Contractor shall submit written notification to both the Engineer and the Director of Research and Materials Testing not less than 30 calendar days prior to start of fabrication. No material shall be manufactured or worked in the shop before the Engineer has been so notified. The notification shall include the name and location of the fabrication shop where the work will be done so that arrangements can be made for an audit of the facility and the assignment of a Department Quality Assurance inspector.

(b) Camber: All members shall be cambered prior to heat curving and painting. Rolled beams shall be heat cambered by methods approved by the Engineer. Plate girders shall be cambered by cutting the web to the prescribed shape with allowances for shrinkage due to cutting, welding, and heat curving. The fabricator is responsible to determine what allowances should be made. Rolled, plate-rolled, or fabricated sections shall be cambered to the total amount shown on the plans and within the camber deviation tolerances permitted for welded beams and girders, as indicated in the ANSI/AASHTO/AWS D1.5 Bridge Welding Code. The Contractor must submit to the Engineer for approval, a plan for corrective action if the actual camber is not within tolerance.

(c) Welding: Unless otherwise indicated on the plans or specifications, all work shall be performed in accordance with ANSI/AASHTO/AWS D1.5 – Bridge Welding Code.

(d) Preassembly of Field Connections: Field connections of main members of continuous beams, plate girders, bents, towers, rigid frames, trusses and arches shall be preassembled prior to erection as necessary to verify the geometry of the completed structure or unit and to verify or prepare field splices. The Contractor shall propose an appropriate method of preassembly for review and comment by the Engineer. The method and details of preassembly shall be consistent with the erection procedures shown on the working drawings and camber diagrams. As a minimum, the preassembly procedure shall consist of assembling three contiguous panels accurately adjusted for line and camber. Successive assemblies shall consist of at least one section or panel of the previous assembly plus two or more sections or panels added at the advancing end. In the case of structures longer than 150 feet (45 meters), each assembly shall not be less than 150 feet (45 meters) long regardless of the length of individual continuous panels or section. All falsework, tools, machinery and appliances, including drift pins and bolts necessary for the expeditious handling of the work shall be provided by the Contractor at no cost to the State.

(e) Inspection: The Contractor shall furnish facilities for the inspection of material and workmanship in the shop by the Engineer. The Engineer and his representative shall be allowed free access to the necessary parts of the premises.

The Engineer will provide Quality Assurance (QA) inspection at the fabrication shop to assure that all applicable Quality Control plans and inspections are adequately adhered to and maintained by the Contractor during all phases of the fabrication. A thorough inspection of a random selection of elements at the fabrication shop may serve as the basis of this assurance.

Prior to shipment to the project, each individual piece of structural steel shall be stamped or marked in a clear and permanent fashion by a representative of the fabricators' Quality Control (QC) Department to indicate complete final inspection by the fabricator and conformance to the project specifications for that piece. The stamp or mark must be dated. A Materials Certificate in accordance with Article 1.06.07 may be used in lieu of individual stamps or markings, for all material in a single shipment. The Materials Certificate must list each piece within the shipment and accompany the shipment to the project site.

Following the final inspection by the fabricator's QC personnel, the Engineer may select pieces of structural steel for re-inspection by the Department's QA inspector. Should non-conforming pieces be identified, all similar pieces must be re-inspected by the fabricator and repair procedure(s) submitted to the Engineer for approval. Repairs will be made at the Contractor's expense.

The pieces selected for re-inspection and found to be in conformance, or adequately repaired pieces, may be stamped or marked by the QA inspector. Such markings indicate the Engineer takes no exception to the pieces being sent to the project site. Such marking does not indicate acceptance or approval of the material by the Engineer.

Following delivery to the project site, the Engineer will perform a visual inspection of all material to verify shipping documents, fabricator markings, and that there was no damage to the material or coatings during transportation and handling.

The Engineer is not responsible for approving or accepting any fabricated materials prior to final erection and assembly at the project site.

(f) Nondestructive Testing: All nondestructive testing of structural steel and welding shall be performed as designated on the plans and in the project specifications. Such testing shall be performed by personnel approved by the Engineer.

Personnel performing Radiographic, Ultrasonic or Magnetic Particle testing shall be certified as a NDT Level II technician in accordance with the American Society for Non Destructive Testing (ASNT), Recommended Practice SNT-TC-1A.

Nondestructive testing shall be performed in accordance with the procedures and standards set forth in the AASHTO/AWS D1.5, Bridge Welding Code. The Department reserves the right to perform additional testing as determined by the Engineer.

All nondestructive testing shall be witnessed by an authorized representative of the Department. Certified reports of all tests shall be submitted to the Materials Testing Division for examination. Each certified report shall identify the structure, member, and location of weld or welds tested. Each report shall also list the length and location of any defective welds and include information on the corrective action taken and results of all retests of repaired welds.

Should the Engineer require nondestructive testing on welds not designated in the contract, the cost of such inspection shall be borne by the Contractor if the testing indicates that any weld is defective. If the testing indicates the weld to be satisfactory, the actual cost of such inspection will be paid by the Department.

(g) Marking: Each member shall be identified with an erection mark corresponding with the member identification mark on the approved shop drawings. Identification marks shall be impressed into the member with a low stress stamp in a location in accordance with standard industry practice.

(h) Shipping, Handling, Storage and Receiving: The Contractor shall make all arrangements necessary to properly load, transport, unload, handle and store all material. The Contractor shall furnish to the Engineer copies of all shipping statements. The weight (mass) of the individual members shall be shown on the statements. Members having a weight (mass) of more than 3 tons (2700 kilograms) shall have the weight (mass) marked thereon. All material shall be unloaded promptly upon delivery. The Contractor shall be responsible for any demurrage charges. Damage to any material during transportation, improper storage, faulty erection, or undocumented fabrication errors may be cause for rejection of said material at the project site. Top lateral bracing should be installed in tub girders prior to shipping and erection of the field pieces. All costs associated with any corrective action will be borne by the Contractor.

4. Field Erection: A meeting shall be held on site prior to any erection of structural steel. The Contractor shall name the person responsible for the steel erection work and provide copies of all crane operator licenses. Proposed equipment, rigging, timetable and methods shall be proposed at this meeting.

(a) Falsework: Any temporary work shall be constructed in conformance with the working drawings. The Contractor shall verify that the quality of materials and work employed are consistent with their design.

All girders shall be stabilized with falsework, temporary braces, or holding cranes until a sufficient number of adjacent girders are erected with all diaphragms and cross frames connected to provide necessary lateral support as shown in the erecting diagrams.

Adjustment shall be provided in the falsework and other temporary supports so that the temporary elevation of the structural steel provided by the falsework is consistent with the deflections that will occur as the structure is completed. The elevation of falsework shall be such as to support the girders at the cambered no-load elevation. Unloading of temporary supports should be performed such that all temporary supports at each cross section are unloaded uniformly. Unless specifically permitted by the Engineer, welding of falsework support brackets to structural steel is not allowed.

Unless erected by the cantilever method, truss spans shall be erected on blocking. The blocking shall be left in place until the tension chord splices are fully bolted and all other truss connections pinned and bolted and the proper geometric shape is achieved.

(b) Anchorages: Anchor bolts and similar materials which are to be placed during the erection of the structural steel shall be carefully and accurately set to the requirements of Article 6.01.03.

(c) Bearings: Bearing plates shall have a full and uniform bearing upon the substructure masonry. Bearing plates shall be placed upon bearing areas which are finished according to the requirements of Article 6.01.03.

Prefabricated pads conforming to the requirements of Article M.12.01 shall be installed unless specifically noted otherwise on the contract plans.

Each piece shall be the same size as the bearing plate it is to support and the holes to accommodate the anchor bolts shall be clearly and accurately punched before setting the pad in place.

In placing expansion bearings, due consideration shall be given to the temperature at the time of erection and stage construction requirements. The nuts of anchor bolts at expansion bearings shall be adjusted to permit the free movement of the span.

(d) Field Assembly: Members and components shall be accurately assembled as shown on the plans and any match marks shall be followed. The material shall be carefully handled so that no components will be bent, broken or otherwise damaged.

Hammering which will injure or distort the members is not permitted. Bearing surfaces and surfaces to be in permanent contact shall be cleaned before the members are assembled.

Cylindrical erection pins shall be 1/32 inch (0.8 mm) larger than the nominal diameter of the holes.

Splices and field connections of main stress carrying members shall be made with a minimum of 50% of the holes filled and tightened with high strength bolts before the lifting system is released. The bolts shall be installed uniformly throughout the connection. Lateral stability must be maintained until the deck is placed.

The Contractor shall ensure that girders are stable throughout the erection process. The stage of completeness of the bolted connections shall be considered when evaluating the strength and stability of the steel during erection. For Closed Box and Tub Girders the Contractor shall ensure that the cross- section shape of each box is maintained during erection. Top lateral bracing should be installed in tub girders prior to shipping and erection of the field pieces.

(e) Welded Connections:

Unless otherwise shown on the plans or indicated by the special provisions, welding of structural steel shall be done in accordance with "ANSI/AASHTO/AWS D1.5 Bridge Welding Code."

The Contractor's welding and inspection procedures for each type of field weld and field tacking must be submitted to the Engineer on the form designated by the Department. All procedures must be approved by the Materials Testing Division prior to any work and must be adhered to at all times.

Quality control is the responsibility of the Contractor. The Contractor must provide an AWS Certified Welding Inspector (CWI) in accordance with AWS D1.5. The CWI must be qualified and certified in accordance with the provisions of AWS QC1, *Standard for Qualification and Certification of Welding Inspectors*.

The CWI shall make visual inspection of all welds. The Contractor will perform magnetic particle inspection, ultrasonic testing inspection, or radiographic testing inspection of field welds when required on the plans or special provisions. Each test may be witnessed by an authorized representative of the Engineer.

Welds or sections of welds containing imperfections determined to be unacceptable by either the CWI or the Engineer shall be removed and re-welded by the Contractor at their expense. Welds so removed and replaced shall be re-inspected by the CWI. All costs for re-inspection or testing of such welds shall be borne by the Contractor.

(f) High Strength Bolted Connections:

The assembly of structural connections using ASTM A 325/ A 325M or ASTM A 490/A 490M high-strength bolts shall be installed so as to develop the minimum required bolt tension specified in Table A. The Manufacturer's certified test report; including the rotational capacity test results **must** accompany the fastener assemblies. Fastener Assemblies delivered without the certified reports will be rejected.

Bolts, nuts and washers from each rotational-capacity lot shall be shipped in the same container. If there is only one production lot number for each size of nut and washer, the nuts and washers may be shipped in separate containers. Each container shall be permanently marked with the rotational-capacity lot number such that identification will be possible at any stage prior to installation. Assemblies of bolts, nuts and washers shall be installed from the same rotational-capacity lot. Pins, small parts and packages of bolts, washers, and nuts shall be shipped in boxes, crates, kegs, or barrels. A list and description of the contained materials shall be plainly marked on the outside of each shipping container.

Bolted Parts: All material within the grip of the bolt shall be steel; there shall be no compressible material, such as gaskets or insulation, within the grip. Bolted steel shall fit solidly together after the bolts are tensioned. The length of the bolts shall be such that the end of the bolt will be flush with or outside of the face of the nut when properly installed.

Surface Conditions: At the time of assembly, all connection surfaces, including surfaces adjacent to the bolt head and nut, shall be free of scale, except tight mill scale, and shall be free of dirt or other foreign material. Burrs that would prevent solid seating of the connected parts in the snug tight condition shall be removed.

Paint is permitted on the faying surface, including slip critical connections, only when shown on the plans. The faying surfaces of slip-critical connections shall meet the requirements of the following paragraphs, as applicable:

- Connections specified to have un-coated faying surfaces: any paint, including any inadvertent over spray, shall be excluded from areas closer than one bolt diameter, but not less than 1.0 in. (25 mm), from the edge of any hole and all areas within the bolt pattern.
- Connections specified to have painted faying surfaces: shall be blast cleaned and coated in accordance with Section 6.04, and shall not be assembled until the coating system has been properly cured.

- Connections specified to have galvanized faying surfaces: shall be hot-dip galvanized in accordance with ASTM A 123/A 123M, and shall subsequently be roughened by means of hand wire brushing. Power wire brushing is not permitted.

Installation: At the pre-erection meeting, the Contractor shall inform the Engineer of their planned method of tensioning high strength bolts. Acceptable methods are: Turn-of-Nut, Calibrated Wrench or Direct Tension Indicator.

Fastener Assemblies:

A "fastener assembly" is defined as a bolt, a nut, and a washer. Only complete fastener assemblies of appropriately assigned lot numbers shall be installed.

Fastener assemblies shall be stored in an area protected from dirt and moisture. Only as many fastener assemblies as are anticipated to be installed and tensioned during a work shift shall be taken from protected storage. Fastener assemblies not used shall be returned to protected storage at the end of the shift. Prior to installation, fastener assemblies shall not be cleaned of lubricant. Fastener assemblies which accumulate rust or dirt resulting from site conditions shall be cleaned, relubricated and tested for rotational-capacity prior to installation. All galvanized nuts shall be lubricated with a lubricant containing a visible dye. Plain bolts must be oily to the touch when delivered and installed. Lubricant shall be removed prior to painting.

All bolts shall have a hardened washer under the turned element (nut or bolt head). All hardened washers shall conform to the requirements of ASTM F 436/F 436M.

Where necessary, washers may be clipped on one side to a point not closer than $7/8$ of the bolt diameter from the center of the washer. Circular and beveled washers, when used adjacent to direct tension indicator washers shall not be clipped. Direct tension indicator washers shall not be clipped.

Bolt Tension Measuring Device: The Contractor shall provide a calibrated bolt tension measuring device (a Skidmore-Wilhelm calibrator (Skidmore) or other acceptable bolt tension indicating device) at all times when, and at all locations where high-strength fasteners are being installed and tensioned. The tension measuring device (Skidmore) shall be calibrated by an approved testing agency at least annually. The Skidmore shall be used to perform the rotational-capacity test of the fastener assemblies. The Skidmore will also be used to substantiate (1) the suitability of the fastener assembly to satisfy the requirements of Table A, including lubrication as required, (2) calibration of the installation wrenches, if applicable, and (3) the understanding and proper use by the contractor of the selected method of tensioning to be used.

Complete fastener assemblies shall be installed in properly aligned holes and then tensioned by the Turn-of-Nut, Calibrated Wrench or Direct Tension Indicator method to the minimum tension specified in Table A. Tensioning may be done by turning the bolt while the nut is prevented from rotating when it is impractical to turn the nut. Impact wrenches, if

used, shall be of adequate capacity and sufficiently supplied with air to perform the required tensioning of each bolt in approximately 10 seconds.

Bolts shall be installed in all holes of the connection and the connection brought to a snug condition. Snug is defined as having all the plies of the connection in firm contact. Snugging shall progress systematically from the most rigid part of the connection to the free edges. The bolts of the connection shall then be tightened in a similar manner as necessary until the connection is properly tensioned.

Nuts shall be located, whenever practical, on the side of the connection which will not be visible from the traveled way.

Unless otherwise approved by the Engineer fastener assemblies shall be brought to full tension immediately following snugging.

Fully tensioned fastener assemblies shall not be reused. Retightening previously tensioned bolts which may have been loosened by the tensioning of adjacent bolts shall not be considered as reuse.

Rotational-Capacity Tests: In addition to the certified test reports, on site Rotational-capacity tests may be required by the Engineer. This test shall be performed by the Contractor at the location where the fasteners are installed and tensioned. When performed in the field, the procedure shall conform to the requirements of ASTM A 325/ A 325M Appendix A-1.

Turn-of-Nut Installation Method:

At the start of the work, the Contractor shall demonstrate that the procedure used by the bolting crew to develop a snug condition and to control the turns from a snug condition develops the tension required in Table A. To verify their procedure, the Contractor shall test a representative sample of not less than three complete fastener assemblies of each diameter, length and grade to be used in the work. This shall be performed at the start of work using a Skidmore. Periodic retesting shall be performed when ordered by the Engineer.

After snugging the connection, the applicable amount of rotation specified in Table B shall be achieved. During the tensioning operation there shall be no rotation of the part not turned by the wrench. Tensioning shall progress systematically from the most rigid part of the connection to its free edges.

Calibrated Wrench Installation Method:

Calibrated wrench method may be used only when the installation wrenches are properly calibrated daily, or as determined by the Engineer. Standard torques determined from tables or from formulas which are assumed to relate torque to tension **shall not** be acceptable.

The Contractor shall demonstrate to the Engineer periodically that all equipment and wrenches are providing a torque which has been calibrated to produce the minimum tension specified in Table A. The installation procedures shall be verified periodically, as determined by the Engineer, for each bolt diameter, length and grade using the fastener assemblies that are being installed in the work. This verification testing shall be accomplished in a Skidmore by tensioning three complete fastener assemblies of each diameter, length and grade from those being installed with a hardened washer under the element turned.

When significant difference is noted in the surface condition of the bolts, threads, nuts or washers, as determined by the Engineer, wrenches shall be recalibrated. The Contractor shall verify during the installation of the assembled steel work that the wrench adjustment selected by the calibration does not produce a nut or bolt head rotation from snug greater than that permitted in Table B. If manual torque wrenches are used, nuts shall be turned in the tensioning direction when torque is measured.

When calibrated wrenches are used to install and tension bolts in a connection, bolts shall be installed with hardened washers under the element turned to tension the bolts. Once the connection has been snugged, the bolts shall be tensioned using the calibrated wrench. Tensioning shall progress systematically from the most rigid part of the connection to its free edges. A calibrated torque wrench shall be used to "touch up" previously tensioned bolts which may have been relaxed as a result of the subsequent tensioning of adjacent bolts until all bolts are tensioned to the prescribed amount.

Direct Tension Indicator Installation Method:

When Direct Tension Indicators (DTIs) meeting the requirements of Section M.06 are used with high-strength bolts to indicate bolt tension, they shall be subjected to the verification testing described below and installed in accordance with the method specified below. Unless otherwise approved by the Engineer, the DTIs shall be installed under the head of the bolt and the nut turned to tension the bolt. The Manufacturer's recommendations shall be followed for the proper orientation of the DTI and additional washers, if any, required for the correct use of the DTI. Installation of a DTI under the turned element may be permitted if a washer is used to separate the turned element from the DTI.

Verification: Verification testing shall be performed in a Skidmore. A special flat insert shall be used in place of the normal bolt head holding insert. Three verification tests shall be required for each combination of fastener assembly rotational-capacity lot, DTI lot, and DTI position relative to the turned element (bolt head or nut) to be used on the project. The fastener assembly shall be installed in the tension-measuring device with the DTI located in the same position as in the work. The element intended to be stationary (bolt or nut) shall be restrained from rotation.

The verification tests shall be conducted in two stages. The bolt nut and DTI assembly shall be installed in a manner so that at least three and preferably not more than five threads are located between the bearing face of the nut and the bolt head. The bolt shall be tensioned first to the load equal to that listed in Table C

under Verification Tension for the grade and diameter of the bolt. If an impact wrench is used, the tension developed using the impact wrench shall be no more than two-thirds of the required tension. Subsequently, a manual wrench shall be used to attain the required tension. The number of refusals of the 0.005-in. (0.125-mm) tapered feeler gage in the spaces between the protrusions shall be recorded. The number of refusals for uncoated DTIs under the stationary or turned element, or coated DTIs under the stationary element, shall not exceed the number listed under Maximum Verification Refusals in Table C for the grade and diameter of bolt used. The maximum number of verification refusals for coated DTIs (galvanized, painted, or epoxy-coated), when used under the turned element, shall be no more than the number of spaces on the DTI less one. The DTI lot shall be rejected if the number of refusals exceeds the values in the table or, for coated DTIs if the gage is refused in all spaces.

After the number of refusals is recorded at the verification load, the bolt shall be further tensioned until the 0.005-in (0.125-mm) feeler gage is refused at all the spaces and a visible gap exists in at least one space. The load at this condition shall be recorded and the bolt removed from the tension-measuring device. The nut shall be able to be run down by hand for the complete thread length of the bolt excluding thread run-out. If the nut cannot be run down for this thread length, the DTI lot shall be rejected unless the load recorded is less than 95 percent of the average load measured in the rotational capacity test of the fastener lot as specified previously in "Rotational-Capacity Tests."

If the bolt is too short to be tested in the calibration device, the DTI lot shall be verified on a long bolt in a calibrator to determine the number of refusals at the verification tension listed in Table C. The number of refusals shall not exceed the values listed under maximum verification refusals in Table C. Another DTI from the same lot shall then be verified with the short bolt in a convenient hole in the work. The bolt shall be tensioned until the 0.005-in. (0.125-mm) feeler gage is refused in all spaces and a visible gap exists in at least one space. The bolt shall then be removed from the tension-measuring device and the nut shall be able to be run down by hand for the complete thread length of the bolt excluding thread run-out. The DTI lot shall be rejected if the nut cannot be run down this thread length.

Installation: Installation of fastener assemblies using DTIs shall be performed in two stages. The stationary element shall be held against rotation during each stage of the installation. The connection shall be first snugged with bolts installed in all holes of the connection and tensioned sufficiently to bring all the plies of the connection into firm contact. The number of spaces in which a 0.005-in. (0.125-mm) feeler gage is refused in the DTI after snugging shall not exceed those listed under maximum verification refusals in Table C. If the number exceeds the values in the table, the fastener assembly shall be removed and another DTI installed and snugged.

For uncoated DTIs used under a stationary or turned element and for coated DTIs used under a stationary element, the bolts shall be further tensioned until the number of refusals of the 0.005-in. (0.125-mm) feeler gage shall be equal or greater than the number listed under Minimum Installation Refusals in Table C. If the bolt is

tensioned so that no visible gap in any space remains, the bolt and DTI shall be removed and replaced by a new properly tensioned bolt and DTI.

When coated DTIs (galvanized, painted or epoxy coated) are used under a turned element, the 0.005-in (0.125-mm) feeler gage shall be refused in all spaces.

Inspection:

The Contractor shall provide all the material, equipment, tools and labor necessary for the inspection of the bolted connections. Access to the bolted parts and fastener assemblies, both before and after the fasteners are installed and tensioned, shall be provided.

The Contractor is responsible for Quality Control (QC). The Contractor shall review this specification with its project personnel prior to performing the work. The Contractor shall verify the proper markings, surface conditions and storage of fastener assemblies. The Contractor shall inspect the faying surfaces of connections for compliance with the plans and specifications. The Contractor shall provide to the Engineer a copy of their written QC report for each shift of the calibration or verification testing specified. This report shall confirm that the selected procedure is properly used and that the fastener assemblies installed meet the tensions specified in Table A. The Contractor shall monitor the installation of fasteners in the work to assure that the selected procedure, as demonstrated in the initial testing to provide the specified tension, is routinely and properly applied.

The Contractor, in the presence of the Engineer, shall inspect the tensioned bolts using an inspection torque wrench, as defined below. If direct tension indicator devices are used, the appropriate feeler gauge will be used. Inspection tests shall be performed within 24 hours of bolt tensioning to prevent possible loss of lubrication or corrosion influence on tensioning torque.

The inspection torque wrench shall be calibrated as follows. Three bolts of the same grade, size, and condition as those under inspection shall be placed individually in a device calibrated to measure bolt tension. This calibration operation shall be done at least once each inspection day. There shall be a washer under the part turned in torquing each bolt. In the calibrated device, each bolt shall be tightened by any convenient means to the specified tension. The inspection wrench shall then be applied to the tensioned bolt to determine the torque required to turn the nut or head five degrees in the tightening direction. The average of the torque required for all three bolts shall be defined as the job-inspection torque.

Twenty-five percent, but a minimum of two, of the tensioned bolts shall be selected by the Engineer for inspection in each connection. (The Engineer may reduce the number of bolts tested at a connection to 10% based on the Contractor's past performance and splice location.) The job-inspection torque shall then be applied to each selected assembly with the inspection torque wrench turned in the tightening direction. If all inspected bolt heads or nuts do not turn, the bolts in the connection shall be considered to be properly tensioned. If the torque turns one or more bolt heads or nuts, the job-inspection torque shall then be applied to **all** bolts in the connection or to the satisfaction of the Engineer. Any bolt whose head or nut turns shall be re-tensioned and re-inspected. The Contractor

may, however, re-tension all the bolts in the connection with the inspection torque wrench and resubmit it for inspection, so long as the bolts are not over-tensioned or damaged by this action.

(g) Field Corrections and Misfits: Reaming of bolt holes during erection shall be permitted only with approval of the Engineer. No excessive forces shall be applied to any member to provide for proper alignment of the bolt holes.

The correction of minor misfits involving minor amounts of reaming, cutting, grinding and chipping shall be considered a legitimate part of the erection. However, any error in the shop fabrication or deformation resulting from handling and transportation may be cause for rejection. The Contractor shall be responsible for all misfits, errors and damage and shall make the necessary corrections and replacements.

TABLE A (Metric)
Minimum Bolt Tension in Kilonewtons*

Bolt Size	ASTM A 325M	ASTM A 490M
M16	91	114
M20	142	179
M22	176	221
M24	205	257
M27	267	334
M30	326	408
M36	475	595

*Equal to 70% of specified minimum tensile strength of bolts (as specified in ASTM Specifications for tests of full-size A 325M and A 490M bolts with metric coarse threads series ANSI B1.13M, loaded in axial tension) rounded to the nearest kilonewton.

Table A (English)
Minimum Bolt Tension in kips*

Bolt Size (Inches)	ASTM A 325	ASTM A 490
5/8	19	24
3/4	28	35
7/8	39	49
1	51	64
1 1/8	56	80
1 1/4	71	102
1 3/8	85	121
1 1/2	103	148

*Equal to 70% of specified minimum tensile strength of bolts (as specified in ASTM Specifications for tests of full-size A 325 and A 490 bolts with UNC threads, loaded in axial tension) rounded to the nearest kip.

**TABLE B (English and Metric)
Nut Rotation from the Snug Condition
Geometry^{a,b,c} of Outer Faces of Bolted Parts**

Bolt Length (measured from underside of head to end of bolt)	Both Faces Normal to Bolt Axis	One Face Normal to Bolt Axis and Other Face Sloped Not More Than 1:20, Bevel Washer Not Used	Both Faces Sloped Not More Than 1:20 From Normal to Bolt Axis, Bevel Washer Not Used
Up to and including 4 diameters	1/3 turn	1/2 turn	2/3 turn
Over 4 diameters but not exceeding 8 diameters	1/2 turn	2/3 turn	5/6 turn
Over 8 diameters but not exceeding 12 diameters	2/3 turn	5/6 turn	1 turn

(a) Nut rotation, as used in Table B, shall be taken as relative to the bolt, regardless of the element (nut or bolt) being turned. For bolts installed by 1/2 turn and less, the tolerance should be plus or minus 30 degrees; for bolts installed by 2/3 turn and more, the tolerance should be plus or minus 45 degrees.

To determine the nut rotation for installation and inspection of the fasteners, the nut and the end of the bolt or the head of the bolt and the adjacent steel shall be match marked.

(b) The values, given in Table B, shall be applicable only to connections in which all material within grip of the bolt is steel.

(c) No research work has been performed by the Research Council Riveted and Bolted Structural Joints to establish the turn-of-nut procedure when bolt lengths exceed 12 diameters. For situations in which the bolt length, measured from the underside of the head to the end of the bolt, exceeds 12 diameters, the required rotation shall be determined by actual tests in a suitable tension device simulating the actual conditions.

TABLE C (Metric)

Bolt Dia. (in.)	Verification Tension		Maximum Verification Refusals		DTI Spaces		Minimum Installation Refusals	
	A325	A490	Type 8.8	Type 10.9	Type 8.8	Type 10.9	Type 8.8	Type 10.9
M16	96	120	1	1	4	4	2	2
M20	149	188	2	2	5	6	3	3
M22	185	232	2	2	5	6	3	3
M24	215	270	2	2	5	6	3	3
M27	280	351	2	3	6	7	3	4
M30	342	428	3	3	7	8	4	4
M36	499	625	3	4	8	9	4	5

TABLE C (English)

Bolt Dia. (in.)	Verification Tension		Maximum Verification Refusals		DTI Spaces		Minimum Installation Refusals	
	A325	A490	325	490	325	490	325	490
5/8	20	25	1	2	4	5	2	3
¾	29	37	2	2	5	6	3	3
7/8	41	51	2	2	5	6	3	3
1	54	67	2	3	6	7	3	4
1 1/8	59	84	2	3	6	7	3	4
1¼	75	107	3	3	7	8	4	4
1 3/8	89	127	3	3	7	8	4	4
1½	108	155	3	4	8	9	4	5

Method of Measurement: Payment under this item will be at the contract lump sum price per each complete bridge structure or shall be based on the net weight (mass) of metal in the fabricated structure, whichever method appears on the proposal form.

When payment is based on a lump sum basis, the work, including anchor bolts, steel bearings and plates will not be measured for payment. Bearing plates welded to the girder are included in the price of the structural steel and bearing plates bonded to the bearings are included in the price of the bearing.

When payment is based on the net weight (mass) of metal in the fabricated structure, it shall be computed as described below.

The weight (mass) of the metal works to be paid for under the item of structural steel shall be computed on the basis of the net finished dimensions of the parts as shown on the shop drawings, deducting for copes, cuts, clips and all open holes, except bolt holes, and on the following basis:

1. The weights (masses) of rolled shapes shall be computed on the basis of their nominal weights (masses) per foot (meter), as shown in the shop drawings or listed in handbooks.

The weight (mass) of plates shall be computed on the basis of the nominal weight (mass) for their width and thickness as shown on the shop drawings.

2. The weight (mass) of temporary erection bolts, shop and field paint, galvanization, boxes, crates and other containers used for shipping, and materials used for supporting members during transportation and erection, shall not be included.

3. The weight (mass) of all high strength bolts, nuts, and washers shall be included on the basis of the following weights (masses):

Weight per 100			
Nominal diameter of H.S. bolt (inch)	Bolthead, nut, 1 washer and stickthrough (lbs)	Nominal diameter of H.S. bolt (mm)	Bolthead, nut, 1 washer and stickthrough (kg)
1/2	22	16	17
5/8	33	20	26
3/4	55	22	39
7/8	84	24	50
1	120	27	60
1 1/8	169	30	73
1 1/4	216	36	122

4. The weight (mass) of weld metal shall be computed on the basis of the theoretical volume from plan dimensions of the welds.

Size of fillet in Inches (mm)		Weight of weld in pounds per foot (kg per meter)	
3/16	(5)	0.08	(0.119)
1/4	(6)	0.14	(0.208)
5/16	(8)	0.22	(0.327)
3/8	(9.5)	0.30	(0.446)
1/2	(13)	0.55	(0.818)
5/8	(16)	0.80	(1.190)
3/4	(19)	1.10	(1.636)
7/8	(22)	1.50	(2.231)
1	(25)	2.00	(2.974)

5. The weight (mass) of steel shims, filler plates and anchor bolts shall be measured for payment.

When the pay item "Materials for Structural Steel (Site No.)" is included in the Contract, payment for furnishing of the raw steel material for the plates and shape material only, excluding any markup, based on the net weight (mass) required, and the payment will be made under the estimated item "Materials for Structural Steel (Site No.)". The overruns or wastage shall not exceed ten per cent for straight girders and fifteen per cent for curved girders. All other work specified in this section for the bridge will be deemed paid for under the lump sum price. In the absence of the pay item "Materials for Structural Steel (Site No.)", the cost of the raw material is included in the Lump Sum payment for this item, "Structural Steel (Site No.)".

Basis of Payment: The structural steel, incorporated in the completed and accepted structure, will be paid for at the contract lump sum price for "Structural Steel (Site No.)," or at the contract unit price per hundred weight (kilogram) for "Structural Steel," whichever is indicated in the contract documents.

Payment for either method shall be for structural steel, complete in place, which price shall include quality control, furnishing, fabricating, transporting, storing, erecting, welding, surface preparation and all materials including fastener assemblies, steel bearing assemblies and anchor bolts, equipment, tools and labor incidental thereto.

When the pay item "Materials for Structural Steel (Site No.)" is included in the Contract, payment for furnishing of the raw steel material for the plates and shape material only,

excluding any markup, based on the net weight (mass) required, and the payment will be made under the estimated item "Materials for Structural Steel (Site No.)". All remaining work including, but not limited to, preparation of shop drawings, fabricating, transporting, storage and handling, erecting, surface preparation and all materials, equipment, tools and labor incidental thereto, will be paid for under "Structural Steel (Site No.)".

In the absence of the pay item "Materials for Structural Steel (Site No.)", the cost of the raw material is included in the Lump Sum payment for this item, "Structural Steel (Site No.)". All remaining work including, but not limited to, preparation of shop drawings, fabricating, transporting, storage and handling, erecting, surface preparation and all materials, equipment, tools and labor incidental thereto, will be paid for under "Structural Steel (Site No.)".

No direct payment will be made for setting anchor bolts, preparing bearing areas, furnishing and placing materials under bearings. No direct payment will be made for non destructive testing as shown on the plans.

<u>Pay Item</u>	<u>Pay Unit</u>
Structural Steel (Site No.)	l.s. (l.s.)
Structural Steel	cwt. (kg)

**CONNECTICUT
SUPPLEMENTAL SPECIFICATION
SECTION 6.12
CONCRETE CYLINDER CURING BOX**

Delete the entire section and replace with it the following:

6.12.01 –Description: This item shall consist of furnishing a box for curing concrete test cylinders. The box shall be commercially available and manufactured specifically for curing concrete test cylinders. The box will remain the property of the Contractor at the conclusion of the project. The box shall be delivered to a location on the project as directed by the Engineer.

6.12.02 – Materials: A catalog cut listing detailed specifications of the box and operating instructions from the manufacturer must be submitted to the Engineer. The box and its components shall be constructed of non-corroding materials and shall be capable of storing a minimum of 18 test cylinders, 6" X 12" (152 mm X 305 mm) stored vertically with the lid closed. The lid must be watertight when closed and hinged in the back with security latches on the front that can be padlocked. The box must be capable of holding water to a maximum level of one inch above test cylinders placed in the box vertically. A drain hole must be provided in a wall of the box to allow manual drainage of the water that exceeds this level. A drain hole must also be provided at the bottom of the box so that it can be manually emptied. The temperature of the water must be controlled by heating and cooling device capable of maintaining the temperature of the water within a range of 60 to 80° F, +/- 2 °F (15.5 to 26.7 °C, +/- 1 °C) within an outside ambient air temperature range of -10 to 120 ° F (-23.3 to 49 °C). The heating and cooling device must be positioned to allow free circulation of air and water around the cylinders and be rated at 120 volts and 15 amps. A rack must be provided within the box to support the cylinders above the pool of temperature controlled water. The device must be thermostatically controlled with a digital readout that is capable of displaying the high/low water temperature within the box since the last reading was taken.

6.12.03 - Construction Methods: The Contractor shall maintain the curing box in working order and shall provide all necessary electrical service and water so that the curing box can be used properly during the entire course of the project. Any curing box that is not operating properly, as determined by the Engineer, shall be replaced within 24 hours by the Contractor at no expense to the State. The Engineer reserves the right to prohibit placement of fresh concrete on the project until a curing box acceptable to the Engineer is operational on the project site.

6.12.04 - Method of Measurement: The furnishing of the concrete test cylinder curing box will be measured for payment by the number of boxes delivered by the Contractor and accepted by the Engineer.

6.12.05 – Basis of Payment: This item will be paid for at the contract unit price each for “Concrete Cylinder Curing Box” ordered and accepted on the project, which price shall include all submittals, material, tools, equipment, and labor incidental thereto. The price shall also include all maintenance and operating costs related to the curing box for the duration of the project.

Pay Item	Pay Unit
Concrete Cylinder Curing Box	ea. (ea.)

**CONNECTICUT
SUPPLEMENTAL SPECIFICATION
SECTION 6.51
CULVERTS**

6.51.02 – Materials:

Delete the 2nd paragraph, “Pipes of the type indicated ... of Article M.02.01.” and insert the following paragraph:

“Pipes of the type indicated on the plans and joint sealant shall conform to the requirements of Article M.08.01. Bedding material shall conform to the requirements of Article M.08.03. Granular fill shall conform to the requirements of Article M.02.01.”

6.51.03 – Construction Methods:

In the 8th paragraph replace “gravel fill” with “granular fill”.

Delete the 13th paragraph, “Bituminous fiber and ... as the pipe.”

6.51.04 – Methods of Measurement:

In the 7th paragraph, replace “Gravel Fill” with “Granular Fill”.

6.51.05 – Basis of Payment:

In the 8th paragraph, replace “Gravel Fill” with “Granular Fill”.

**CONNECTICUT
SUPPLEMENTAL SPECIFICATION
SECTION 7.01
DRILLED SHAFTS**

Add the following section:

**SECTION 7.01
DRILLED SHAFTS**

7.01.01 – Description

7.01.02 – Materials

7.01.03 – Construction Methods

7.01.04 – Method of Measurement

7.01.05 – Basis of Payment

7.01.01 - Description: This work shall consist of all labor, materials, equipment and services necessary to complete the Drilled Shaft installation in accordance with the Contract. Drilled shafts shall be made primarily of reinforced or unreinforced concrete.

7.01.02 - Materials: Drilled Shafts shall be made of the following materials:

1. Portland Cement Concrete: Concrete used in the construction of the shaft shall conform to the plans, Section M.03, and to the following:

(a) The concrete shall have a minimum initial slump of 8 in (200 mm).

(b) The concrete mix shall maintain a slump of no less than 4 in (100 mm) for a minimum of three (3) hours beyond the expected time for placement of concrete and removal of temporary casing (if used), as indicated by trial mixes and physical tests of slump loss. The trial mix and physical tests (slump loss tests) shall be conducted using concrete mix and ambient air temperatures anticipated during concrete placement.

(c) All admixtures, if approved for use, shall be adjusted for the conditions encountered on the job so as to conform to the slump loss requirements within this specification and must not adversely affect the timing of, taking of or interpretation of any Nondestructive Testing that may be called for in the Contract.

(d) Coarse aggregate shall conform to Article M.01.01, No. 8 Gradation.

2. Reinforcing Steel: Reinforcing steel used in construction of the shaft shall conform to Article M.06.01.

3. Access Tubes: Access tubes for cross-hole acoustic logging shall be made of Schedule 40 steel pipe conforming to ASTM A 53, Grade A or B, Type E, F, or S. The tubes' inside diameter shall be at least 1.5 in (38 mm). All access tubes, including all pipe joints, shall

have a round, regular inside surface free of defects and obstructions, in order to permit the free, unobstructed passage of probes to the bottoms of the tubes. The access tubes shall be watertight, free from corrosion and free of deleterious material on the outside that could prevent bonding with the concrete. All access tubes shall be fitted with watertight caps on the bottom and top.

4. **Grout:** Grout used for filling Access Tubes shall meet the requirements of Article M.03.05. The grout shall have strength properties equivalent to or better than those of the drilled shaft concrete.
5. **Permanent Casing:** Steel casing shall conform to the requirements of ASTM A36 or A252 Grade 2 unless otherwise specified on the plans. Casings shall be smooth, clean, watertight, and of ample strength to withstand handling, installation, and the pressure from surrounding concrete and earth materials. The outside diameter of any casing shall not be less than the specified diameter of the shaft.

7.01.03 - Construction Methods:

1. **Qualifications of Drilled Shaft Contractor and Submittals:** The Contractor performing the work described in this specification shall have been installing drilled shafts of both diameter and length similar to those shown on the plans for a minimum of three (3) years prior to the bid date for this Project. The Contractor shall submit a list of projects that it has performed in said three (3) years that met these criteria. The list of projects shall contain names and phone numbers of owner's representatives who can verify the Contractors' participation on those projects, and that they met said criteria.

As early as possible, and no later than thirty (30) days prior to constructing drilled shafts, the Contractor shall submit to the Engineer an Installation Plan for the shafts. This Plan shall provide the following information:

- (a) A list identifying the intended on-Site supervisor(s) and drill operator(s), for approval by the Engineer. The on-Site supervisor(s) shall have a minimum of two (2) years' experience supervising the construction of drilled shafts of a diameter and length similar to those shown on the plans. The drill operator(s) shall have a minimum of one (1) years' experience drilling for the construction of drilled shafts of a diameter and length similar to those shown on the plans. The list shall contain a summary of each individual's experience.

Should the Contractor elect to change any of these intended personnel during construction of the shafts, this same approval process will need to be completed for the new personnel prior to their starting work on the Project. The Contractor shall not be compensated for any delays resulting from such changing of personnel.

- (b) List of proposed equipment to be used, including cranes, drills, augers, bailing buckets, final cleaning equipment, desanding equipment, slurry pumps, core sampling equipment, tremies or concrete pumps, casing and any other equipment required for construction of the shafts.

- (c) Details of overall construction operation sequence and the sequence of shaft

construction in bents or groups.

- (d) Details of the Contractor's intended shaft excavation methods.
- (e) When the use of slurry is anticipated, details of the mix design and its suitability for the subsurface conditions at the Site, mixing and storage methods, maintenance methods, and disposal procedures.
- (f) Details of methods for cleaning the shaft excavation.
- (g) Details of reinforcement placement, including support and centralization methods.
- (h) Details of concrete mix design and test results of both a trial mix and a slump loss test. The tests shall be conducted by an approved testing laboratory, using approved methods to demonstrate that the concrete meets slump loss requirements.
- (i) Details of concrete placement, including proposed operational procedures for free fall, tremie or pumping methods, proposed concreting log form and computations for time duration of shaft pour estimates.
- (j) Details of casing installation and removal methods. If welding of casing is proposed, submit the welding procedure. All welding shall be done in accordance with the current AWS Structural Welding Code.
- (k) Details of methods for removal of obstructions. Obstructions for which the Contractor shall provide details of methods for removal include, but are not necessarily limited to, removal of boulders, concrete, riprap, steel, timber or miscellaneous debris.
- (l) Details for any monitoring plan as called for in the Contract.

The Engineer will evaluate the drilled shaft Installation Plan for conformance with the Contract and will then notify the Contractor of any additional information required or changes necessary in order to meet Contract requirements. All procedural approvals given by the Engineer shall be subject to trial in the field and shall not relieve the Contractor of the responsibility to satisfactorily complete Project work as detailed in the plans and specifications. The Contractor shall not commence construction of drilled shafts until the Engineer has approved the Installation Plan.

If integrity or load testing of the drilled shafts is called for by the Contract or the Site conditions, this submittal shall be developed in coordination with and submitted concurrently with working drawing submittals, as required in the testing specifications.

All submittals shall comply with the working drawing submittal requirements outlined in Article 1.05.02.

- 2. Trial Drilled Shaft Installation and Load Testing:** When called for in the Contract, the Contractor shall demonstrate the adequacy of the proposed methods, techniques and equipment by successfully constructing a trial drilled shaft in accordance with these

specifications. This trial drilled shaft shall be positioned away from production shafts, in the location shown on the plans or as directed by the Engineer. The trial shaft shall be drilled to the maximum depth shown in the plans. Failure by the Contractor to demonstrate to the Engineer the adequacy of methods and equipment shall be reason for the Engineer to require alterations of the Contractor's equipment or methods in order to prevent results unacceptable under the Contract or to the Engineer. Any additional trial drilled shaft required to demonstrate the adequacy of altered methods or construction equipment shall be at the Contractor's expense. Once the Engineer approves construction of production shafts, no changes will be permitted in the personnel, materials, methods or equipment used by the Contractor in constructing the satisfactory trial drilled shaft, unless the Contractor obtains the Engineer's written approval to do so.

Unless otherwise shown in the Contract, the trial drilled shaft shall have reinforcing bars, access tubes and concrete placed using the same materials and methods of construction to be used during construction of the production drilled shafts. The trial drilled shaft shall be cut off 2 ft (0.6 m) below finished grade and left in place. The disturbed area(s) at the site(s) of the trial drilled shaft(s) shall be restored as nearly as practical to original conditions.

Should the plans call for load testing of the trial drilled shaft, all necessary loading apparatus, instrumentation and other equipment required for performing the load test will be specified and paid for under a separate item.

All trial drilled shaft(s) and load test(s) must be completed and accepted by the Engineer prior to construction of any production drilled shafts. In the event that there is more than one trial drilled shaft and load test, the Contractor may begin construction of some of the production drilled shafts, in whatever way that the Engineer requires or approves.

- 3. Protection of Existing Structures:** The Contractor shall control drilled shaft operations in a way that will prevent damage to existing structures or utilities, in accordance with Articles 1.07.09 and 1.07.13. Preventive measures shall include, but are not limited to: selecting construction methods and procedures to prevent caving of the shaft excavation, and that will include monitoring and controlling the vibrations from construction activities such as the driving of casing or sheeting, drilling of the shaft, or from any blasting that the Contract or the Engineer may have permitted.

If monitoring is called for in the Contract, a preconstruction survey of existing facilities shall be performed to establish baseline data, including ambient vibration levels and existing structural defects. In general, monumented survey points shall be established on structures which are located within a distance of either ten (10) shaft diameters or the estimated shaft depth, whichever is greater. These points shall be monitored by the Contractor for vertical and lateral movement in an approved manner to the accuracy required by the Engineer.

When deformations exceed the predetermined amount included in the plans, the Contractor shall immediately stop work and, if directed by the Engineer to do so, backfill the excavated hole. The Contractor shall be responsible for selecting and using equipment and procedures that keep deformations of existing structures within levels specified by the Contract or Engineer.

When vibrations are to be monitored, the Contractor must engage the services of a professional vibrations consultant to monitor and record vibration levels during drilled shaft construction. Unless the Engineer states otherwise, vibration monitoring equipment must be capable of detecting velocities of 0.1 in/sec (2.5 mm/sec) or less. When vibration levels exceed tolerable levels established by the Contract or Engineer, the Contractor shall immediately stop the work causing the vibrations and take whatever measures are necessary to reduce vibration levels to below tolerable levels. All costs related to vibration monitoring required in the Contract shall be included in the bid price for the Drilled Shaft item.

- 4. Construction Sequence:** Excavation to footing elevation shall be completed before shaft construction begins unless otherwise noted in the Contract or approved by the Engineer. Any disturbance at or below the footing area caused by shaft installation shall be repaired by the Contractor prior to the footing construction.

When drilled shafts are to be installed in conjunction with embankment placement, the Contractor shall construct drilled shafts after the placement of fills, unless shown otherwise in the Contract or approved by the Engineer.

Drilled shafts, constructed prior to the completion of the fills, shall not be capped until the fills have been placed as near to final grade as possible, leaving only the workroom necessary for construction of the caps.

- 5. Exploration Test Borings:** As soon as possible, the Contractor shall take soil samples or rock cores, where shown on the plans or as directed by the Engineer, in order to determine the character of the material directly below the completed shaft excavation. The soil samples shall be extracted with a split spoon sampler or undisturbed sample tube. The rock cores shall be cut with an approved triple tube core barrel to a minimum of 10 ft (3 m) below the bottom of the drilled shaft excavation before the excavation is made. The Engineer may require the depth of coring be extended up to a total depth of 20 ft (6 m). Rock core and standard penetration test samples shall be measured, visually identified and described in the Contractor's log. The samples shall be placed in suitable containers, identified by shaft location, elevation, and Project number and shall be delivered with the Contractor's field log to the Engineer within twenty-four (24) hours after each boring exploration is completed. The Engineer will inspect the samples and log in order to determine the final depth of required excavation based on evaluation of the material's suitability. The Contractor shall not start shaft drilling or construction of the shafts until the Engineer has determined the final depth of required excavation. Two (2) copies of the Contractor's final typed log shall be furnished to the Engineer within seven (7) calendar days after completion of the borings. The logs shall contain specific information about the drilling equipment and tools used and the rate of hole advancement, as well as descriptions of soil, rock, obstructions, and water encountered. The Contractor shall supply a suitable, secure location on the Site for storage of all soil and rock samples. At no time shall the soil or rock core samples be taken off the Site without the Engineer's permission to do so.

- 6. General Methods and Equipment:** The Contractor shall perform the excavations required for shafts through whatever materials are encountered, to the dimensions and elevations shown in the plans or otherwise required by the Contract. The Contractor's methods and equipment shall be suitable for the intended purpose and materials encountered. The

permanent casing method shall be used only at locations shown on the plans or authorized by the Engineer in writing. Blasting shall be permitted only if specifically authorized on the plans or in writing by the Engineer.

- 7. Uncased Construction Method:** This method consists of using water or slurry (mineral or polymer) to maintain stability of the borehole perimeter while advancing the excavation to final depth, placing the reinforcing cage, and concreting the shaft. Where drilled shafts are located in open water areas, exterior casings shall be extended from above the anticipated high water elevation into the ground in order to protect the shaft concrete from water action during placement and curing of the concrete. The exterior casing shall be installed in a manner that will produce a positive seal at the bottom of the casing, so that no piping of water or other materials occurs into or from the shaft excavation.
- 8. Casing Construction Method:** The casing method may be used either where shown on the plans or at sites where uncased construction methods are inadequate to prevent hole caving or excessive deformation of the hole. In using this method, the casing may either be placed in a predrilled hole or advanced through the ground by twisting, driving or vibration before being cleaned out.
- 9. Excavation and Drilling Equipment:** The Contractor's excavation and drilling equipment shall have adequate capacity, including power, torque and down-thrust to make it possible to excavate a hole of the maximum diameter and to a depth of twenty percent (20%) beyond the depths shown on the plans.

The excavation and overreaming tools shall be of adequate design, size and strength to perform the work shown in the plans or described herein. When the material encountered cannot be drilled using conventional earth augers with soil or rock teeth, drill buckets, grooving tools, or underreaming tools, the Contractor shall provide special drilling equipment, including but not limited to: rock core barrels, rock tools, air tools, blasting materials, or other equipment as necessary to enable construction of the shaft excavation to the size and depth required. Excavation by blasting may not be performed without the prior written approval of same by the Engineer.

- 10. Excavation:** Shaft excavations shall be made at locations and to the top of shaft elevations, estimated bottom of shaft elevations, shaft geometry and dimensions shown in the Contract. If material encountered during excavation is unsuitable for these purposes or differs from that anticipated in the design of the drilled shaft, the Contractor shall extend drilled shaft tip (base) elevations as and when the Engineer directs it to do so.

The Contractor shall maintain a construction method log during shaft excavation. The log shall contain information such as the description and approximate top and bottom elevation of each soil or rock material encountered, of seepage or ground water, and any other relevant information or observations, including a description of the tools and drill rigs used and any changes necessitated by changing ground conditions.

The Contractor shall dispose of any excavated materials removed from shaft excavations in accordance with the applicable Contract requirements for disposal of excavated materials, including those in Section 1.10.

The Contractor shall not permit workers to enter the shaft excavation for any reason unless (1) a suitable casing has been installed and the water level has been lowered and stabilized below the level to be occupied, and (2) adequate safety equipment and procedures have been provided to workers entering the excavation. Any placement of workers within the shaft excavation shall be in conformance with OSHA regulations and industry standards.

- 11. Drilled Shaft Earth Excavation:** Drilled shaft earth excavation is (1) excavation accomplished with conventional tools such as augers and drilling buckets attached to drilling equipment of the size, power, torque, and down-thrust (crowd) proposed by the Contractor in a construction procedure approved by the Engineer, or (2) successful construction of a trial drilled shaft. Earth excavation may include, but will not necessarily be limited to, excavation of clay, silt, sand, gravel, cobbles, boulders, weathered rock, and miscellaneous fill.
- 12. Drilled Shaft Rock Excavation:** Drilled shaft rock excavation is (1) excavation of competent rock, accomplished with conventional rock drilling tools, such as core barrels attached to drilling equipment of the size, power, torque, and down-thrust (crowd) as proposed by the Contractor in a construction procedure approved by the Engineer or (2) successful construction of a trial drilled shaft. Top of competent rock is as shown on the Contract drawings.
- 13. Obstructions:** When obstructions are encountered, the Contractor shall notify the Engineer of them immediately. Obstructions are defined as impenetrable objects that
 - (a)** cannot be removed or excavated using conventional augers fitted with soil or rock teeth, underreaming tools, or drilling buckets; or
 - (b)** cause a significant decrease in the rate of excavation advancement, relative to the rate of advancement for the rest of the shaft excavation within the particular strata where the obstruction is located that had been achieved using the techniques and equipment that had previously been used successfully to excavate the shaft.

The Engineer will be the sole judge of the significance of any reduced rate of shaft advancement and of the classification of obstruction excavation. The Engineer will be present at the site of the obstruction in order to evaluate obstructions, to authorize measures for dealing with them, and to approve the designation each obstruction. Sloping bedrock or bedrock that is higher than anticipated by the plans shall not be considered as requiring obstruction excavation. Shallow obstructions are obstructions located within 5 ft (1.5 m) of the top level of the shaft. Shallow obstructions at shaft locations shall be removed at the Contractor's expense.

The Contractor shall remove all subsurface obstructions at drilled shaft locations. Such obstructions may include man-made materials, such as concrete foundations, and natural materials, such as boulders. Subsurface obstruction removal special procedures/tools may include, but are not limited to, chisels, boulder breakers, core barrels, down-the-hole hammers, air tools, hand excavation, temporary casing, and increases of the hole diameter. Blasting shall not be permitted unless specifically approved in advance in writing by the Engineer.

14. Lost Tools: Drilling tools lost in the excavation shall not be considered obstructions and shall be promptly removed by the Contractor without compensation. All costs due to lost tool removal shall be borne by the Contractor including, but not limited to, costs associated with the repair of hole degradation due to removal operations or due to the hole's remaining open for an excessively long time.

15. Casing: Casings shall be steel, smooth, clean, watertight, and of ample strength to withstand both handling and installation and the pressure of both concrete and the surrounding earth materials. The outside diameter of casings shall not be less than the specified diameter of the shaft, and the outside diameter of any excavation made below the casing shall not be less than the specified diameter of the shaft. No extra compensation will be paid for concrete required to fill an oversized casing or oversized excavation. All casings, except permanent casings, shall be removed from shaft excavations. Any length of permanent casing installed below the shaft cutoff elevation shall remain in place.

When the shaft extends above ground or through a body of water, the portion exposed above ground or through the water may be formed with removable casing, except when permanent casing is specified. Removable casing shall be stripped from the shaft in a manner that will not damage the concrete. Casings may be removed when the concrete has attained sufficient strength, provided: curing of the concrete is continued for a seventy-two (72) hour period; the shaft concrete is not exposed to salt water or moving water for seven (7) days; and the concrete reaches a compressive strength of at least 2500 psi (17,235 kPa) as determined from concrete cylinder breaks.

16. Temporary Casing: All subsurface casing shall be considered temporary unless specifically shown as permanent casing in the Contract. The Contractor shall be required to remove temporary casing before or immediately after completion of concreting the drilled shaft. Casing shall never be pulled after the concrete begins to set, due to probable entrapment of drilling fluid in the shaft concrete and probable separation of the concrete within the shaft.

If the Contractor elects to remove a casing and substitute a longer or larger-diameter casing through caving soils, the excavation shall either be stabilized with slurry or backfilled before the new casing is installed. Other methods approved by the Engineer may be used to control the stability of the excavation and protect the integrity of foundation materials.

Before the casing is withdrawn, the level of fresh concrete in the casing shall be a minimum of 5 ft (1.5 m) above either the hydrostatic water level in the formation or the level of drilling fluid in the annular space behind the casing, whichever is higher. As the casing is withdrawn, care shall be exercised to maintain an adequate level of concrete within the casing, so that fluid trapped behind the casing is displaced upward and discharged at the ground surface without contaminating or displacing the shaft concrete.

Temporary casings that become bound or fouled during shaft construction and cannot practicably be removed shall constitute a defect in the drilled shaft. The Contractor shall be responsible to improve such defective shafts to the satisfaction of the Engineer. Improvement may consist of, but not be limited to, removing the shaft concrete and extending the shaft deeper, in order to compensate for loss of frictional capacity in the cased zone; providing straddle shafts to compensate for capacity loss; grouting around the

exterior of the shaft; or providing a replacement shaft. All corrective measures, including redesign of footings caused by defective shafts, shall be done to the satisfaction of the Engineer by the Contractor without either compensation or an extension of Contract time of the Project. In addition, no compensation will be paid for casing remaining in place.

- 17. Permanent Casing:** Permanent casing shall be used where specified by the Contract. The casing shall be continuous between top and bottom elevations as shown in the plans. After installation is complete, the permanent casing shall be cut off at the prescribed elevation.

In cases in which special temporary casings are shown on the plans or authorized in writing by the Engineer to be used in conjunction with permanent casing, the Contractor shall maintain both alignment of the temporary casing with the permanent casing and a positive, watertight seal between the two casings during excavation and concreting operations.

Permanent casing shall maintain close contact with the surrounding earth after installation. Use of an oversized hole or temporary casing outside the permanent casing beneath the ground surface will not be allowed without the advance written permission of the Engineer to do so. Should an oversized hole or temporary casing outside the permanent casing beneath the ground surface be allowed by the Engineer, grouting of the exterior annular space shall be provided by the Contractor in order to create close contact between the casing and the surrounding ground. The grouting shall extend from the bottom of the annular space to an elevation determined by the Engineer. No compensation will be paid to the Contractor for grouting of the exterior annular space.

- 18. Slurry:** Mineral or polymer slurries shall be employed when slurry is used in the drilling process, unless other drilling fluids are approved in writing by the Engineer. Mineral slurry shall have both a mineral grain size that will remain in suspension and sufficient viscosity and gel characteristics to allow it to transport excavated material to a suitable screening system. The percentage and specific gravity of the material used to make the mineral suspension shall be sufficient to maintain the stability of the excavation and to allow proper concrete placement.

During construction, the level of the slurry shall be maintained at a height sufficient to prevent caving of the hole. The slurry head shall remain above the piezometric head of the groundwater. This includes initial drilling of the borehole down to the piezometric level. Slurry shall be introduced when the depth of the borehole is still above the piezometric level, not after the inflow of water can be detected and sloughing has begun. In the event of a sudden significant loss of slurry to the hole, the construction of that foundation shall be stopped until either a method to stop slurry loss or an alternate construction procedure has been approved by the Engineer.

Mineral slurry shall be premixed thoroughly with clean fresh water and adequate time (as prescribed by the mineral manufacturer) shall be allotted for hydration prior to introduction into the shaft excavation. Slurry tanks of adequate capacity shall be required for slurry circulation, storage, and treatment. No excavated slurry pits will be allowed in lieu of slurry tanks without the written consent of the Engineer to the substitution. Desanding equipment shall be provided by the Contractor as necessary to keep slurry sand content at less than

four percent (4%) by volume at any point in the borehole at the time the slurry is introduced, including situations in which temporary casing will be used. The Contractor shall take all steps necessary to prevent the slurry from "setting up" in the shaft. Such methods may include, but are not limited to: agitation, circulation and adjusting the properties of the slurry. The Contractor shall dispose of all slurry in suitable off-Site areas. Disposal of the slurry shall also comply with Section 1.10.

Control tests using suitable apparatus shall be carried out on the mineral slurry by the Contractor in order to determine density, viscosity and pH. An acceptable range of values for mineral slurry physical properties is shown in Table 7.01-1:

TABLE 7.01-1, MINERAL SLURRY PROPERTIES
(Sodium Bentonite or Attapulgite in Fresh Water)

Property	Acceptable Range of Values		
	At Time of Slurry Introduction	In Hole at Time of Concreting	Test Method
Density - pcf (kN/m ²)	64.3* - 69.1* (10.1* - 10.8*)	64.3* - 75.0* (10.1* - 11.8*)	Density Balance
Viscosity - sec./quart (sec./liter)	28 - 45 (26 - 43)	28 - 45 (26 - 43)	Marsh Funnel
pH	8 - 11	8 - 11	pH paper, pH meter
<p align="center">* Increase by 2 pcf (0.3 kN/m²) in salt water</p> <p>Notes: (a) Tests shall be performed when the slurry temperature is above 40° F (4.5° C). (b) If desanding is required, sand content shall not exceed 4% (by volume) at any point in the borehole, as determined by the American Petroleum Institute sand content test when the slurry is introduced.</p>			

Tests to determine density, viscosity and pH value shall be performed during the shaft excavation to establish a consistent working pattern. A minimum of four (4) sets of tests shall be made during the first eight (8) hours of slurry use. When the tests show consistent results, the testing frequency may be decreased to one (1) set every four (4) hours of slurry use.

If the Contractor proposes to use polymer slurry, either natural or synthetic, use of the product must be approved in advance by the Engineer. Slurry properties at the time of mixing and at the time of concreting must comply with the manufacturer's written recommendations. Whatever product is used, the sand content at the base of the drilled shaft excavation shall not exceed one percent (1%) when measured by Method API 13B-1, Section 5, immediately prior to concreting.

If the Contractor proposes to use blended mineral-polymer slurry, the Contractor shall submit to the Engineer a detailed report specific to the Project, prepared and signed by a qualified slurry consultant, describing the proposed slurry materials, the mix proportions, mixing methods and quality control methods.

If polymer slurry, or blended mineral-polymer slurry, is proposed, the Contractor's slurry management plan shall include detailed provisions for controlling the quality of the slurry, including tests to be performed, the frequency of those tests, the test methods, and any maximum or minimum property requirements that must be met in order to ensure that the slurry meets its intended functions in the subsurface conditions at the Project site and with the construction methods to be used. The slurry management plan shall include a set of the slurry manufacturer's written recommendations and shall include the following tests, as a minimum: Density test (API 13B-1, Section 1), viscosity test (Marsh funnel and cup, API 13B-1, Section 2.2, or approved viscometer), pH test (pH meter, pH paper), and sand content test (API sand content kit, API 13B-1, Section 5).

If such a proposal is approved by the Engineer, the Contractor may use water as a drilling fluid. In that case, all of the provisions in Table 7.01-1 for mineral slurries must be met, except that the maximum density shall not exceed 70 pcf (11 kN/m²).

The Contractor shall ensure that a heavily-contaminated slurry suspension, which could impair the free flow of concrete, has not accumulated in the bottom of the shaft. Prior to placing concrete in any shaft excavation, the Contractor shall take slurry samples using a sampling tool approved by the Engineer. Slurry samples shall be extracted from the base of the shaft and at intervals not exceeding 10 ft (3 m) up the slurry column in the shaft, until two (2) consecutive samples produce acceptable values for density, viscosity, and pH.

When any slurry samples are found to be unacceptable, the Contractor shall take whatever action is necessary to bring the slurry within specification requirements. Concrete shall not be placed until the slurry in the hole is re-sampled and test results produce acceptable values.

Reports of all tests specified above, signed by an authorized representative of the Contractor, shall be furnished to the Engineer on completion of each drilled shaft.

During construction, the level of mineral or blended mineral-polymer slurry in the shaft excavation shall be maintained at a level not less than 4 ft (1.2 m) above the highest expected piezometric pressure head along the depth of the shaft, and the level of polymer slurry shall be maintained at a level not less than 6 ft (1.8 m) above the highest expected piezometric pressure head along the shaft. If at any time, in the opinion of the Engineer, the slurry construction method fails to produce the desired final results, the Contractor shall discontinue this method and propose an alternate method for approval by the Engineer.

Drilling tools shall contain vents to stabilize hydrostatic pressure above and below the tool during insertion and extraction. The rate of tool extraction shall not cause any noticeable turbulence in the slurry column in the borehole.

The Contractor shall arrange for the slurry manufacturer's technical representative to be present at the Site during Project startup, or throughout the entire Project if continual difficulty is expected, in order to ensure that the slurry is mixed and managed properly.

- 19. Excavation Inspection:** The Contractor shall check the dimensions and alignment of each shaft excavation. Final shaft depths shall be measured with a suitable weighted tape or other approved method after final cleaning. The Contractor shall provide equipment and

access to the Engineer for confirming dimension, alignment, and bottom cleanliness. Acceptable shaft cleanliness will be determined by the Engineer.

20. Construction Tolerances: The following construction tolerances apply to drilled shafts, unless otherwise stated in the Contract:

- (a) The center of the drilled shaft shall be within 3 in (76 mm) of plan position in the horizontal plane at the plan elevation for the top of the shaft.
- (b) The vertical alignment of a vertical shaft excavation shall not vary from the plan alignment by more than 1/4 in/ft (21 mm/m) of depth.
- (c) After the concrete is placed, the top of the reinforcing steel cage shall be no more than 6 in (150 mm) above and no more than 3 in (76 mm) below plan position.
- (d) All casing diameters shown on the plans refer to outside diameter ("OD") dimensions. The dimensions of casings are subject to American Petroleum Institute tolerances applicable to regular steel pipe. The Contractor may elect to provide a casing larger in diameter than shown in the plans, if the Engineer approves its doing so.
- (e) The top elevation of the shaft shall have a tolerance of plus 1 in (25 mm) or minus 3 in (76 mm) from the plan top-of-shaft elevation.
- (f) Excavation equipment and methods shall be designed so that the completed shaft excavation will have a planar bottom. The cutting edges of excavation equipment shall be normal to the vertical axis of the equipment within a tolerance of +/- 3/8 in/ft (+/- 3 mm/m) of diameter.

Drilled shaft excavations and completed shafts not constructed within the required tolerances are unacceptable. The Contractor shall be responsible for correcting all unacceptable shaft excavations and completed shafts to the satisfaction of the Engineer. Materials and work necessary, including engineering analysis and redesign, in order to complete corrections for out-of-tolerance drilled shaft excavations, shall be furnished without cost to the State or extension of Contract time.

21. Reinforcing Steel Cage Construction and Placement: The reinforcing steel cage, consisting of longitudinal bars, ties, cage stiffener bars, spacers, centralizers, and other necessary appurtenances, shall be completely assembled and placed as a unit immediately after the shaft excavation is inspected and accepted, and prior to concrete placement. Internal stiffeners shall be removed as the cage is placed in the borehole, so as not to interfere with the placement of concrete.

The reinforcing steel in the shaft shall be tied and supported so that the reinforcing steel will remain within allowable tolerances. Concrete spacers or other approved noncorrosive spacing devices shall be used at sufficient intervals near the bottom and at intervals not exceeding 10 ft (3 m) up the shaft, in order to ensure concentric spacing for the entire cage length. Spacers shall be constructed of approved material, equal in quality and durability to the concrete specified for the shaft. The spacers shall be of adequate dimension to ensure

a minimum 3 in (76 mm) annular space between the outside of the reinforcing cage and the side of the excavated hole. Approved cylindrical concrete feet (bottom supports) shall be provided to ensure that the bottom of the cage is maintained the proper distance above the base.

The elevation of the top of the steel cage shall be checked before and after the concrete is placed. If the upward displacement of the rebar cage exceeds 2 in (51 mm) or if the downward displacement exceeds 6 in per 20 ft (152 mm per 6 m) of shaft length, the drilled shaft will be considered defective. In such a case, corrections shall be made by the Contractor to the satisfaction of the Engineer. No additional shafts shall be constructed until the Contractor has modified the rebar cage support in a manner satisfactory to the Engineer.

- 22. Concrete Placement:** Concrete placement shall be performed in accordance with the applicable portions of Section 6.01 and with the requirements herein dealing with concrete materials.

Concrete shall be placed as soon as possible after reinforcing steel placement and after the Engineer has accepted the cleanliness of the shaft. The Engineer may re-inspect the shaft for cleanliness should there be any delays between initial acceptance of shaft cleanliness and commencement of the concrete placement. If during such a delay the Engineer has determined that shaft cleanliness has deteriorated, the Engineer may require the Contractor to re-clean the shaft. The Contractor may be required to remove the rebar cage should it be necessary in order to achieve the required shaft cleanliness. The Contractor will not be compensated for any cost or loss of time due to the need to re-clean the shaft.

Concrete placement shall be continuous from the bottom to the top elevation of the shaft. Concrete placement shall continue after the shaft excavation is filled and good quality concrete is evident at the top of shaft. Concrete shall be placed by free fall, or through a tremie or concrete pump. Free fall placement will be permitted only in dry holes. Concrete placed by free fall shall fall directly to the base without contacting the rebar cage or hole sidewall. Drop chutes may be used to direct concrete to the base during free fall placement.

The Contractor shall maintain Concreting Logs during all concrete placement. The log shall include, but not be limited to, concreting curves plotting Depth-to-Top of Concrete vs. Volume of Concrete Placed (for both theoretical and actual volumes of concrete placed). The Contractor shall provide a copy of each log to the Engineer upon completion of each drilled shaft concrete placement. A sample of the proposed log to be used by the Contractor shall be submitted as part of the Installation Plan working drawing submittal.

- 23. Tremies:** Tremies may be used for concrete placement in either wet or dry holes. Tremies used to place concrete shall consist of a tube of sufficient length, weight, and diameter to discharge concrete at the shaft base elevation. The tremie shall not contain aluminum parts that may come in contact with the concrete. The tremie's inside diameter shall be at least six (6) times the maximum size of aggregate used in the concrete mix, but shall not be less than 10 in (254 mm). The inside and outside surfaces of the tremie shall be clean and

smooth in order to permit flow of concrete and unimpeded withdrawal during concreting. The wall thickness of the tremie shall be adequate to prevent crimping or sharp bends, which would restrict concrete placement.

The tremie used for wet excavation concrete placement shall be watertight. Underwater or under-slurry placement shall not begin until the tremie is placed to the shaft base elevation, and the concrete shall be kept completely separated from the water or slurry prior to the time that it is discharged. Valves, bottom plates or plugs may be used for this purpose only if concrete discharge can begin within 1 tremie diameter of the base of the drilled shaft. Plugs shall either be removed from the excavation or be of a material approved by the Engineer that will not cause a defect in the shaft if not removed. The discharge end of the tremie shall be constructed to permit the free radial flow of concrete during placement operations. The tremie discharge end shall be immersed at least 5 ft (1.5 m) in concrete at all times after starting the flow of concrete. The flow of the concrete shall be continuous. The level of the concrete in the tremie shall be maintained above the level of slurry or water in the borehole at all times, in order to prevent water or slurry intrusion into the shaft concrete.

If at any time during the concrete placement, the tremie line orifice is removed from the fluid concrete column and it discharges concrete above the rising concrete level, the shaft will be considered defective. All costs of repair or replacement of defective shafts shall be the responsibility of the Contractor.

- 24. Pumped Concrete:** Concrete pumps and lines may be used for concrete placement in either wet or dry excavations. All pump lines shall have a minimum 4 in (102 mm) diameter and be constructed with watertight joints. Concrete placement shall not begin until the pump line discharge orifice is at the shaft base elevation.

For wet excavations, a plug or similar device shall be used to separate the concrete from the fluid in the hole until pumping begins. The plug shall either be removed from the excavation or be of a material approved by the Engineer that will not cause a defect in the shaft if not removed.

The discharge orifice shall remain at least 5 ft (1.5 m) below the surface of the fluid concrete. When lifting the pump line during concreting, the Contractor shall temporarily reduce the line pressure until the orifice has been repositioned at a higher level in the excavation.

If at any time during the concrete placement the pump line orifice is removed from the fluid concrete column and it discharges concrete above the rising concrete level, the shaft will be considered defective. All costs of repair or replacement of defective shafts shall be the responsibility of the Contractor.

- 25. Drop Chutes:** Drop chutes may be used to direct placement of free-fall concrete in excavations where the maximum depth of water does not exceed 3 in (76 mm). Free fall placement is not permitted in wet excavations. Drop chutes shall consist of a smooth tube of either one-piece construction or sections that can be added and removed. A drop chute can also be a hopper with a short tube to direct the flow of concrete. Concrete may be placed through either the hopper at the top of the tube or side openings as the drop chute

is retrieved during concrete placement. If concrete placement causes the shaft excavation to cave or slough, or if the concrete strikes the rebar cage or sidewall, the Contractor shall reduce the height of free fall or reduce the rate of concrete flow into the excavation, or both. If caving or sloughing of the borehole walls occurs during free-fall placement of concrete, the shaft will be considered defective. All costs of repair or replacement of defective shafts shall be the responsibility of the Contractor. If concrete placement cannot be satisfactorily accomplished by free fall, in the opinion of the Engineer, the Contractor shall use either tremie or pumping techniques to accomplish the concrete placement.

- 26. Access Tubes for Crosshole Acoustic Logging:** Access tubes for crosshole acoustic logging shall be placed on each reinforcing cage designated in the Contract in the position and at the frequency shown on the plans. Access tubes must be firmly secured to the cage. Normally, the tubes shall extend from 6 in (150 mm) above the bottom of the shaft to at least 3 ft (0.9 m) above the top of the shaft, or 2 ft (0.6 m) above the ground surface if the shaft is cut off below the ground surface. If cross-hole acoustic tests are to be performed, the access tubes shall be filled with clean water no later than four (4) hours after placement of the concrete and the tubes capped during concrete placement to keep out concrete and debris. In all cases, the access tubes shall be as nearly parallel as possible and be placed as far from the longitudinal steel bars as possible.

Prior to the beginning of downhole logging, the Contractor shall assure that the Cross-Hole Acoustic Logging test probes can pass through every tube to the bottom. If a tube is obstructed, the entire length of the obstructed access tube will not be measured for payment. The Engineer may also require the Contractor to core a hole within the drilled shaft near and to the full depth of the obstructed tube. The cored hole shall be large enough to accommodate the test probe for the full length of the hole. The coring equipment, coring procedure and location of the core hole shall be approved by the Engineer before the coring process may begin. The coring method shall provide for complete core recovery and shall minimize abrasion and erosion of the core. The core hole shall be placed at a position in the shaft that will not produce damage to the reinforcing steel in the shaft. The core hole shall be logged, voids or defects indicated on the log, and the log submitted to the Engineer. Cores shall be preserved and made available for inspection by the Engineer. The core hole will be treated as an access tube for downhole testing. Core holes that are drilled to substitute for a blocked access tube shall be measured and paid for at the Contract unit price for Access Tubes.

Upon completion of all tests involving access tubes and after acceptance of the drilled shaft, the access tubes and core holes shall be filled with grout.

- 27. Evaluation and Acceptance or Rejection of Drilled Shafts:** Upon completion and integrity testing (if called for) of a drilled shaft, the Engineer will review all available drilling logs, drilled shaft construction logs, concreting logs, inspection reports, load test results, and integrity test results in order to determine the acceptability of the drilled shaft. If the Engineer determines that available data is inconclusive, the Engineer may call for additional integrity testing, coring, or other appropriate actions necessary for evaluating the drilled shaft. Should the additional integrity testing or coring confirm the presence of anomalies, the Contractor will not be compensated for the cost of the additional integrity testing or coring (even if the anomalies are determined to be non-critical and the shaft is found to be acceptable). Should additional integrity testing or coring demonstrate that anomalies are

not present (prior to any remedial work), the additional integrity testing or coring will be paid for by the Department. The Contractor may continue to construct drilled shafts before receipt of notice of acceptance of the tested shaft or shafts by the Engineer. If the Engineer finds previously-constructed shaft(s) to be unacceptable, the Contractor shall be required to repair, at its expense, the unacceptable shaft(s) to the satisfaction of the Engineer. The Contractor shall prove to the satisfaction of the Engineer, at no expense to the State, the acceptability of all shafts constructed since the time that the unacceptable shaft was constructed and to prove the acceptability of the procedure to be used in constructing future shafts. If the Engineer deems the construction procedure to be unacceptable, the Contractor shall cease all drilled shaft construction until submittal of a new construction procedure to the Engineer and the Engineer has accepted it.

The Contractor shall submit repair procedures to the Engineer for review and approval. If these plans involve change of or impact on the structural design of the shafts or shaft caps, or the geometry of the shafts, any proposed redesign of the Contractor's plan shall be performed at the Contractor's expense by a qualified Professional Engineer registered in the State of Connecticut.

The Engineer may require that additional shafts be tested. If the testing of the additional shaft(s) indicates the presence of a defect in any additional shaft, the testing cost for that shaft shall be borne by the Contractor, and the Contractor shall repair the shaft at its own expense, as above. Any additional testing required by the Engineer on repaired drilled shafts shall be considered part of the Contractor's remediation plan, to be paid for by the Contractor.

7.01.04 - Method of Measurement:

- 1. Furnishing Drilled Shaft Drilling Equipment:** There will be no measurement of the work performed under this Lump Sum item.
- 2. Drilled Shaft** will be measured for payment by the length in linear feet (meters) of the completed and accepted concrete drilled shaft, of the diameter and containing the reinforcement shown on the plans. The length will be determined as the difference between the plan top-of-shaft elevation and the final bottom-of-shaft elevation.
- 3. Drilled Shaft Earth Excavation** will be measured for payment by the length in linear feet (meters) of completed earth excavation of the diameter shown on the plans (measured along the centerline of the shaft), either from the top of existing grade elevation prior to drilling or from the bottom of the drilled shaft cap elevation (whichever is lower), to either the top of competent rock elevation (if the drilled shaft extends onto or into competent rock) or to the bottom of the shaft elevation (if the shaft does not extend onto or into competent rock).
- 4. Drilled Shaft Rock Excavation** will be measured for payment by the length in linear feet (meters) of completed rock excavation of the diameter shown on the plans, measured along the centerline of the shaft from the top-of-competent-rock elevation to the bottom-of-the-shaft elevation
- 5. Obstructions** will be measured for payment, after designation as an obstruction by the

Engineer, by the number of hours of work, or fraction thereof per obstruction, required to remove the obstruction.

6. **Trial Drilled Shaft** will be measured for payment by the authorized linear feet (meters) of trial shaft holes drilled to the diameter shown on the plans, completed (including backfill and restoration of area, when required) and accepted. The length of trial shaft holes will be determined as the difference between the existing ground surface elevation at the center of the trial shaft hole prior to drilling and the authorized bottom elevation of the hole.
7. **Exploration Test Borings** will be measured for payment by the length in linear feet (meters), measured from the existing grade elevation to the bottom elevation of the exploration hole, for each authorized exploration boring drilled.
8. **Permanent Casing** will be measured for payment by the length in linear feet (meters) of each diameter casing installed and accepted. The length to be paid will be measured along the casing from the top-of-the-shaft elevation or the top of the casing, whichever is lower, to the bottom of the casing at each shaft location where permanent casing is used.
9. **Access Tubes** will be measured for payment by the length in linear feet (meters) of unobstructed access tube, installed and accepted in the drilled shafts, to the depths shown on the plans

7.01.05 - Basis of Payment:

1. **Furnishing Drilled Shaft Drilling Equipment:** Payment for this item will be at the Contract lump sum price for "Furnishing Drilled Shaft Drilling Equipment" which will be considered full and complete payment for furnishing and moving the drilling equipment to the Site, setting up the equipment at the required locations, and removing the equipment from the Site.

Payment of sixty percent (60%) of the lump sum amount bid for this item will be made when all drilling equipment is on the Site, assembled and ready to drill foundation shafts. Payment of the remaining forty percent (40%) of the lump sum amount will be made when all shafts have been drilled, all shaft concrete has been placed to the top of the shaft, all defects are repaired, and all drilled shafts have been accepted by the State.

2. **Drilled Shaft:** Drilled shafts will be paid for at the Contract unit price per linear foot (meter) for "Drilled Shaft (Diameter)" complete and accepted in place, including submittals, concrete and reinforcing steel, all labor, equipment, materials, temporary casings, slurry, slurry technical representative, blasting (if allowed), protection of existing facilities or utilities, vibration monitoring and incidentals necessary to complete the drilled shaft.
3. **Drilled Shaft Earth Excavation:** This work will be paid for at the Contract unit price per linear foot (meter) for "Drilled Shaft Earth Excavation (Diameter)" complete, including all labor, equipment, materials, water control, and disposal of excavated material necessary.
4. **Drilled Shaft Rock Excavation:** Drilled shaft rock excavation will be paid for at the Contract unit price per linear foot (meter) for "Drilled Shaft Rock Excavation (Diameter)" complete, including all labor, equipment, materials, water control, and disposal of excavated

material necessary. No payment will be made for additional rock excavation or placement of additional shaft concrete resulting from blasting overbreak (if blasting is allowed).

- 5. **Obstructions:** Removal of obstructions will be paid for at the Contract unit price per hour for “Obstructions” complete, including all labor, equipment, materials, excavation of obstructions, water control, disposal of excavated material necessary. If the Contractor chooses to use a larger shaft diameter for obstruction excavation, no additional compensation will be paid for performing such oversized obstruction excavation.
- 6. **Trial Drilled Shaft:** Trial drilled shafts will be paid for at the Contract unit price per linear foot (meter) for “Trial Drilled Shaft (Diameter)” complete and accepted, including all labor, equipment, materials, excavation of the trial drilled shaft through whatever materials are encountered, to the bottom of shaft elevation shown on the plans or as authorized by the Engineer (using slurry approved by the Engineer as necessary), providing inspection facilities, backfilling the hole, restoring the Site as required, and all other expenses to complete the trial shaft.
- 7. **Exploration Test Borings:** Soil samples, rock cores or both, of the diameter and length required and authorized by the Engineer will be paid for at the Contract unit price per linear foot (meter) for “Exploration Test Boring” complete, including drilling, extracting, packaging and classifying samples or cores, delivery of same to the Engineer, furnishing concrete or grout to fill the core hole, providing a written log of the hole, and all other expenses necessary.
- 8. **Permanent Casing:** Permanent casings will be paid for at the Contract price per linear foot (meter) for “Permanent Casing (Diameter)” complete, including furnishing and placing the permanent casing in the shaft excavation.
- 9. **Access Tubes:** Access tubes will be paid for at the Contract unit price per linear foot (meter) of unobstructed “Access Tubes” complete and accepted, installed in the drilled shafts to the depths shown on the plans, including the post-test grouting of the access tubes.

Pay Item	Pay Unit
Furnishing Drilled Shaft Drilling Equipment	l.s. (l.s.)
Drilled Shaft (Diameter)	l.f. (m)
Drilled Shaft Earth Excavation (Diameter)	l.f. (m)
Drilled Shaft Rock Excavation (Diameter)	l.f. (m)
Obstructions	hr. (hr.)
Trial Drilled Shaft (Diameter)	l.f. (m)
Exploration Test Boring	l.f. (m)
Permanent Casing (Diameter)	l.f. (m)
Access Tubes	l.f. (m)

**CONNECTICUT
SUPPLEMENTAL SPECIFICATION
SECTION 7.02
PILES**

Delete the entire section and replace it with the following:

**SECTION 7.02
PILES**

7.02.01—Description

7.02.02—Materials

7.02.03—Construction Methods

7.02.04—Method of Measurement

7.02.05—Basis of Payment

7.02.01—Description: This item shall consist of furnishing and driving foundation piles of the type and dimensions designated. Piles shall conform to and be installed in accordance with these specifications, and at the location, and to the elevation, penetration and/or capacity shown on the plans, or as directed by the Engineer. If specified in the plans or directed by the Engineer, piles shall be tipped, shaped, reinforced or otherwise pointed and strengthened

Test piles shall be piles of the type specified, driven in advance of placing orders for the piles, for the purpose of determining length or bearing capacity of piles. The Contractor shall furnish the piles in accordance with an itemized order list which will be furnished by the Engineer, showing the number and length of all piles. When test piles are specified, the pile lengths shown on the plans are for estimating purposes only. The actual lengths to be furnished for production piles will be determined by the Engineer after the test piles have been driven.

7.02.02—Materials: Piles of the type indicated on the plans shall conform to the requirements of Articles M.09.02 and M.14.01.

7.02.03—Construction Methods

1. Pile Types:

(a) Timber Piles: The method of storing and handling timber piles shall be such as to avoid damage to the piles. Special care shall be taken to avoid breaking the surface of treated piles. Cant dogs, hooks, or pike-poles shall not be used. Cuts or breaks in the surface of treated piling shall be given three brush coats of hot creosote oil of approved quality, and hot creosote oil shall be poured into all bolt holes.

(b) Steel Piles: The methods of storing and handling steel piles shall be such as to prevent damage to the piles and to protect them from corrosion.

(c) Cast-In-Place Concrete Piles: Cast-in-place concrete piles shall be constructed by driving steel shells and filling them with concrete. Shells shall be continuously or incrementally tapered, or cylindrical, or a combination of continuously or incrementally

tapered lower sections, which are extended with cylindrical upper sections, unless otherwise provided in the plans or special provisions. The tapered portion of piles shall have a minimum tip diameter of 8 inches (200 millimeters) and shall change in diameter not less than 1 inch in every 12 feet (7 millimeters/meter). Cylindrical piles and the cylindrical extension portions of tapered piles shall have a minimum diameter of 12 inches (300 millimeters). Shells for cast-in-place concrete piles shall be formed by joining sections of the same manufacture, unless otherwise permitted by the Engineer. Composite shell piles, which are piles composed of different thicknesses or of different manufacture, shall not be used unless shown on the plans or approved by the Engineer. Prefabricated driving points or other type tip enclosures shall be subject to the approval of the Engineer.

The Contractor shall furnish shells of a type and gage which can be driven without distortion. Shells which fail, fracture or otherwise distort during driving or after driving shall be withdrawn or replaced at the Contractor's expense. The metal of shells which are to be driven without a mandrel shall be of sufficient thickness to withstand the driving without failure, fracture or distortion, but in no case shall the thickness be less than No. 7 gage. Shells driven with a mandrel shall have a thickness not less than No. 18 gage. Piles having a shell thickness less than No. 9 gage shall be reinforced as shown on the plans.

Composite shell piles formed by extending lower sections of No. 7 or heavier gage, with upper sections of lighter than No. 7 gage, shall be driven with an internal mandrel in such a manner so as to insure shell alignment and maximum hammer energy transmission throughout the pile shell length. All details concerning compatibility of shell and mandrel construction shall be subject to the approval of the Engineer.

After driving has been completed, the shell shall be inspected and approved before any concrete is placed. The Contractor shall provide suitable lights and other equipment necessary to inspect each shell throughout its length.

All seams, joints and splices in shells shall develop the full strength of the shell and shall be watertight. Damaged shells that are unacceptable to the Engineer shall be filled with sand and a replacement shell or shells shall be driven adjacent thereto.

Reinforcement shall be placed in accordance with the requirements of the plans or special provisions.

No concrete shall be placed in a pile until all driving within a radius of 15 feet (4.5 meters) from the pile has been completed, or until all the shells for any one bent have been completely driven. If this is not practical, all driving within the above limits shall be discontinued until the concrete in the last pile cast has set at least 7 days.

Concrete shall be placed continuously in each pile, care being used to fill every part of the shell, and to work concrete around the reinforcement without displacing it. No concrete shall be placed in shells containing an accumulation of water or any foreign material.

Extensions, or "build-ups" on concrete piles, shall be avoided; but when necessary, they shall be made as specified in Subarticle 7.02.03-7.

(d) Prestressed Concrete Piles (Pretensioned): The piles shall be manufactured in accordance with the provision of Article 5.14.03, except as follows:

(1) Forms: The forms for the piles shall be of substantial construction and shall produce a uniformly smooth surface on all formed sides. A minimum concrete cover of 2 inches (50 millimeters) shall be maintained for prestressing elements by the use of spreaders or by bundling in areas adjacent to openings or inserts. Ties shall also have a minimum cover of 2 inches (50 millimeters) at these locations. Side forms carrying no load may be removed after 24 hours with the permission of the Engineer or after the concrete has reached the minimum transfer strength as required by Subarticle M.09.02-6.

(2) Finishing: The topside surface of the piles shall be given a uniformly smooth steel trowel finish to match the surface of the formed sides. The prestressing elements shall be cut flush or recessed 1/8 inch (3 millimeters) to the top of the pile. Projecting fins and surface imperfections shall be removed in a workmanlike manner. Exposed jet pipe connections, inserts or other devices shall be removed or recessed to a depth as directed, and the hole or opening patched with non-shrink grout in a workmanlike manner. The patching material shall have a degree of finish comparable to the adjacent surfaces. Additional finishing of piles, if required, shall be as shown on the plans or as otherwise directed.

(3) Handling and Storage: Care shall be taken during storage, transporting, hoisting and handling of the prestressed piles to prevent cracking or damage. Damaged piles shall be replaced by the Contractor at his expense. Lifting and support points shall be marked on the piles as required.

(4) Pile Extensions: Pile extensions shall normally be fabricated for this purpose in accordance with the specifications. However, sound sections of pile cutoffs or sound portions of rejected piles may be used, subject to the approval of the Engineer. Short pile extensions may, with the permission of the Engineer, be cast-in-place monolithically with the footing or cap.

2. Pile Driving Equipment:

(a) Hammers: Piles shall be driven with approved air, steam, diesel, or hydraulic hammers or a combination of acceptable hammer and water jet. The plant and equipment furnished for air/steam hammers shall have sufficient capacity to maintain at the hammer, under working conditions, the volume and pressure specified by the manufacturer. The plant and equipment shall be equipped with accurate pressure gauges which are easily accessible to the Engineer. The valve mechanism and other parts of the hammer shall be properly maintained so that the length of stroke for a single-acting hammer and the number of blows per minute for a double-acting hammer will be obtained. The power plant for hydraulic hammers shall have sufficient capacity to maintain at the hammer, under working conditions, the volume and pressure specified by the manufacturer. The power plant and equipment shall be equipped with accurate pressure gauges which are easily accessible to the Engineer.

The size of hammer shall be adapted to the type and size of piles and the driving conditions. Unless otherwise specified, the minimum rated striking energy per blow for

hammers used shall be 7,000-foot pounds (9,500 joules) for driving timber piles; 15,000-foot pounds (20,000 joules) for driving steel piles and for driving shells for cast-in-place concrete piles; and 19,000-foot pounds (25,000 joules) for driving precast concrete piles and for driving prestressed concrete piles. The hammer model used for the driving of test piles shall be used for the driving of service or production piles, unless a change is authorized by the Engineer in writing. Hammers delivering an energy which the Engineer considers detrimental to the piles shall not be used.

Non-impact hammers, such as vibratory hammers, or driving aids such as jets, followers, pre-augered and prebored holes shall not be used unless either specifically permitted in writing by the Engineer or stated in the contract documents.

(b) Pile Hammer Approval: All pile driving equipment furnished by the Contractor shall be subject to the approval of the Engineer. All pile driving equipment shall be sized in such a way that the piles can be driven with reasonable effort to the ordered lengths without damage. Approval of pile driving equipment by the Engineer will be based on wave equation analysis and/or other judgments. In no case shall the driving equipment be used without written approval of the Engineer. Prerequisite to such approval, the Contractor shall submit to the Engineer the necessary pile driving equipment information and wave equation analysis at least 30 days prior to driving piles. The wave equation analysis shall be signed, sealed and dated by a Connecticut licensed Professional Engineer.

The criteria that the Engineer will use to evaluate the driving equipment consists of both the required number of hammer blows per foot (per 0.25 meters) as well as the pile stresses at the required ultimate pile capacity. The required number of hammer blows indicated by the wave equation at the ultimate pile capacity shall be between 36 and 180 blows per foot (29 and 147 blows per 0.25 meters) for the driving equipment to be acceptable. In addition, for the driving equipment to be acceptable the pile stresses which are indicated by the wave equation to be generated by the driving equipment shall not exceed the maximum driving stresses allowed by the governing design code stated in the contract documents.

During pile driving operations, the Contractor shall use the approved system. No variations in the driving system will be permitted without the Engineer's written approval. Any change in the driving system will only be considered after the Contractor has submitted the necessary information for a revised wave equation analysis.

If the Engineer determines the Contractor's hammer is unable to transfer sufficient energy to the pile, the hammer shall be removed from service until repaired to the satisfaction of the Engineer.

(c) Drive System Components and Accessories:

(1) Hammer Cushion: Impact pile driving equipment designed to be used with a hammer cushion shall be equipped with a suitable thickness of hammer cushion material to prevent damage to the hammer or pile and to insure uniform driving behavior. Hammer cushions shall be made of durable manufactured materials, provided in accordance with the hammer manufacturer's guidelines. Wood, wire rope, and asbestos hammer cushions are specifically disallowed and shall not be

used. A striker plate as recommended by the hammer manufacturer shall be placed on the hammer cushion to insure uniform compression of the cushion material. The hammer cushion shall be removed from the helmet and inspected prior to beginning pile driving at each structure or after each 100 hours of pile driving, whichever is less. The Contractor shall replace any hammer cushion whose thickness is less than 75% of the original thickness.

(2) Helmet: Piles driven with impact hammers require an adequate helmet or drive head to distribute the hammer blow to the pile head. The helmet shall be axially aligned with the hammer and the pile. The helmet shall be guided by the leads and not be free-swinging. The helmet shall fit around the pile head in such a manner as to prevent transfer of torsional forces during driving, while maintaining proper alignment of hammer and pile. For steel and timber piling, the pile heads shall be cut squarely and a helmet, as recommended by the hammer manufacturer, shall be provided to hold the axis of the pile in line with the axis of the hammer. For precast concrete and prestressed concrete piles, the pile head shall be plane and perpendicular to the longitudinal axis of the pile to prevent eccentric impacts from the helmet. For special types of piles, appropriate helmets, mandrels or other devices shall be provided in accordance with the manufacturer's recommendations so that the piles may be driven without damage.

(3) Pile Cushion: The heads of concrete piles shall be protected by a pile cushion. Pile cushions shall be made of plywood, hardwood, or composite plywood and hardwood materials. The minimum pile cushion thickness placed on the pile head prior to driving shall be at least 4 inches (100 millimeters). A new pile cushion shall be provided for each pile. In addition the pile cushion shall be replaced if, during the driving of any pile, the cushion is compressed more than one-half the original thickness or it begins to burn. The pile cushion dimensions shall match the cross sectional area of the pile top. The use of manufactured pile cushion materials in lieu of a wood pile cushion shall be evaluated on a case by case basis.

(4) Leads: Piles shall be supported in line and position with leads while being driven. Pile driver leads shall be constructed in a manner that affords freedom of movement of the hammer while maintaining alignment of the hammer and the pile to insure concentric impact for each blow. Leads may be either fixed or swinging type. Swinging leads, when used, shall be fitted with a pile gate at the bottom of the leads and, in the case of batter piles, a horizontal brace may be required between the crane and the leads. The pile section being driven shall not extend above the leads. The leads shall be adequately embedded in the ground or the pile constrained in a structural frame such as a template to maintain alignment. The leads shall be of sufficient length to make the use of a follower unnecessary, and shall be so designed as to permit proper alignment of batter piles.

(5) Followers: Followers shall only be used when approved in writing by the Engineer, or when specifically stated in the contract documents. In cases where a follower is permitted, the first pile in each bent and every tenth pile driven thereafter shall be driven full length without a follower, to determine that adequate pile penetration is being attained to develop the ultimate pile capacity. The follower and pile shall be held and maintained in equal and proper alignment during driving. The follower shall be of such material and dimensions to permit the piles to be driven to the penetration depth

determined necessary from the driving of the full length piles. The final position and alignment of the first two piles installed with followers in each substructure unit shall be verified to be within the required location tolerances before additional piles are installed.

(6) Jets: Jetting shall only be permitted if approved in writing by the Engineer or when specifically stated in the contract documents. When jetting is not required in the contract documents, but approved after the Contractor's request, the Contractor shall determine the number of jets and the volume and pressure of water at the jet nozzles necessary to freely erode the material adjacent to the pile without affecting the lateral stability of the in place pile. When jetting is specifically required in the contract documents, the plant shall have sufficient capacity to deliver at all times at least 100 psi (700 kilopascals) pressure at two 3/4-inch (19 millimeter) jet nozzles. In either case, unless otherwise indicated by the Engineer, jet pipes shall be removed when the pile toe is a minimum of 5 feet (1.5 meters) above prescribed toe elevation and the pile shall be driven to the required ultimate pile capacity with an impact hammer. Also, the Contractor shall control, treat if necessary, and dispose of all jet water in a manner satisfactory to the Engineer and in accordance with the provisions of Article 1.10.

(7) Pre-Augering: When stated in the contract documents, the Contractor shall pre-auger holes at pile locations to the depths shown on the plans. Pre-augered holes shall be of a size smaller than the diameter or diagonal of the pile cross section; however, large enough to allow penetration of the pile to the specified depth. If subsurface obstructions, such as boulders or rock layers, are encountered, the hole diameter may be increased to the least dimension which is adequate for pile installation. Any void space remaining around the pile after completion of driving shall be filled with sand or other approved material. The use of spuds shall not be permitted in lieu of pre-augering. Augering, wet-rotary drilling, or other methods of pre-augering shall be used only when approved by the Engineer. When permitted, such procedures shall be carried out in a manner which will not impair the capacity of the piles already in place or the safety of existing adjacent structures. If the Engineer determines that pre-augering has disturbed the capacities of previously installed piles, those piles that have been disturbed shall be restored to conditions meeting the requirements of this specification by re-driving or by other methods acceptable to the Engineer. Redriving or other remedial measures shall be instituted after the pre-augering operations in the area have been completed.

3. Pile Capacity

(a) Ultimate Pile Capacity: Piles shall be driven by the Contractor to the penetration depth shown on the plans or to a greater depth if necessary to obtain the ultimate pile capacity. The ultimate pile capacity shall be as defined in the contract documents.

Jetting or other methods shall not be used to facilitate pile penetration unless specifically permitted in the contract documents or in writing by the Engineer. The ultimate pile capacity of jetted piles shall be based on driving resistances recorded during impact driving after the jet pipes have been removed. Jetted piles not attaining the ultimate pile capacity at the ordered length shall be spliced, as

required, at the Contractor's cost, and driven with an impact hammer until the ultimate pile capacity is achieved.

The ultimate pile capacity of piles driven with followers shall only be considered acceptable when the follower driven piles attain the same pile toe elevation or top of bedrock elevation as required for the full length piles driven without followers that attained the required ultimate pile capacity.

(b) Wave Equation: The ultimate pile capacity shall be determined by the Engineer. Piles shall be driven with the approved driving equipment to the ordered length or other lengths necessary to obtain the required ultimate pile capacity. Jetting or other methods to facilitate pile penetration shall not be used unless specifically permitted either in the contract documents or approved by the Engineer after a revised driving resistance is established from the wave equation analysis. Adequate pile penetration shall be considered to be obtained when the specified wave equation resistance criteria is achieved within 5 feet (1.5 meters) of the pile toe elevation, based on ordered length. Piles not achieving the specified resistance within these limits shall be driven to penetrations established by the Engineer.

(c) Static Load Tests: Compression load tests shall be performed by procedures set forth in ASTM D-1143 using the quick load test method, except that the test shall be taken to plunging failure or the capacity of the loading system. Testing equipment and measuring systems shall conform to ASTM D-1143, except that the loading system shall be capable of applying 150% of the ultimate pile capacity as stated in the contract documents, and that a load cell and spherical bearing plate shall be used. The apparatus shall be constructed to allow the various increments of the load to be placed gradually, without causing vibration to the test pile. The Contractor shall submit to the Engineer for approval working drawings of the loading apparatus in accordance with Article 1.05.02. When the approved method requires the use of tension (reaction) piles, the tension piles, when feasible, shall be of the same type and diameter as the production piles, and shall be driven in the location of permanent piles except that timber or tapered piles installed in permanent locations shall not be used as tension piles.

The top elevation of the test pile shall be determined immediately after driving and again just before load testing to check for heave. Any pile which heaves more than 1/4 inch (6 millimeters) shall be redriven or jacked to the original elevation prior to testing. Unless otherwise specified in the contract, a minimum 3-day waiting period shall be observed between the driving of any anchor piles or the load test pile and the commencement of the load test.

On completion of the load testing, any test or anchor piling not a part of the finished structure shall be removed or cut off at least 1 foot (300 millimeters) below either the bottom of footing or the finished ground elevation, if not located within the footing area.

(d) Dynamic Pile Driving Analysis (PDA) Test: Dynamic measurements following procedures set forth in ASTM D-4945 will be taken during the driving of piles designated as dynamic monitoring test piles. The Contractor shall employ a qualified specialty Consultant, which has successfully completed no less than ten

dynamic pile driving tests, to perform the testing and report preparation for all Dynamic Pile Driving Analysis (PDA) Tests to be performed.

At least thirty days prior to driving the test piles the Contractor shall submit to the Engineer for review and approval the qualified specialty consultant, as well as the complete installation, and testing procedures. The submittal shall include all necessary pile driving equipment and support facilities to drive the piles to capacities and depths shown on the plans within allowable stress limits. As part of the submittal the Contractor's Consultant shall perform a wave equation analyses, and a summary report confirming that the pile driving system proposed by the Contractor can meet the capacity, driving resistance and allowable stress limits.

All equipment necessary for the dynamic monitoring of the piles such as gages, cables, etc., shall be furnished by the Contractor's Consultant. The equipment shall conform to the requirements of ASTM D-4945, Standard Test Method for High Strain Dynamic Testing of Piles, and be capable of testing the pile to one and one-half times the ultimate pile capacity. An experienced engineer, who has successfully completed no less than ten dynamic pile driving tests, shall operate the Pile Driving Analyzer in the field. The Contractor shall furnish a shelter within 100 feet (30 meters) of test location(s) to protect the dynamic test equipment from the elements. The shelter shall be a minimum floor size of 400 square feet (40 square meters), with a minimum ceiling height of 7 feet (2 meters), and an inside temperature maintained between 50° and 85°F (10° and 29°C).

The Contractor shall provide power to the test pile locations for the duration of the dynamic testing. The power supply shall consist of a power source providing 115-Volt alternating current with a frequency of 60 Hz and a minimum of 2 kilowatts. If field generators are used as the power source, provide functioning meters to monitor power voltage and frequency. Direct current welders or non-constant power sources are unacceptable.

Prior to lifting the pile to be dynamically tested, the Contractor shall provide as a minimum 3 feet (1 meter) of clear access to 180 degree opposite faces of the pile for pile preparation. The Contractor or its Consultant shall then drill and prepare holes in the pile for gage attachment.

The Contractor or its Consultant shall attach the gages to the pile before driving the piles. Pile driving shall be performed using routine pile installation procedures. When the level of the gages is within 1 foot (300 millimeters) of the ground surface, or obstruction, driving shall be halted to remove the gages from the pile. If additional driving is required, the pile shall be spliced and gages shall be reattached to the head of the next pile segment.

With the dynamic testing equipment attached, the Contractor shall drive the pile to the design penetration depth or to a depth determined by the Engineer. The Engineer will use the ultimate pile capacity estimates at the time of driving and/or restriking from dynamic test methods to determine the required pile penetration depth for the ultimate pile capacity. The stresses in the piles will be monitored during driving with the dynamic test equipment to ensure that the actual driving stresses do not exceed the maximum allowed values. If necessary, the Contractor

shall reduce the driving energy transmitted to the pile by using additional cushions or reducing the energy output of the hammer in order to maintain driving stresses below the maximum values. If non-axial driving is indicated by dynamic test equipment measurements, the Contractor shall immediately realign the driving system.

After the initial drive of the pile, the Contractor shall wait 24 hours, or the time specified in the contract documents, and restrike the dynamic monitoring test pile with the dynamic testing instruments attached. A cold hammer shall not be used for the restrike. The hammer shall be warmed up before restrike begins by applying at least 20 blows to another pile. The maximum amount of penetration required during restrike shall be 6 inches (150 millimeters), or 50 hammer blows, whichever occurs first.

The Contractor's Consultant shall provide preliminary estimates of pile capacity of the test pile to the Engineer within 24 hours of the restrike of each tested pile. The Contractor's Consultant shall also prepare and submit a written report within 5 calendar days of the completion of the testing. This report shall contain a discussion of the pile capacity obtained from the dynamic testing. CAPWAP analyses of the dynamic testing data shall be performed on data obtained at the end of initial driving and the beginning of restrike. The Engineer may request additional analyses at selected pile penetration depths. The report shall also discuss hammer and driving system performance, driving stress levels, and pile integrity. The report is to be prepared, signed, sealed and dated by a Connecticut licensed Professional Engineer. No production piles can be driven until the report has been submitted and approved by the Engineer.

4. Test Piles and Order Lists: Test piles shall be driven at the locations shown on the plans and to the penetration depths specified by the Engineer. Test piles shall be driven to a driving resistance established by the Engineer at the estimated pile toe elevation. The Contractor shall excavate the ground at each test pile to the elevation of the bottom of the footing before the pile is driven. All test piles shall be driven with impact hammers unless specifically stated otherwise in the plans. In general, the specified length of test piles will be greater than the estimated length of production piles in order to provide for variation in soil conditions. The driving equipment used for driving test piles shall be identical to the equipment proposed for driving the production piling. Approval of driving equipment shall conform to the requirements of these Specifications.

Test piles that do not attain the specified driving resistance at a depth of 6 inches (150 millimeters) above the estimated pile tip elevation, or are specified as a dynamic monitoring pile, shall be redriven after being allowed to set up. The minimum time period before restrike shall be 24 hours, or as specified in the contract documents. A cold hammer shall not be used for the restrike. The hammer used shall be warmed up by applying at least 20 blows to another pile.

Unless otherwise specified in the contract documents, the Contractor shall not order piling to be used in the permanent structure until test pile data has been reviewed and pile order lengths are authorized by the Engineer. The Engineer will provide the pile order list after completion of the test pile(s) and dynamic pile driving analysis (PDA) tests and/or pile loading tests specified in the contract documents.

When no test piles are specified for a substructure, the estimated pile lengths in the contract documents are taken as the pile order length.

The lengths given in the order list will be based on the lengths which are assumed after cutoff to remain in the completed structure. The Contractor shall, without added compensation, increase the lengths to provide for fresh heading and for such additional length as may be necessary to suit the Contractor's method of operation.

5. Pile Preparation and Driving: The heads of all piles shall be plane and perpendicular to the longitudinal axis of the pile before the helmet is attached. Approval of a pile hammer relative to driving stress damage shall not relieve the Contractor of responsibility for piles damaged because of misalignment of the leads, failure of cushion materials, failure of splices, malfunctioning of the pile hammer, or other improper construction methods. Piles damaged for such reasons shall be rejected and replaced at the Contractor's expense when the Engineer determines that the damage impairs the strength of the pile.

If it becomes necessary and is authorized by the Engineer to resort to jetting, spudding or pre-holing — and further, if no contract bid price is asked for in the proposal for jetting, spudding, or pre-holing — such work will be paid for as "extra work" in accordance with Articles 1.04.05 and 1.09.04.

The use of a hammer with a greater mass, or the use of piles manufactured or designed with pile tips of a nature to provide for better penetration such as but not limited to composite shells, tapered sections or H-pile sections, shall not be considered as extra work. Authorized point reinforcement for piles shall be a separate item.

Piles for exposed pile bents shall be driven with pile driver leads and templates. They shall be of rigid design and construction and shall maintain the required position and alignment of the piles within the tolerances hereinafter specified. Templates shall be anchored or spudded into position, shall be capable of guiding all piles required for the bent and shall remain in place until all the piles in the bent are driven.

(a) Location and Alignment Tolerance: Piles shall be driven with a variation of not more than 1/4 inch per foot (20 millimeters/meter) from the vertical or from the batter line indicated, except that piles for trestle bents shall be so driven that the cap may be placed in its proper location without inducing excessive stresses in the piles. Upon completion of driving and released from leads, exposed piles such as in bents shall not have a variation of more than 2 inches (50 millimeters) at the cut-off elevation from the position shown on the plans. Unless otherwise permitted in writing by the Engineer, failure to meet this tolerance shall be cause for rejection. Other foundation piles shall not be out of the position shown on the plans more than 6 inches (150 millimeters) after driving. The Engineer may require that driving be stopped in order to check the pile alignment. Pulling laterally on piles to correct misalignment, or splicing a properly aligned section on a misaligned section shall not be permitted.

If the location and/or alignment tolerances specified are exceeded, the extent of overloading shall be evaluated by the Engineer. If in the judgment of the Engineer, corrective measures are necessary, suitable measures shall be designed and constructed by the Contractor.

(b) Heaved Piles: Level readings to measure pile heave after driving shall be made by the Contractor at the start of pile driving operations and shall continue until the Engineer determines that such checking is no longer required. Level readings shall be taken immediately after the pile has been driven and again after piles within a radius of 15 feet (4.5 meters) have been driven. If pile heave is observed, the Contractor shall take accurate level readings referenced to a fixed datum on all piles immediately after installation and periodically thereafter as adjacent piles are driven to determine the pile heave range. All piles that have been heaved more than $\frac{1}{4}$ inch (6 millimeters) shall be redriven at the Contractor's cost, to the required resistance or penetration. Concrete shall not be placed in pile casings until pile driving has progressed beyond a radius of 15 feet (4.5 meters) from the pile to be concreted. If pile heave is detected for pipe or shell piles which have been filled with concrete, the piles shall be redriven to original position after the concrete has obtained sufficient strength and a proper hammer-pile cushion system, satisfactory to the Engineer, is used.

(c) Installation Sequence: The order of placing individual piles in pile groups shall be either starting from the center of the group and proceeding outwards in both directions or starting at the outside row and proceeding progressively across the group.

6. Unsatisfactory Piles: The method used in driving piles shall not subject the piles to excessive or undue abuse producing crushing and spalling of concrete, injurious splitting, splintering, and brooming of the wood, or deformation of the steel. Misaligned piles shall not be forced into proper position. Any pile damaged during driving by reason of internal defects, or by improper driving, or driven out of its proper location, or driven below the designated cutoff elevation, shall be corrected by the Contractor by a method approved by the Engineer.

Piles which have been bent during installation shall be considered unsatisfactory unless the ultimate capacity is proven by load tests performed at the Contractor's expense. If such tests indicate inadequate capacity, corrective measures as determined by the Engineer shall be taken, such as use of bent piles at reduced capacity, installation of additional piles, strengthening of bent piles, or replacement of bent piles.

A concrete pile will be considered defective if a visible crack, or cracks, appears around the entire periphery of the pile, or if any defect is observed which, as determined by the Engineer, affects the strength or life of the pile.

7. Splicing Piles and Extensions: Full length piles shall be used when practicable; but if splices cannot be avoided, piles or shells for cast-in-place piles may be spliced in accordance with the requirements of the plans. Piles shall not be spliced except with the approval of the Engineer. Splices in excess of two per pile for timber, steel and cast-in-place concrete piles will not be permitted except with special permission of the Engineer. Only one splice per pile will be permitted in precast concrete or prestressed concrete piles. In the absence of splice details in the plans, piles or shells for cast-in-place concrete piles shall be spliced in accordance with the pile or shell manufacturer's recommendations, subject to the approval of the Engineer. Working Drawings for prefabricated splicing devices and their method of installation shall be submitted to the Engineer for review. All seams, joints and splices shall develop the full strength of the pile.

8. Point Reinforcement: When directed by the Engineer, the contractor shall point-reinforce piles. Such point-reinforcement shall be in accordance with the plans or as directed.

9. Cutoff Lengths: The pile head of all permanent piles and pile casings shall be cutoff at the elevation shown on the plans or as ordered by the Engineer. All cutoff lengths shall become the property of the Contractor, and shall be removed by the Contractor from the site of the work.

10. Painting Steel Piles and Steel Pile Shells: When steel piles or steel pile shells extend above the ground surface or water surface, they shall be painted as specified elsewhere in the contract documents or as ordered by the Engineer. This protection shall extend from an elevation 2 feet (600 millimeters) below the ground or water surface to the top of the exposed steel.

11. Welding on Piles: When required or permitted, all welding on piles shall be done in accordance with the requirements of the current AWS Structural Welding Code.

7.02.04—Method of Measurement

1. Steel Piles-Timber Piles-Precast Concrete Piles: The length of (type) piles which will be the basis for the pay computation to be included under the item of furnishing (type) piles, shall be number of linear feet (meters) of (type) piles authorized by the Engineer or actually furnished by the Contractor, whichever is the lesser amount.

Length of pile cutoffs previously paid for under authorized lengths of piles and subsequently incorporated into the work will not be measured for payment.

The work, materials, tools, equipment and labor incidental to the disposal of pile cutoffs will not be measured for payment.

The amounts to be included under the item for driving (type) piles will be the number of linear feet (meters) of piles actually driven and accepted in the completed structure.

2. Cast-in-Place Concrete Piles: The amount to be included under the item of cast-in-place concrete piles shall be the number of linear feet (meters) of piles actually driven and accepted in place in the completed structure.

Cut-off materials from shells shall remain the property of the Contractor. They will be paid for in accordance with the unit cost applying in the Contractor's bill or bills for such shells, except that no payment will be made of material cut off from shells furnished by the Contractor in excess of the ordered length. The unit of measurement will be the unit applying in the Contractor's bill or bills for such shells. Material cut off from shells furnished by the Contractor in lengths in excess of those ordered by the Engineer will not be measured for payment hereunder. The work, materials, tools, equipment and labor incidental to the disposal of cutoffs will not be measured for payment.

Reinforcement, if required in cast-in-place concrete piles, will not be measured for payment.

3. Prestressed Concrete Piles (Pretensioned): The length of the prestressed concrete piles, which will be the basis for the pay computation, shall be the number of linear feet (meters) of piles authorized by the Engineer or actually furnished by the Contractor, whichever is the lesser amount. The length of any specified pile tip protruding from the concrete will be included in the length measured for payment.

Also included in the length measured for payment will be the length of precast pile extensions ordered by the Engineer. Not to be included, however, is the length of pile extension furnished in excess of the ordered length. The length of projection dowels shall not be included in the length measured for payment.

Extensions to prestressed concrete piles which are poured monolithically with the footing or pier cap will be paid for at the Contract unit prices for the several items involved, which prices shall be full compensation for all materials, tools, equipment and labor necessary to the completion of the work.

Cut-offs shall not be used for pile extension. The work, material, tools equipment and labor incidental to the disposal of cutoffs will not be measured for payment.

The amounts to be included under the item for driving prestressed concrete piles shall be the number of linear feet (meters) of piles actually driven and accepted in the completed structure.

4. Test Piles: The amounts to be included under the respective items for test piles, of the type and length specified, shall be the number of test piles actually driven and accepted. Lengths of test piles ordered by the Engineer in excess of the length or lengths specified in the contract will be measured for payment by the actual number of linear feet (meters) ordered, furnished and accepted by the Engineer. Driving of such pile extensions will be measured for payment by the actual length driven and left in place.

Authorized splices performed on test piles will be measured for payment by the number of authorized splices actually completed and accepted. Splicing of test piles shall not be considered as authorized splices when such splicing is done to complete piles to the test pile length specified in the contract.

5. Static Load Tests: The amount to be included under the item of static loading tests shall be the actual number of static load tests completed and accepted.

6. Dynamic Pile Driving Analysis (PDA) Test: The amount to be included under this item shall be the actual number of piles which are driven and restruck with dynamic monitoring equipment attached, completed and accepted

7. Splices: The amount to be included under the items for splicing timber, steel, cast-in-place concrete, precast concrete and prestressed concrete piles (pretensioned) shall be the number of authorized pile splices actually completed and accepted. The splicing of timber and steel piles, steel shells for cast-in-place concrete piles, precast concrete piles and prestressed concrete piles (pretensioned) shall not be considered as authorized splices when such splicing is performed to complete piles to the order lengths, as defined in Subarticle 7.02.03-7, or when the furnished lengths of such piles are less than the order lengths approved by the Engineer.

8. Point Reinforcement for Piles: The amount to be included under the item of "Point Reinforcement for Piles" for the type of piles specified shall be the number of authorized reinforced points actually completed and accepted.

9. Pre-Augering of Piles: The amount to be included under the item "Pre-Augering of Piles" shall be the number of linear feet (meters) of pre-augering completed and accepted by the Engineer.

7.02.05--Basis of Payment: This work will be paid for as follows:

1. Steel Piles: Payment for furnishing steel piles of the lengths authorized will be at the Contract unit price per pound (kilogram) for "Furnishing Steel Piles," which price shall include furnishing, delivery, storage and handling, and all materials, equipment, tools and labor incidental thereto. The weight (mass) of steel pile caps will be included with and paid for under this item.

Payment for driving steel piles will be at the contract unit price per linear foot (meter) for "Driving Steel Piles," complete in place, which price shall include all materials, equipment, tools and labor incidental thereto.

2. Timber Piles: Payment for furnishing timber piles or treated timber piles, up to a length 10 feet (3 meters) greater than that specified on the plans or in the proposal form, will be at the Contract unit price per foot (meter) for "Furnishing Timber Piles (' Length)" and "Furnishing Treated Timber Piles (' Length)," respectively, which price shall include furnishing, delivery, peeling, storage and handling, and all materials, equipment, tools and labor incidental thereto.

In case the length of any piles finally ordered is more than 10 feet (3 meters), but less than 20 feet (6 meters), greater than the length specified on the plans or proposal form, payment for furnishing such piles shall be at a price per linear foot (meter) equal to the original contract price, plus 20 percent thereof.

In case the length of any piles finally ordered is 20 feet (6 meters) or more greater than the length specified on the plans or proposal form, payment for furnishing such piles shall be at a price per linear foot (meter) equal to the original contract price plus 40 percent thereof.

Payment for driving timber piles or treated timber piles will be at the contract unit price per linear foot (meter) for "Driving Timber Piles" and "Driving Treated Timber Piles," respectively, complete in place and regardless of length, which price shall include all materials, equipment, tools and labor incidental thereto.

3. Cast-in-Place Concrete Piles: Payment for cast-in-place concrete piles will be at the contract unit price per linear foot (meter) for "Cast-in-Place Concrete Piles," complete in place, including all materials, equipment, tools and labor incidental thereto.

Cut-off materials from shells shall remain the property of the Contractor. They will be paid for in accordance with the unit cost applying in the Contractor's bill or bills for such shells, except that no payment will be made for material cut off from shells furnished by the Contractor in excess of the ordered length.

4. Prestressed Concrete Piles: Payment for furnishing prestressed concrete piles, of the lengths required, will be at the contract unit price per linear foot (meter) for "Furnishing Prestressed Concrete Piles" of the type and size as shown on the plans, which price shall include furnishing, delivery, storage and handling, and all materials, equipment, tools and labor incidental thereto.

Payment for driving prestressed concrete piles will be at the contract unit price per linear foot (meter) for "Driving Prestressed Concrete Piles," complete in place, which price shall include all material, equipment, tools and labor incidental thereto. Also included shall be all work involved in cutting piles to the direct cut-off elevation.

5. Test Piles: Test piles will be paid for at the contract unit price each for "Test Pile," of the type and length specified, which price shall constitute the complete compensation for furnishing and driving test piles and shall include all materials, equipment, tools and labor incidental thereto. Authorized splices to test piles will be paid for at 200 percent of the contract unit price bid for Splicing Timber Piles, Splicing Steel Piles, Splicing Cast-in-Place Piles or Splicing Prestressed Concrete Piles, whichever type of test pile the splice has been performed on; and such payment shall be for all costs including materials, equipment, tools and labor incidental thereto.

Extension to test piles in excess of the specified length will be paid for on the following basis, which shall include all equipment, tools, splices, labor and work incidental thereto.

(a) Timber Test Piles: Extensions will be paid for at 125 percent of the contract unit price per linear foot (meter) for "Furnishing Timber Piles," of the shortest length specified in the proposal, and at 125 percent of the contract unit price per linear foot (meter) for "Driving Timber Piles."

(b) Steel Test Piles: Extensions will be paid for at 125 percent of the contract unit price per pound (kilogram) for "Furnishing Steel Piles" and at 125 percent of the contract unit price per linear foot (meter) for "Driving Steel Piles."

(c) Cast-in-Place Concrete Test Piles: Extensions will be paid for at 125 percent of the contract unit price per linear foot (meter) for "Cast-in-Place Concrete Piles." Cut-off materials from shells will be paid for as provided in Subarticle 7.02.05-3.

(d) Prestressed Concrete Test Piles: Extensions will be paid for at 125 percent of the contract unit price per linear foot (meter) for "Furnishing Prestressed Concrete Piles," and at 125 percent of the contract unit price per linear foot (meter) for "Driving Prestressed Concrete Piles."

6. Static Load Tests: Loading tests will be paid for at the contract unit price each for "Pile Loading Test," which price shall include all expenses incidental to loading the pile or group of piles and removing the load, platform, etc., upon completion of the test.

7. Dynamic Pile Driving Analysis (PDA) Test: Dynamic monitoring will be paid for at the contract unit price each for "Dynamic Pile Driving Analysis (PDA) Test" which price shall include complete compensation for each pile tested using a pile driving analyzer during driving and restrike, including all materials, equipment, tools and labor incidental thereto, as well as providing preliminary and summary report(s).

8. Splices: Authorized splices in timber, steel, cast-in-place piles, precast concrete and prestressed concrete piles will be paid for at the contract unit price each for "Splicing Timber Piles," "Splicing Steel Piles," "Splicing Cast-in-Place Concrete Piles," "Splicing Precast Concrete Piles," "Splicing Prestressed Concrete Piles," respectively, which price shall include all materials, except as otherwise noted, and all equipment, tools and labor incidental thereto. In the absence of such prices, authorized splices will be paid for as extra work.

9. Trimming and Cutting: There shall be no direct compensation for cutting off timber, steel, precast concrete or prestressed concrete piles and shells for cast-in-place concrete piles as ordered; but the cost thereof shall be considered as included in the cost of the pile items.

10. Point Reinforcement for Piles: Authorized points for pointing and reinforcing piles will be paid for at the contract unit price each for "Point Reinforcement for Timber Piles," or "Point Reinforcement for Steel Piles," respectively, whichever applies, which price shall include all materials, equipment, tools and labor incidental thereto. In the absence of such prices, authorized points will be paid for as extra work.

11. Pre-Augering of Piles: Payment for "Pre-Augering of Piles" will be at the contract unit price per linear foot (meter) for "Pre-Augering of Piles," which price shall include which price shall include all materials, and all equipment, tools and labor incidental thereto.

12. Underground Obstructions: If the required pile penetration is not reached due to the presence of underground obstructions which are not the result of the Contractor's operations but are due to the presence of earlier construction at the site, then the cost of removing these obstructions and back-filling the area will be paid for as extra work unless otherwise specified in the contract documents.

13. Painting: There will be no additional payment for painting steel piles and steel pile shells, but the cost thereof shall be considered as included in the cost of furnishing and driving the piles.

14. Disposal of Pile Cutoffs: All costs incidental to the disposal of cutoff material will be included in the price of furnishing of the type of pile specified.

Pay Item	Pay Unit
Furnishing (Type) Piles (Lengths)	lb. (kg)
Driving (Type) Piles	l.f. (m)
Test Pile (Type-Length)	ea. (ea.)
Splicing (Type) Piles	ea. (ea.)
Point Reinforcement for (Type) Piles	ea. (ea.)
Pile Loading Test	ea. (ea.)
Dynamic Pile Driving Analysis (PDA) Test	ea. (ea.)
Pre-Augering of Piles	l.f. (m)

**CONNECTICUT
SUPPLEMENTAL SPECIFICATION
SECTION 7.06
MICROPILES**

Add the following section:

**SECTION 7.06
MICROPILES**

- 7.06.01 – Description**
- 7.06.02 – Materials**
- 7.06.03 – Construction Methods**
- 7.06.04 – Method of Measurement**
- 7.06.05 – Basis of Payment**

7.06.01 - Description: This work shall consist of constructing micropiles in accordance with the Contract. The Contractor is responsible for furnishing all design, materials, products, accessories, tools, equipment, services, transportation, labor and supervision required for design, installation and testing of micropiles and micropile top attachments for this Project.

The Contractor shall select the micropile type, size, pile-top attachment, installation means and methods, and shall estimate the grout-to-ground bond value(s) and determine the required grout bond length and final micropile diameter.

The Contractor shall design and install micropiles that will develop the load capacities indicated on the plans. The micropile load capacities shall be confirmed by verification and proof-load testing as required and must meet the test acceptance criteria specified herein. The Contractor's micropile design shall conform to requirements set forth in this specification and to micropile design minimums/maximums shown on the Contract drawings.

7.06.02 - Materials: Furnish new materials without defects. Materials for micropiles shall comply with the following:

- 1. Admixtures for Grout:** Admixtures shall comply with Article M.03.01 hereof. Accelerators are not permitted. Expansive admixtures and admixtures containing chlorides are not permitted.
- 2. Cement:** Cement shall conform to ASTM C 150/AASHTO M85, Types II, III or V.
- 3. Centralizers and Spacers:** Centralizers and spacers shall be fabricated from Schedule 40 PVC pipe.
- 4. Grout:** Grout shall consist of neat cement or fine aggregate/cement mixture meeting the three (3) and twenty-eight-(28-)day required compressive strengths specified in the Contract. The grout shall conform to AASHTO T106/ASTM C109 and to any minimum and

maximum properties shown on the plans or in Article M.03.05.

- 5. Permanent Casing Pipe:** Permanent steel casing or steel pipe shall conform to required minimum and maximum properties shown on the plans. The steel casing or steel pipe shall comply with one or more of the following specifications: ASTM A252 or A106, or API N-80.
- 6. Reinforcing Bars:** Reinforcing steel shall be deformed bars in accordance with ASTM A615/AASHTO M31. Continuous spiral deformations (*i.e.*, continuous thread bars) shall be used for same. Bar tendon couplers, if required, shall develop the ultimate tensile strength of the bars without evidence of any failure.
- 7. Encapsulation:** Encapsulation (double corrosion protection) shall be shop-fabricated using high-density, corrugated polyethylene tubing complying with the requirements of ASTM D3350/AASHTO M252 with a nominal wall thickness of 0.03 in (0.8 mm). The inside annulus between the reinforcing bar(s) and the encapsulation tube shall measure a minimum 0.2 in (5 mm) and be fully grouted with non-shrink grout conforming to Section M.03.

7.06.03 - Construction Methods:

- 1. Contractor's Experience Requirements:** The micropile Contractor shall be experienced in the construction and load testing of micropiles, having successfully constructed at least five (5) projects in the last five (5) years involving construction totaling at least one hundred (100) micropiles of capacity similar to that required of the ones in these plans and Specifications.

The Contractor shall have previous micropile drilling and grouting experience in soil/rock conditions similar to those on this Project. The Contractor shall submit construction details, structural details and load test results for at least three (3) previous successful micropile load tests from different projects similar in scope to this Project.

The Contractor shall assign or hire a professional engineer, licensed in the State of Connecticut, to supervise the micropile work. That engineer shall have experience on at least ten (10) projects of similar scope to this Project, completed over the past five (5) years. The Contractor shall not use manufacturers' representatives to satisfy the supervising engineer requirements of this Section. The Contractor may use a single independent consultant for this purpose, provided that the consultant has specific experience as described above and operates specifically for the purpose of transferring technology and skills in micropiling to contractors. The on-Site foremen and drill rig operators shall also have experience on at least ten (10) projects over the past five (5) years installing micropiles of equal or greater capacity than is required in these plans and Specifications.

The Contractor shall assign or hire a professional engineer, licensed in the State of Connecticut, to design the micropiles. This engineer shall have experience in the design of at least three (3) successfully-completed micropile projects over the past five (5) years, with micropiles of capacity similar to that required in these plans and specifications. This engineer shall also be responsible for design, supervision and reporting of the verification and proof test(s).

At least forty-five (45) calendar days before the planned start of micropile construction, the Contractor shall submit five (5) copies of the completed Project reference list and a personnel list. The Project reference list shall include a brief Project description with the owner's name and current phone number and load test reports. The personnel list shall identify the supervising Project Engineer, drill rig operators, and on-Site foremen to be assigned to this Project by the Contractor. The personnel list shall contain a summary of each individual's experience and be complete enough for the Engineer to determine whether each individual has the required qualifications.

Work shall not start, nor materials be ordered, until the Engineer gives written approval of the Contractor's experience qualifications. The Engineer may suspend work if the Contractor uses non-approved personnel on the Project. If work is suspended for that reason, the Contractor shall be fully liable for all resulting costs, and Department will not make any Contract time adjustments because of the suspension.

2. Micropile Design Requirements and Submittals: The micropiles shall be designed to meet the specific loading conditions, as shown on the plans and approved working drawings. The micropile design shall conform to all required minimum and maximum properties shown on the plans, the "American Association of State Highway and Transportation Officials (AASHTO) LRFD Bridge Design Specifications" (including the latest Interims), and the "Connecticut Department of Transportation Bridge Design Manual."

Where called for on the plans, the Contractor shall provide corrosion protection of the internal steel reinforcing bars, consisting of encapsulation, epoxy coating or grout. Where the permanent casing is used for a portion of the micropile, the corrosion protection shall extend at least 5 ft (1.5 m) into the casing. Steel pipe used for micropile permanent casing shall incorporate an additional 1/16 in (1.6 mm) thickness of sacrificial steel for corrosion protection.

The Contractor shall submit working drawings in accordance with Section 1.05 to the Engineer. The working drawings shall include all information required for the design, plans, construction and quality control of the micropile installation. The information shall include, but not necessarily be limited to, the following;

(a) Design Computations

- I. A written summary report describing the overall micropile design.
- II. A statement of applicable code requirements and design references.
- III. Micropile structure critical design cross-section(s) geometry, including soil/rock strata and piezometric levels and location, magnitude and direction of applied loadings, including slope or external surcharge loads.
- IV. A description of design criteria to be applied to the work, including, soil/rock shear strengths (friction angle and cohesion), unit weights, and grout-to-ground bond value(s) and micropile drill-hole diameter assumptions for each soil/rock stratum.
- V. A statement of Resistance/Load factors used in the design of the grout-to-ground

bond value(s), surcharges, soil/rock and material unit weights, steel, grout and concrete materials.

- VI. Design calculation sheets with the Project number, micropile structure location, designation, date of preparation, initials of designer and checker, and page number at the top of each page. Provide an index page for the design calculations.
- VII. Design notes including a list of symbols and computer program used in the design.
- VII. Pile-to-footing connection calculations.

(b) Plans

- I. A plan view of the micropile structures providing:
 - i. A reference baseline and elevation datum.
 - ii. The offset from the construction centerline or baseline to the face of the micropile structure at all changes in horizontal alignment.
 - iii. Beginning and end of micropile structure stations.
 - iv. Right-of-way and permanent or temporary construction easement limits, location of all known active and abandoned utilities, adjacent structures or other potential interference; and the centerline of any drainage structure or drainage pipe behind, passing through or passing under the micropile structure.
 - v. Subsurface exploration locations shown on the plan view of the proposed micropile structure alignment with appropriate reference baselines to fix the locations of the exploration relative to the micropile structure.
- II. An elevation view of the micropile structure(s) providing:
 - i. Elevation view showing micropile locations and elevations; vertical and horizontal spacing; batter and alignment and the location of drainage elements (if applicable).
 - ii. Existing and finished grade profiles both behind and in front of the micropile structure.
- III. Design parameters and applicable codes.
- IV. General notes for constructing the micropile structure, including construction sequencing or other special construction requirements.
- V. Horizontal and vertical curve data affecting the micropile structure and micropile structure control points. Match lines or other details to relate micropile structure stationing to centerline stationing.
- VI. A listing of the summary of quantities on the elevation drawing of each micropile structure, showing pay item estimated quantities.

- VII. Micropile typical sections, including micropile spacing and inclination; minimum drill-hole diameter; pipe casing and reinforcing bar size and details; splice type and locations; centralizers and spacers; grout bond zone and casing plunge length (if used); corrosion protection details; and connection details to the substructure footing, anchorages and plates.
- VIII. A typical detail of verification and production proof test micropiles defining the micropile length, minimum drill-hole diameter, inclination, and load test bonded and unbonded test lengths.
- IX. Details, dimensions and schedules for all micropiles, casing and reinforcing steel, including reinforcing bar bending details.
- X. Details for constructing micropile structures around drainage facilities (if applicable).

(c) Construction Procedures

- I. Detailed step-by-step description of the proposed micropile construction procedure, including personnel, testing and equipment to ensure quality control. This step-by-step procedure shall be shown in sufficient detail to allow the Engineer to monitor the construction and quality of the micropiles.
- II. Proposed start date, time schedule and micropile installation schedule providing the following:
 - i. Micropile number.
 - ii. Micropile design load.
 - iii. Type and size of rebar.
 - iv. Minimum total bond length.
 - v. Total micropile length.
 - vi. Micropile top footing attachment.
- III. If welding of casing is proposed, submit the welding procedure. All welding shall be done in accordance with the current AWS Structural Welding Code.
- IV. Information on space requirements for installation equipment that verify the proposed equipment can perform at the Site.
- V. Proposed plan describing how surface water, drill flush, and excess waste grout will be controlled and disposed. This will include computations showing that the proposed equipment used for flushing the micropile during installation (*i.e.*, pumps for water flushing and compressors for air flushing) will maintain up-hole (flushing) velocities necessary to ensure that all of the flush and drill cuttings are returned up through the annulus between the drill rod and casing.

- VI. Certified mill test reports for the reinforcing steel and for permanent casing. The ultimate strength, yield strength, elongation, and material properties composition shall be included. For API N-80 pipe casing, coupon test results may be submitted in lieu of mill certification.
- VII. Proposed Grouting Plan. The grouting plan shall include complete descriptions, and details for the following:
 - a. Grout mix design and type of materials to be used in the grout, including certified test data and trial batch reports. The Contractor shall also provide specific gravity of the wet mix design.
 - b. Methods and equipment for accurately monitoring and recording the grout depth and grout volume as the grout is being placed.
 - c. Estimated curing time for grout to achieve specified strength. Previous test results for the proposed grout mix completed within one (1) year of the start of grouting may be submitted for initial verification and acceptance and start of production work. During production, grout shall be tested in accordance with Article M.03.05.
 - d. Procedure and equipment for Contractor monitoring of grout quality. At a minimum, the Contractor shall be required to use a Baroid Mud Balance (per API RP-13B-1) to check the specific gravity of the mixed grout prior to placement into each drilled micropile.
- (d) Detailed plans for the proposed micropile load testing method. This shall include all drawings, details, and structural design calculations necessary to clearly describe the proposed test method, reaction load system capacity and equipment setup, types and accuracy of apparatus to be used for applying and measuring the test loads and pile top movements in accordance with this Specification.
- (e) Calibration reports and data for each test jack, pressure gauge and master pressure gauge and electronic load cell to be used. The calibration tests shall have been performed by an independent testing laboratory within ninety (90) calendar days of the date submitted. Testing shall not commence until the Engineer has reviewed and accepted the jack, pressure gauge, master pressure gauge and electronic load cell calibration data.

Work shall not begin until the construction submittals have been received, reviewed, and accepted in writing by the Engineer. Any submittals found to be unacceptable by the Engineer shall be revised, resubmitted and accepted prior to commencing work.

3. Pre-construction Meeting: A pre-construction meeting will be scheduled by the Engineer and held prior to the start of micropile construction. The Engineer, prime Contractor, micropile specialty Contractor and micropile design engineer shall attend the meeting. Attendance is mandatory. The pre-construction meeting will be conducted in order to clarify the construction requirements for the work, to coordinate the construction schedule and activities, and to identify contractual relationships and delineation of responsibilities among the prime Contractor and the various subcontractors - specifically those pertaining to

excavation for micropile structures, installation of temporary sheeting, anticipated subsurface conditions, micropile installation and testing, micropile structure survey control and Site drainage control.

- 4. Site Drainage Control:** The Contractor shall control and properly dispose of drill flush and construction related waste, including excess grout, in accordance with Section 1.10, any related Special Provisions in the Contract, and all applicable codes and regulations. Drill flush shall be conveyed by pipe, hose or conduit away from the location where the micropile is being drilled and away from any adjacent structure or facility. The Engineer will determine the acceptable distance required to convey the drill flush away from the micropile location. The Contractor shall provide positive control and discharge of all surface water that will affect construction of the micropile installation; maintain all pipes or conduits used to control surface water during construction; and repair any damage caused by surface water at no additional cost to the Department. Upon substantial completion of the work, the Contractor shall remove surface water control pipes or conduits from the Site. Alternatively, with the approval of the Engineer, the Contractor may leave pipes or conduits in place if fully grouted.

The Contractor shall immediately contact the Engineer if unanticipated existing subsurface drainage structures or other utilities are discovered during excavation or drilling; and shall suspend work in such areas until remedial measures meeting the Engineer's approval are implemented.

5. Micropile Allowable Construction Tolerances:

- (a) Centerline of piling shall not be more than 3 in (75 mm) from indicated plan location. Centerline of reinforcing steel shall not be more than 0.5 in (13 mm) from the centerline of the pile.
- (b) Pile shall be plum or battered within two percent (2%) of total-length plan alignment.
- (c) Top elevation of pile shall be plus 1 in (25 mm) or minus 1 in (25 mm) maximum from vertical elevation indicated.

- 6. Micropile Installation:** The micropile Contractor shall select the drilling method, the grouting procedure and the grouting pressure used for installation of the micropiles. The micropile Contractor shall also determine the micropile casing size, final drill-hole diameter and bond length, and central tendon reinforcement steel size necessary to develop the specified load capacities and load testing requirements. All micropile material properties and dimensions shall conform to minimum/maximum properties and dimensions as shown in the Contract drawings. The micropile Contractor is also responsible for estimating the grout take. The Department will make no extra payment for grout overruns.

Should the plans require uncased drilling of the micropile into bedrock, the permanent or temporary casing shall be drilled a minimum 6 in (150 mm) into ledge or to a depth within the ledge so as to prevent subsidence of overburden into the uncased and bonded zone portion of the drill-hole (*i.e.*, the rock socket). The plans show estimated permanent casing lengths for each substructure unit. Any difference in the required length of permanent casing accepted by the Engineer from the estimated lengths shown on the plans shall be

measured for payment and credit. The Department will make no payment for differences in required length of temporary casing.

The drilling equipment and methods shall be suitable for drilling through the conditions to be encountered, without causing damage to the overburden, any overlying or adjacent structures, buried structures, utilities or services. If called for in the drilling method description, or by the nature of the stratum to be drilled through, the micropile Contractor shall furnish an overburden casing of the type and thickness that can be installed without distortion. Casings that fail, fracture, or otherwise distort during drilling or after drilling shall, unless otherwise directed, be withdrawn or replaced at the micropile Contractor's expense. The drill-hole must be open along its full length to at least the design minimum drill-hole diameter prior to placing grout and reinforcement.

Temporary casing or other approved method of pile drill-hole support will be required in caving or unstable ground in order to permit the pile shaft to form a drill hole of the minimum design diameter. The Contractor's proposed method(s) to provide drill-hole support and to prevent detrimental ground movements must be reviewed by the Engineer in advance of its use. Detrimental ground movement is defined as movement that requires remedial repair measures, in order to maintain Site conditions as determined by the Engineer.

Drilling and flushing methods shall be selected by the Contractor. Use of drilling fluid containing bentonite or any other non-reverting drilling fluid, however, is not allowed. The drilling and flushing system chosen by the Contractor shall be capable of providing the necessary up-hole velocity so as to ensure that all the flush and drill cuttings are returned up through the annulus between the drill rod and casing. The flush must not be allowed to escape in an uncontrollable fashion into the soil and rock formations outside the casing. The return flush must never be blocked or suppressed within the casing on its way back to the surface. The Contractor shall monitor and modify, as needed, the flush velocity and other elements of its drilling methods that could contribute to return of flush outside the casing. When return of flush is substantially lost during drilling, the Contractor shall halt drilling operations and immediately notify the Engineer of the situation.

During construction, the Contractor shall observe the ground conditions in the vicinity of the micropile construction site on a daily basis for signs of ground heave or subsidence, and must immediately notify the Engineer if signs of movements are observed. The micropile Contractor shall immediately suspend or modify drilling or grouting operations if ground heave or subsidence is observed, if the micropile structure is adversely affected, or if adjacent structures are damaged because of the drilling or grouting. If the Engineer determines that the movements require corrective action, the micropile Contractor shall take corrective actions necessary to stop the movement or perform repairs.

Reinforcement may be placed prior to grouting the drill-hole. Reinforcement surface shall be free of deleterious substances such as soil, mud, grease or oil that might contaminate the grout or coat the reinforcement and impair bond. Pile reinforcement groups, if used, shall be sufficiently strong to withstand the installation and grouting process without damage or disturbance.

The micropile Contractor shall check pile-top elevations and adjust all installed micropiles to the planned elevations.

Centralizers and spacers shall be provided at 10 ft (3 m) on center maximum spacing. The uppermost and lowest centralizers shall be located a maximum of 3 ft (0.9 m) from the top and bottom of the micropile. Centralizers and spacers shall be securely attached to the reinforcement, sized to position the reinforcement within 1/2 in (12 mm) of plan location from center of pile, sized to allow grout tremie pipe insertion to the bottom of the drill-hole, and must be of sufficient size to allow grout to flow freely up the drill-hole, up the casing, and between adjacent reinforcing bars. The reinforcing steel shall be inserted into the drill-hole to the desired depth without difficulty. Partially inserted reinforcing bars shall not be driven or forced into the hole. The micropile Contractor shall re-drill and reinsert reinforcing steel when necessary in order to facilitate insertion.

Lengths of casing and reinforcing bars to be spliced shall be secured in proper alignment and in a manner that prevents eccentricity or an angle between the axes of the lengths to be spliced. Splices and threaded joints shall meet the requirements of the rebar material. Threaded pipe casing joints shall be located at least two (2) casing diameters (OD) from a splice in any reinforcing bar. When multiple bars are used, bar splices shall be staggered at least 1 ft (0.3 m).

Micropiles shall be grouted on the same day that the load transfer bond length is drilled. The grouting equipment used shall be a colloidal grout plant and shall produce a grout free of lumps and undispersed cement. Paddle type mixers are not acceptable. The micropile Contractor shall have means and methods of measuring the grout quantity and pumping pressures during the grouting operations. The grout pump shall be equipped with a pressure gauge to monitor grout pressure. A second pressure gauge shall be placed at the point of injection into the pile top. The pressure gauge shall be capable of measuring pressures of at least 145 psi (1000 kPa) or two (2) times the actual grout pressure used, whichever is greater. The grout shall be kept in agitation prior to mixing. Grout shall be placed within one (1) hour of mixing. The grouting equipment shall be sized to enable each pile to be grouted in one continuous operation. The grout shall be injected from the lowest point of the drill-hole, and injection shall continue until uncontaminated grout flows from the top of the pile. The grout may be pumped through grout tubes, casing, hollow stem augers or drill rods. Temporary casing, if used, shall be extracted in stages so as to ensure that, after each length of casing is removed, the grout level is brought back up to the ground level before the next length is removed. The tremie pipe or casing shall always extend below the level of the existing grout in the drill-hole. The grout takes shall be controlled to prevent excessive heave or fracturing of rock or soil formations. Upon completion of grouting, the grout tube may remain in the hole, but must be filled with grout.

If the Contractor elects to use a post-grouting system, working drawings and details shall be submitted to the Engineer for review in accordance with Section 1.05.

Grout within the micropile verification and proof test piles shall attain the minimum required three-(3-)day compressive strength prior to load testing. During production, micropile grout shall be tested by the Contractor for compressive strength in accordance with AASHTO T106/ASTM C109 at a frequency of no less than one (1) set of three (3) each 2 in (50 mm) grout cubes, or 3 in (75 mm) cylinders, from each grout plant each day of operation, or per every ten (10) micropiles, whichever occurs more frequently. The compressive strength shall be the average of the three (3) cubes or cylinders tested.

Grout consistency as measured by grout density shall be determined by the micropile Contractor per API RP-13B-1 at a frequency of at least one (1) test per pile, conducted just prior to start of pile grouting. The Baroid Mud Balance used in accordance with API RP-13B-1 is an approved device for determining the grout density of neat cement grout.

Provide grout cube or cylinder compressive strength and grout density test results to the Engineer within twenty-four (24) hours of testing.

- 7. Micropile Installation Records:** The micropile Contractor shall prepare and submit to the Engineer full-length installation records for each micropile installed. The records shall be submitted within one (1) work shift after that pile installation is completed. The data shall be recorded on a micropile installation log. A separate log shall be provided for each micropile.
- 8. Verification and Proof Tests:** The Contractor shall perform verification and proof testing of piles at the locations specified on the plans, and perform compression load testing in accord with ASTM D1143 and tension load testing in accord with ASTM D3689, except as modified herein. If the Contractor designs micropiles using tip resistance, it shall use ASTM 1143 for verification and proof tests thereof.

The Contractor shall perform pre-production verification pile load test(s) to verify the design of the pile system and the construction methods proposed prior to installing any production piles. Sacrificial verification test pile(s) shall be constructed by the Contractor in conformance with the approved working drawings, and shall install verification test pile(s) at the location(s) shown on the plans or at location(s) approved by the Engineer.

Verification load test(s) shall be performed in order to verify that the micropiles installed by the Contractor will meet the compression and tensile load capacities and load test acceptance criteria, and to verify that the length of the micropile load transfer bond zone is adequate. The micropile verification load test results must verify the Contractor's design and installation methods.

The drilling method, grouting method, permanent casing length, micropile diameter (cased and uncased) and bond zone length for the verification test pile shall be identical to those specified for the production piles at the given locations. The verification test micropile structural steel sections shall be sized to safely resist the maximum test load.

The maximum verification and proof test loads applied to the micropile shall not exceed eighty percent (80%) of the structural capacity of the micropile structural elements, including steel yield in tension, steel yield or buckling in compression, or grout crushing in compression. Any required increase in strength of the verification and proof test pile elements above the strength required for the production piles shall be provided for in the Contractor's bid price.

Testing equipment used in connection with the micropiles shall include dial gauges, dial gauge independent reference frame, jack and pressure gauge, electronic load cell (with readout device), and a reaction frame. The load cell is required only for the creep test portion of the verification test. The Contractor shall provide a description of test setup and jack, pressure gauge and load cell calibration curves as outlined in the Submittals Section.

The Contractor shall design the testing reaction frame to be sufficiently rigid and of adequate dimensions to ensure that excessive deformation of the testing equipment does not occur; and must align the jack, bearing plates, and stressing anchorage so that unloading and repositioning of the equipment will not be required during the test.

The Contractor shall also apply and measure the test load with a hydraulic jack and pressure gauge. The pressure gauge shall be graduated in 100 psi (690 kPa) increments or less. The jack and pressure gauge shall have a pressure range not exceeding twice the anticipated maximum test pressure. Jack ram travel shall be sufficient to allow the test to be done without resetting the equipment. The Contractor shall monitor the creep-test-load-hold during verification tests with both the pressure gauge and the electronic load cell; and shall use the load cell in order to accurately maintain a constant load hold during the creep-test-load-hold increment of the verification test.

The Contractor shall measure the pile top movement with a dial gauge capable of measuring to 0.001 in (0.025 mm). The dial gauge shall have a travel sufficient to allow the test to be done without having to reset the gauge; and the Contractor shall visually align the gauge to be parallel with the axis of the micropile and support the gauge independently from the jack, pile or reaction frame. The Contractor shall also use a minimum of two (2) dial gauges when the test setup requires reaction against the ground or single reaction piles on each side of the test pile.

The Contractor shall test verification piles to the following loads: Alignment Load ("AL"), Maximum Service Limit Pile Load ("SVL") and the Ultimate Pile Capacity ("UPC"). The SVL and UPC loads are provided on the Contract drawings. The AL is the minimum load applied to the micropile during testing needed to keep the testing equipment correctly positioned. The AL shall not exceed five percent (5%) of the SVL. The verification pile load tests shall be made by incrementally loading the micropile in accordance with the cyclic load schedule shown in Table 7.06-1, for both compression and tension loading (test the compression prior to tension).

Table 7.06-1, Cyclic Load Schedule for Verification Pile Load Test

Step	Loading	Applied Load	Hold Time (minutes)
1	Apply AL	AL	2.5
2	Cycle 1	0.15 SVL	2.5
		0.30 SVL	2.5
		0.45 SVL	2.5
		0.60 SVL	2.5
		0.75 SVL	2.5
		0.90 SVL	2.5
		1.00 SVL	10 to 60 minutes
		0.60 SVL	2.5
		0.30 SVL	2.5
		AL	
3	Cycle 2	0.075 UPC	2.5
		0.150 UPC	2.5
		0.225 UPC	2.5
		0.300 UPC	2.5
		0.375 UPC	2.5
		0.450 UPC	2.5
		0.525 UPC	2.5
		0.600 UPC	2.5
		0.675 UPC	2.5
		0.750 UPC	2.5
		0.825 UPC	2.5
		0.900 UPC	2.5
		1.000 UPC	10 to 60 minutes
		0.750 UPC	2.5
		0.525 UPC	2.5
		0.225 UPC	2.5
AL			

Pile-top movement shall be measured at each load increment. The load-hold period shall start as soon as each test load increment is applied. Pile movement during the 1.00 SVL and 1.000 UPC loads shall be measured and recorded at 1,2,3, 4, 5, 6, 10, 20, 30, 50, and sixty (60) minutes. The alignment load shall not exceed five percent (5%) of the SVL. Dial gauges shall be reset to zero after the initial AL is applied.

The acceptance criteria for micropile verification load test are:

- (a) The Engineer shall determine the criteria for tolerable movement during the load test at the top of the micropile.
- (b) At the end of the maximum test load increment for each cycle, test piles shall have a creep rate not exceeding 0.05 in (1.3 mm) /log cycle time (1 to 10 minutes) or 0.1 in (2.5 mm) /log cycle time (6 to 60 minutes or the last log cycle if held longer). The creep rate shall be linear or decreasing throughout the hold period.

- (c) Failure does not occur at any load increment up to and including the maximum test load for each cycle. Failure is defined as load at which attempts to further increase the test load simply result in continued pile movement.

Upon completion of the test, the Contractor shall prepare and submit a report of the test results, stamped by a professional engineer, for review and acceptance by the Engineer prior to beginning installation of production micropiles. This report shall include written confirmation of the verification micropile's capacity.

If a verification tested micropile fails to meet the acceptance criteria, the Contractor shall modify the design, the construction procedure, or both. These modifications may include modifying the installation methods, increasing the bond length, or changing the micropile type. Any modification that necessitates changes of the structure shall be submitted as a revision to the working drawings and require the Engineer's review and acceptance. Any modifications of design or construction procedures or cost of additional verification test piles and load testing shall be at the Contractor's expense. At the completion of verification testing, the Contractor shall remove test piles down to the elevation specified by the Engineer.

The Contractor shall perform proof load tests at the micropile locations as shown on the plans, and shall perform proof-load tests on the first set of production piles installed at each designated substructure unit prior to the installation of the remaining production piles in that unit. The initial proof-test piles shall be installed at the locations shown on the plans. Upon completion of each test, the Contractor shall prepare and submit a report of the test results, stamped by a professional engineer, for review and acceptance by the Engineer

The Contractor shall test proof test piles to a maximum test load of 1.00 times the Maximum Strength Limit Pile Load (STL). The STL load is provided on the Contract drawings. Proof tests shall be made by incrementally loading the micropile as shown in Table 7.06-2, to be used for both compression and tension loading:

Table 7.06-2, Incremental Loading for Proof Test Piles

Step	Loading	Applied Load	Hold Time (minutes)
1	Apply AL		2.5
2	Cycle 1	0.15 STL	2.5
		0.30 STL	2.5
		0.45 STL	2.5
		0.60 STL	2.5
		0.75 STL	2.5
		0.90 STL	2.5
		1.00 STL	10 to 60 minutes
		0.60 STL	2.5
		0.30 STL	2.5
		AL	

Depending on performance, either a ten-(10-)minute or sixty-(60-)minute creep test shall be performed at the 1.00 STL test load. Where the pile top movement between one (1) and then (10) minutes exceeds 0.039 in (1 mm), the Maximum Test Load shall be

maintained an additional fifty (50) minutes. Movements shall be recorded at 1, 2, 3, 5, 6, 10, 20, 30, 50 and 60 minutes. The alignment load shall not exceed five percent (5%) of STL. Dial gauges shall be reset to zero after the initial AL is applied.

The acceptance criteria for micropile proof load tests are:

- (a) The Engineer shall determine the criteria for tolerable movement during the load test at the top of the micropile.
- (b) At the end of the 1.00 STL test load increment, test piles shall have a creep rate not exceeding 0.05 in (1.3 mm) /log cycle time (1 to 10 minutes) or 0.1 in (2.5 mm) /log cycle time (6 to 60 minutes). The creep rate shall be linear or decreasing throughout the creep-load hold period.
- (c) Failure does not occur at the 1.00 STL maximum test load. Failure is defined as the load at which attempts to further increase the test load simply result in continued pile movement.

If a proof-tested micropile fails to meet the acceptance criteria, the Contractor shall immediately proof test another micropile within that footing. For failed piles and further construction of other piles, the Contractor shall modify the design, the construction procedure, or both. These modifications may include installing replacement micropiles, incorporating piles at not more than fifty percent (50%) of the maximum load attained, post-grouting the tested pile and re-proof testing the pile, modifying installation methods, increasing the bond length, or changing the micropile type. Any modification that necessitates changes of the structure design shall require the Engineer's prior review and acceptance. Any modifications of design or construction procedures, or cost of additional verification test piles and verification or proof load testing, or replacement production micropiles, shall be at the Contractor's expense.

7.06.04 - Method of Measurement:

- 1. Micropiles** will be measured for payment by the number of micropiles installed and accepted. There will be no separate measurement or payment for furnishing the design of the micropiles or developing installation methods to meet these Specifications.
- 2. Verification Test for Micropiles** will be measured for payment by the number of verification tests performed on sacrificial micropiles.
- 3. Proof Test for Micropiles** will be measured for payment by the number of proof tests performed on production micropiles.
- 4. Micropile Length Adjustment** will be measured for payment by the length in linear feet (meter) of the difference between the estimated length of permanent casing, as shown on the plans, and the actual length of permanent casing installed and accepted by the Engineer. (Note that the permanent casing length is measured from the bottom of the pile cap to the permanent casing tip, including the required embedment of casing into rock. Embedment into the pile cap will not be measured for payment because it is considered incidental to micropile construction. Any increase in casing length will be measured for

payment to the Contractor, and any decrease in casing length will be measured for credit to the State.)

There will be no separate measurement or payment for mobilization and demobilization associated with this item.

7.06.05 - Basis of Payment:

- 1. Micropiles** will be paid for at the Contract unit price each for “Micropiles” complete and accepted in place, including all design, development of installation methods, materials, equipment, tools, proper disposal of drilling spoil and labor incidental thereto.
- 2. Verification Test for Micropiles** will be paid for at the Contract unit price each for “Verification Test for Micropiles” completed on sacrificial micropiles, including all materials, testing equipment, tools, test reports, removal of test piles and labor incidental thereto.
- 3. Proof Test for Micropiles** will be paid for at the Contract unit price each for “Proof Test for Micropiles” completed on production micropiles, including all materials, testing equipment, tools, test reports and labor incidental thereto.
- 4. Micropile Length Adjustment** will be paid for at the Contract unit price per linear foot (meter) for “Micropile Length Adjustment” complete and accepted, including all materials, equipment, tools, and labor incidental thereto.

Pay Item	Pay Unit
Micropiles	ea. (ea.)
Verification Test for Micropiles	ea. (ea.)
Proof Test for Micropiles	ea. (ea.)
Micropile Length Adjustment	l.f. (m)

**CONNECTICUT
SUPPLEMENTAL SPECIFICATION
SECTION 8.22
TEMPORARY PRECAST CONCRETE BARRIER CURB**

8.22.04 – Method of Measurement:

Add the following sentence to the end of the second paragraph:

“Relocation of Temporary Precast Concrete Barrier Curb for access to the work area or for the convenience of the Contractor shall be considered incidental to Maintenance and Protection of Traffic and will not be measured for payment.”

**CONNECTICUT
SUPPLEMENTAL SPECIFICATION
SECTION 9.10
METAL BEAM RAIL**

9.10.02 – Materials:

Change the only sentence in Subarticle 1 as follows:

“Chemical anchoring material shall meet the requirements of Article M.03.07.”

9.10.04 – Method of Measurement

1 – Metal Beam Rail (Type)

Delete the only sentence and replace with the following:

“The length of metal beam rail measured for payment will be the number of linear feet (meters) of accepted rail of the type or designation installed, including radius rail other than Curved Guide Rail Treatment, measured along the top of rail between centers of end posts in each continuous section.”

**CONNECTICUT
SUPPLEMENTAL SPECIFICATION
SECTION 9.18
THREE CABLE GUIDE RAILING
(I-BEAM POSTS) AND ANCHORAGES**

9.18.03 – Construction Methods:

In the 10th paragraph, replace “MIL” with “MILSPEC.”

**CONNECTICUT
SUPPLEMENTAL SPECIFICATION
SECTION 9.22
BITUMINOUS CONCRETE SIDEWALK
BITUMINOUS CONCRETE DRIVEWAY**

9.22.03 – Construction Methods:

Replace the first paragraph with the following:

“1. Excavation: Excavation, including saw cutting, removal of any existing sidewalk, or driveway, shall be made to the required depth below the finished grade, as shown on the plans or as directed by the Engineer. All soft and yielding material shall be removed and replaced with suitable material.”

9.22.05 – Basis of Payment:

Replace the only paragraph with the following:

“This work will be paid for at the contract unit price per square yard (square meter) for "Bituminous Concrete Sidewalk" or "Bituminous Concrete Driveway," as the case may be, complete in place, which price shall include all saw cutting, excavation as specified above, backfill, disposal of surplus material, gravel or reclaimed miscellaneous aggregate base, and all equipment, tools, labor and materials incidental thereto.”

**CONNECTICUT
SUPPLEMENTAL SPECIFICATION
SECTION 9.44
TOPSOIL**

9.44.03—Construction Methods:

Add the following paragraph to the beginning of the article:

“The Contractor shall notify the Engineer of the location of the topsoil at least 15 calendar days prior to delivery. The topsoil and its source shall be inspected and approved by the Engineer before the material is delivered to the project. Any material delivered to the project, which does not meet specifications or which has become mixed with undue amounts of subsoil during any operation at the source or during placing and spreading, will be rejected and shall be replaced by the Contractor with acceptable material.”

**CONNECTICUT
SUPPLEMENTAL SPECIFICATION
SECTION 9.49
FURNISHING, PLANTING and MULCHING
TREES, SHRUBS, VINES and GROUND COVER PLANTS**

9.49.03 – Construction Methods:

Replace subarticle “5. Pits” with the following:

“5. Pits: The pit diameters shall be twice the diameter of the root-spread or container diameters, and shall be 2- inches (50 millimeters) less than the height of the rootball measured from the bottom of the ball to the root collar. (i. e. A 12-inch (300 millimeters) measurement between the root collar and the bottom of the rootball will require a 10- inch (250 millimeters) deep pit). Any excavation in excess of that required shall be replaced with planting soil and compacted to the satisfaction of the Engineer.”

Add the following sentence to subsection “6. Obstructions Below Ground:”

“If removal of obstructions results in a deeper hole than needed for planting, backfill material shall be added and compacted to the satisfaction of the Engineer.”

Replace subarticle “7. Preparation of Backfill” with the following:

“7. Backfill: Backfill shall conform to M.13.01-1 Planting Soil.”

Replace subarticle “8. Setting Plants” with the following:

“8. Setting Plants: All plants shall be plumb and at a level that is 2-inches (50 millimeters) higher than the surrounding ground. Backfill material for all plants shall be thoroughly and properly settled by firming or tamping. Thorough watering shall accompany backfilling. Saucers capable of holding water shall be formed at individual plants (exclusive of plant beds) by placing ridges of planting soil around each, or as directed by the Engineer.

a. Balled and Burlapped plants: Plants shall be handled in such manner so that the soil will not be loosened from the roots inside of the ball. Carefully place the plant into the prepared pits and backfill with planting soil to one - half the depth of the pit, thoroughly tamp to the satisfaction of the Engineer around the ball. Fill the remaining area of the pit with water. Once water has completely drained, loosen the burlap and peel down the top one third. If wire baskets are used, cut and bend down the top third of the basket. Roots that have been wrapped around the ball within the burlap shall be straightened and the remainder of the pit filled with planting soil tamped to ensure that no air pockets remain.

b. Container Grown Plants: Carefully remove the plant from the container over the prepared pits. Gently loosen the soil and straighten all roots as naturally as possible. Place into the bottom of the pit. Backfill with planting soil to one - half the depth of the pit. Thoroughly tamp to the satisfaction of the Engineer. Fill remaining area of the pit with water. Once water has completely drained fill the remainder of the pit with planting soil tamped to ensure that no air pockets remain.

c. Bare-roots Plants: Carefully spread roots as naturally as possible and place into the bottom of the pit. All broken or frayed roots shall be cleanly cut off. Backfill with planting soil to one - half the depth of the pit. Thoroughly tamp to the satisfaction of the Engineer. Fill remaining area of the pit with water. Once water has completely drained fill the remainder of the pit with planting soil tamped to ensure that no air pockets remain.”

Replace subarticle “10. Watering” with the following:

“10. Watering: All plants shall be watered upon setting and as many times thereafter as conditions warrant.

The following is a guide for minimum requirements:

Trees:

2 ½” Caliper and less – Fifteen (15) gallons each.

3” to 5” Caliper – Twenty (20) gallon each.

5 ½” Caliper and above – Twenty-five (25) gallon each.

Shrubs:

24” and less – Six (6) gallon each.

More than 24”- Ten (10) gallon each.

Vines, Perennials, and Ornamental Grasses – Three (3) gallons each.

Groundcovers and Bulbs – Two (2) gallons per square foot.

Water shall be applied at a controlled rate and in such a manner to ensure that the water reaches the root zone (saucer) of the plant or plant bed and does not run off to adjacent areas. Watering shall be applied in a manner that does not dislodge plants, erode soil or mulch, or cause damage to saucer.

The Contractor may use slow-release, drip irrigation bags for watering in accordance with manufacturer’s instructions. The use of these portable/temporary irrigation bags will require the approval of the Engineer.

Overhead hydro-seeder spray nozzles shall not be used as watering devices.”

Replace subarticle “17. Establishment Period” with the following:

“17. One-Year Establishment Period: All plant material shall be subject to a One-Year Establishment Period. During this time, the Contractor shall use currently accepted horticultural practices to keep all plant material installed in a healthy, vigorous growing condition at the date of final acceptance. The date of final acceptance shall be one full

calendar year following the satisfactory completion of the planting activities as confirmed by the Engineer.

An inspection will be held one year from the date of installation with the Contractor, Engineer, and Landscape Designer to determine the acceptability of the plant establishment. An inventory of losses and rejected materials will be made and corrective and necessary clean up measures will be determined at the plant inspection.”

**CONNECTICUT
SUPPLEMENTAL SPECIFICATION
SECTION 9.75
MOBILIZATION**

Delete the entire section and replace with the following new section:

**SECTION 9.75
MOBILIZATION AND PROJECT CLOSEOUT**

9.75.01 – Description: This item consists of

1. all work necessary for moving Project personnel and equipment to the Project Site;
2. all work necessary for the establishment of the Contractors' field offices, buildings and other facilities necessary for Contract performance;
3. the preparation of work plans and other documents that must be submitted by the Contractor to the Department prior to the start of physical Project construction. These initial submittals are identified elsewhere in the Contract and may include Project schedules, Project management plans, staging and storage areas, safety plans, quality control plans, erosion and sedimentation control plans, and other documents addressing general Project sequencing or management;
4. demobilization of plant and equipment;
5. completion of all physical work, and
6. completion of administrative closeout items as required by the Contract.

The work entailed in this item shall not be subcontracted in whole or part.

9.75.04 – Method of Measurement: This work will be measured for payment in the manner described hereinafter; however, the total Contract amount earned will not include payments for mobilization that were earned during the period covered by the current monthly estimate, but will include those payments for mobilization that were previously earned and certified for payment.

1. When the first Project payment estimate is reviewed by the Engineer, twenty-five percent (25%) of the lump sum bid price for this item or two and a half percent (2.5%) of the total original Contract price, whichever is less, will be certified for payment as a part of that estimate.
2. When the Contractor's initial Project submittals are accepted by the Engineer, fifty percent (50%) of the lump sum bid price for this item or five percent (5%) of the total original Contract price, whichever is less, minus any previous Project payments made to the Contractor for this item, will be certified for payment.
3. When the Contractor's initial Project submittals are accepted by the Engineer, and fifteen percent (15%) of the total original Contract price has been earned by the Contractor, seventy percent (70%) of the lump sum price of this item or seven percent (7%) of the total original Contract price, whichever is less, minus any previous Project payments made to the Contractor for this item, will be certified for payment.
4. When thirty percent (30%) of the total original Contract price has been earned by the Contractor, eighty-five percent (85%) of the lump sum price of this item or eight and a half percent (8.5%) of the total original Contract price, whichever is less, minus any previous payments made to the Contractor for this item, will be certified for payment.

5. When the requirements of Article 1.08.13 have been satisfied by the Contractor, ninety-five percent (95%) of the lump sum price of this item, minus any previous payments made to the Contractor for this item, will be certified for payment.
6. When the requirements of Article 1.08.14 have been satisfied by the Contractor, one hundred percent (100%) of the lump sum price of this item, minus any previous payments made to the Contractor for this item, will be certified for payment. When this payment is made, the Contractor should have received full Contract payment for this item.

Nothing herein shall be construed to limit or preclude the Department from making partial payments to the Contractor that are provided for elsewhere in this Contract.

9.75.05 – Basis of Payment: The work under this item will be paid for at the Contract lump sum price for “Mobilization and Project Closeout,” which price shall include materials, equipment, tools, transportation, labor and all work incidental thereto.

Payment for this item shall be made only once; *i.e.*, for only one instance of mobilization as described in Article 9.75.01 above. If the Contractor mobilizes equipment or facilities more than one time during the course of the Project, due to reasons solely the responsibility of the Department, the additional work entailed therein will be paid for as Extra Work under Section 1.04.05 hereof.

Pay Item	Pay Unit
Mobilization and Project Closeout	l.s. (l.s.)

**CONNECTICUT
SUPPLEMENTAL SPECIFICATION
SECTION 10.00
GENERAL CLAUSES FOR HIGHWAY
ILLUMINATION AND TRAFFIC SIGNAL
PROJECTS**

Add the following new article after 10.00.13 Service Installations:

“ 10.00.14- Maintenance of Illumination During Construction: The Contractor shall organize the Project work so that any portion of roadway which has existing roadway illumination and is open for use remains lighted. The Contractor shall also provide illumination on all temporary crossovers, ramps and roadways that are constructed as part of staged construction and that are open for use. Highway illumination may consist of: existing lighting, new lighting, temporary lighting, or any combination thereof. It is the Contractor’s responsibility to stage the installation or relocation of service cabinets, poles, lights, and circuitry so that all roadways of the kind described above remain lighted. If it is necessary to install temporary poles, lights, or circuitry to maintain the integrity of the highway illumination system, such work shall be submitted to the Engineer for approval prior to installation, and will be paid for at the Contract bid unit price for the relevant items. Temporary illumination work not specifically covered by the Contract specifications and pay items will be paid for as extra work at the discretion of the Engineer.

If the Contract includes temporary illumination plans, those plans shall serve as a framework for providing roadway illumination during construction. Temporary illumination plans may not represent the full extent of the temporary illumination work required, or the exact quantity of temporary lights required to maintain proper roadway illumination.

Prior to the start of any work that will interfere with the existing lighting system, the Contractor and ConnDOT District Electrical Maintenance personnel shall inspect the system for lighting outages, pole knockdowns, and circuit malfunctions. Deficiencies will be noted and repaired by Department forces prior to the start of work by the Contractor.

Once the Contractor’s work interferes with or impacts the existing roadway lighting system, maintenance of that system within the Project limits becomes the Contractor’s responsibility. The repair of lighting system malfunctions occurring outside of the project limits, caused by the Contractor’s work, shall also be the Contractor’s responsibility. District Construction personnel will note the start and end date of the Contractor’s responsibility for maintenance of any existing lighting system.

The Contractor shall maintain the illumination throughout the duration of the Project, until the Project is accepted by the State. The Contractor shall supply to the Project Engineer and to the ConnDOT District Electrical Maintenance Supervisor, the names and phone numbers of a primary and back-up representative, to be contacted should a problem with the lighting system occur.

Whoever discovers a lighting outage or pole damage/knockdown within the Project limits shall immediately notify ConnDOT Highway Operations of same as follows:

1. For projects in Districts 1, 2, and 4, call (860) 594-3447.
2. For projects in District 3 and along the Interstate 95 corridor within District 2, call (203) 696-2690.

The following procedures will be followed for lighting outages:

- 1) Once notified of a lighting outage, ConnDOT Electrical Maintenance personnel will assess the situation, and in the case of a pole knockdown, may clear the pole from the roadway and make safe any exposed wires.
- 2) The Project Inspector and the Contractor's designated representative shall be notified after the lighting outage has been assessed by ConnDOT Electrical Maintenance, transferring responsibility for further repairs to the Contractor.
- 3) Upon notification, the Contractor shall be responsible to repair the lighting system before the normal nighttime turn-on of the lights. If this cannot be achieved, the Contractor shall make the lighting operational prior to the next normal nighttime turn-on of the lights, up to a maximum of 24 hours from the time the Contractor was notified of the problem. The Contractor shall contact the Project Inspector to discuss the situation, the steps to be taken to bring the lighting back on line, and the time frame for doing so.
- 4) For isolated individual luminaire outages (not a continuous circuit), the Contractor shall repair such luminaires within 48 hours from the time that the Contractor became aware of the outage.

The Contractor shall follow standard "lock-out," "tag-out," and "Call Before You Dig" procedures when working on the lighting circuit. Both the Contractor and ConnDOT Electrical Maintenance shall have mutual access to active lighting control cabinets.

The Contractor will be reimbursed for any costs associated with the maintenance of the existing lighting system that are beyond the Contractor's control. Reimbursements will be for damage caused by the general public and normal system age related component failures (such as lamp burn-out, ballast/starter failure or cable splice failure). However, the Contractor shall be responsible for repair of damage to the existing lighting system incurred as the result of their operations including damage caused by improper wiring methods. All repairs or replacements due to the Contractor's operations shall be made by the Contractor at their expense.

The Project Inspector will maintain a log book of any lighting repair work performed, which will include a description of the repairs, and the date the work was performed. The log book will be made accessible to ConnDOT Electrical Maintenance personnel.

Temporary illumination circuitry shall consist of pre-assembled aerial cable of the type and size as indicated in the Contract documents or as directed by the Engineer.

The Contractor shall notify the Engineer when aerial cable cannot be installed due to construction activities and shall suggest another method for installation of the cable.

Alternate options may include installing cable in duct underground, or installing surface-mounted cable in duct or PVC conduit with cable along the backside of a bridge parapet or temporary concrete barrier curbing. Temporary cable in duct/conduit or aerial cable lying directly on the ground will not be allowed. The option of surface-mounting duct or conduit to the backside of a parapet or barrier will be allowed only when construction activities make it necessary, and where the surface-mounted conduit will not expose workers to a high voltage hazard. The Contractor must obtain the Engineer's approval to do so prior to installing temporary circuitry not installed overhead, unless otherwise indicated on the plans.

When temporary circuitry is installed in trench, standard warning tape procedures shall be followed as set forth in Article 1.05.15. When temporary circuitry is surface mounted to the backside of a parapet or barrier wall, the Contractor shall install warning placards which read: "Live Electricity." Warning placards shall be installed at the beginning, end, and at intermittent points 100 feet (30 meters) apart along the exposed length of the duct/conduit. All temporary lighting circuits shall include a continuous No. 8 bare copper grounding conductor connected to all light standards and effectively grounded as per the NEC."

**CONNECTICUT
SUPPLEMENTAL SPECIFICATION
SECTION 10.01
TRENCHING AND BACKFILLING**

10.01.01- Description:

In the only sentence of the first paragraph after "...satisfactory..." add the following: "clean-up and".

In the only sentence of the second paragraph after "...reconstruction of..." add the following: "bituminous, concrete and granite curbing,".

10.01.05- Basis of Payment:

In the only sentence of the second paragraph after "...mulching..." add the following: "clean-up and". After "...installing..." add the word "curbing,".

At the end of the third paragraph, add the following: "In the absence of a "Rock in Trench Excavation" item, the work will be compensated as extra work."

In the only sentence of the sixth paragraph, after "...unit price for 'Concrete Sidewalk'..." add the following: "or as extra work, if no unit price has been established."

**CONNECTICUT
SUPPLEMENTAL SPECIFICATION
SECTION 10.10
CONCRETE HANDHOLE**

10.10.02 – Materials:

Replace “M.03.01” with “M.03” for both Class A and Class C Concrete.

10.10.05 – Basis of Payment

In the first sentence, remove the words “ground wire”.

At the end of the paragraph add the following sentence:

“The ground wire (bonding wire) is included in the Contract unit price under Section 10.08 – Electrical Conduit.”

Add the word “Cover” to the end of the pay item “Cast Iron Handhole”

**CONNECTICUT
SUPPLEMENTAL SPECIFICATION
SECTION 11.13
CONTROL CABLE**

11.13.03 – Construction Methods:

In the 1st paragraph of subsection 2 replace “MIL” with “MILSPEC.”

**CONNECTICUT
SUPPLEMENTAL SPECIFICATION
SECTION 12.10
EPOXY RESIN PAVEMENT MARKINGS, SYMBOLS AND LEGENDS**

12.10.03—Construction Methods:

2. Procedures:

Insert the following after the sixth paragraph:

“The epoxy shall be uniformly applied to the surface to be marked to ensure a wet film thickness of the applied epoxy, without glass beads, of 20 mils +/- 1 mil (500 um +/- 25 um).”

**CONNECTICUT
SUPPLEMENTAL SPECIFICATION
SECTION M.03
PORTLAND CEMENT CONCRETE**

Delete the entire Section and replace it with the following:

**SECTION M.03
PORTLAND CEMENT CONCRETE**

- M.03.01 - Component Materials**
- M.03.02 - Mix Design Requirements**
- M.03.03 - Producer Equipment and Production Requirements**
- M.03.04 - Curing Materials**
- M.03.05 - Non Shrink, Non Staining Grout**
- M.03.06 - Expansive Cement for Anchoring**
- M.03.07 - Chemical Anchors**
- M.03.08 - Joint Materials**
- M.03.09 - Protective Compound/Sealers**
- M.03.10 - Formwork**

M.03.01 – Component Materials

1. Coarse Aggregate: Coarse aggregate shall be broken stone, gravel, or reclaimed concrete aggregate defined as mortar-coated rock, consisting of clean durable fragments of uniform quality throughout. It shall be free from soft, disintegrated pieces, mud, dirt, organic or other injurious material and shall not contain more than 1 percent of dust by mass, as determined by AASHTO T-11. Coarse aggregate of a size retained on a 1-inch (25 mm) square opening sieve shall not contain more than 8% of flat or elongated pieces, whose longest dimension exceeds 5 times their maximum thickness. Heating or cooling of coarse aggregates may be required to meet concrete mix temperature requirements at time of placement.

- (a) Soundness:** When tested with magnesium sulfate solution for soundness, using AASHTO Method T 104, coarse aggregate shall not have a loss of more than 10% at the end of 5 cycles.
- (b) Loss on Abrasion:** When tested by means of the Los Angeles Machine, using AASHTO Method T 96, coarse aggregate shall not have a loss of more than 40%.
- (c) Gradation:** Grading and stone sizes of the coarse aggregate shall conform to Article M.01.01 as determined by AASHTO T-27. All coarse aggregate proportions shall be approved in advance by the Transportation Division Chief (TDC) as part of the Mix Design requirements.
- (d) Storage:** Aggregate stockpiles shall be located on smooth, hard, sloped/well-drained areas. Each source and gradation shall have an individual stockpile or bin. Aggregates shall be handled from stockpiles or other sources to the batching plant in such manner as to minimize segregation of the material. Aggregates that have become segregated, or mixed with earth or foreign material, shall not be used.

(e) **Reclaimed Concrete Aggregate:** In addition to the above requirements (a-d), when reclaimed concrete aggregate is proposed, it shall be tested for chloride in AASHTO T-260 "Sampling and Testing for Chloride Ion in Concrete and Concrete Raw Materials." Aggregate shall not be used if the chloride content as determined from this test exceeds 0.5 pound/cubic yard (297 g/cubic meter). Regardless of chloride content, reclaimed concrete aggregate shall not be used in concrete mixes used for pre-stressed concrete construction.

2. Fine Aggregate: Fine aggregate shall be natural or manufactured sand consisting of clean, hard, durable, uncoated particles of quartz or other rock, free from lumps of clay, soft or flaky material, mica, loam, organic or other injurious material. In no case shall fine aggregate containing lumps of frozen material be used. Heating or cooling of fine aggregates may be required to meet concrete mix temperature requirements at time of placement.

For continued shipments of fine aggregate from a given source, the fineness modulus of any sample shall not vary more than 0.20 from the base fineness modulus. The base fineness modulus for a source shall be established by the Engineer and may be revised based on current testing results.

- (a) **Fine Material:** Fine aggregate shall contain not more than 3% of material finer than a #200 sieve (75µm), as determined by AASHTO T 11.
- (b) **Organic Impurities:** Fine aggregate subjected to the colorimetric test shall not produce a color darker than Gardner Color Standard No. 11, using AASHTO T 21. If the fine aggregate fails to meet this requirement, the provisions of AASHTO M 6, Section 7.2.3, may apply.
- (c) **Gradation:** Fine aggregate gradation shall be within the ranges listed in Table M.03.01-1 for any source. All fine aggregate proportions shall be approved in advance by the TDC as part of the Mix Design requirements.
- (d) **Soundness:** When tested with magnesium sulfate solution for soundness, using AASHTO T 104, fine aggregate shall not have a loss of more than 10% at the end of 5 cycles. Fine aggregate that fails to meet this requirement, but meets all other requirements, may be allowed for use on a restricted basis with the approval of the Engineer on a case-by-case basis. Typically concrete forming any surface subject to polishing or erosion from running water will not be allowed to contain such material.
- (e) **Storage:** Aggregate stockpiles shall be located on smooth, hard, sloped/well-drained areas. Each source and gradation shall have an individual stockpile or bin. Aggregates shall be handled from stockpiles or other sources to the batching plant in such manner as to minimize segregation of the material. Aggregates that have become segregated, or mixed with earth or foreign material, shall not be used.

Table M.03.01-1 TOTAL % PASSING BY WEIGHT

Sieve Size	3/8" (9.5mm)	No. 4 (4.75mm)	No. 8 (2.36mm)	No. 16 (1.18mm)	No. 30 (600µm)	No. 50 (300µm)	No. 100 (150µm)
Percent Passing	100	95-100	80-100	50-85	25-60	10-30	2-10

3. Cement:

- (a) **Portland:** Types I, II, and III Portland cement shall conform to the requirements of AASHTO M 85. Type I and Type III Portland cement shall be used only when required or expressly permitted by the Project specification or the Engineer. The use of Type I or III will require that these mixtures be submitted as Non-standard Mix Designs. All cement shall be provided by a mill participating in the Departments' Cement Certification program. The requirements of the Certification Program are detailed in the Department's Quality Assurance Program for Materials.
- (b) **Pre-Blended Cements:** Binary or Ternary cements consisting of Portland Cement and supplemental cementitious materials may be used provided that all the requirements of Subarticles M.03.01- 3(a) and -3(c) are met.

- (c) Replacement Materials:** Unless already approved as a Standard Mix Design, any Contractor proposed Mix Designs with partial replacement of Portland Cement (PC) with fly ash or ground granulated blast furnace slag (GGBFS), shall be submitted in writing to the Engineer for approval prior to the start of work, on a project-by-project basis. The type of material, source, and the percentage of the PC replaced shall be clearly indicated. Upon request, a Certified Test Report for the cement replacement material shall be provided to the Engineer for use during the Mix Design review.
1. Fly Ash: Fly ash to be used as a partial replacement for Portland cement shall meet the requirements of AASHTO M 295, either Class C or Class F, including the uniformity requirements of Table 2A. Loss on Ignition for either class of fly ash shall not exceed 4.0%. Fly ash may be used to replace up to a maximum of 20% of the required Portland cement. The fly ash shall be substituted on a weight (mass) basis, with a minimum of 1 pound (45 kg) of fly ash for 1 pound (45 kg) of Portland cement. Different classes of fly ash or the same class from different sources shall not be permitted on any single project without the written approval of the Engineer.
 2. Ground Granulated Blast Furnace Slag (GGBFS): GGBFS used as a partial replacement for Portland cement shall conform to the requirements of AASHTO M 302/ASTM C989, Grade 100 or 120. As determined by the Engineer, GGBFS may be used to replace a maximum of 30% of the required Portland cement. The Engineer may restrict or prohibit the use of GGBFS if ambient temperatures anticipated during the placement and initial curing of the concrete are low. The GGBFS shall be substituted on a weight (mass) basis, with a minimum of 1 pound (45 kg) of slag for 1 pound (45 kg) of Portland cement. Different sources of GGBFS shall not be permitted on any single project without the written approval of the Engineer.

4. Water: All water used in the mixing of concrete shall be clear in appearance and free from oil, salt, acids, alkalis, sugar, and organic matter. Surface water may be used if not taken from shallow or muddy sources; classified as Class C or Class D on the Department of Energy and Environmental Protection (DEEP) Water Quality Classification mapping; and accommodations have been made to prevent contaminants from entering the supply to the satisfaction of the Engineer. The Engineer may request that water from any surface or ground source be tested in accordance with AASHTO T26 and AASHTO D512 if the appearance or scent of the water is suspect. To be acceptable, the pH of the water must not be less than 6.0 or greater than 8.0 and Chloride Ion Concentration of the water must not exceed 250ppm (250 mg/L). Potable water taken directly from a municipal or regional water supply may be used for mixing concrete without testing. Heating or cooling of water may be required to meet mix temperature requirements at time of placement.

5. Admixtures: All admixtures shall perform their function without injurious effects upon the concrete. If requested by the TDC, the Contractor shall present a certified statement from a recognized laboratory attesting to this requirement. A "recognized" laboratory is any cement and concrete laboratory approved and inspected regularly by the Cement and Concrete Reference Laboratory (CCRL). The statement shall contain results of compression tests of cylinder specimens made with concrete utilizing the admixture(s) in proportions equal to those proposed by the Contractor. The results of at least 5 standard 6-inch x 12-inch (150 mm x 300 mm) cylinders of each mix design shall be listed with the results of at least 5 like-sized cylinders not utilizing the admixture(s). Specimens must be made and cured in the laboratory in accordance with AASHTO T 126 and will be tested in accordance with AASHTO T 22.

(a) Air-Entraining Admixtures: In the event that air entrained concrete is required, an admixture conforming to the requirements of AASHTO M 154 may be used. Tests for 7 and 28-day compressive and flexural strengths and resistance to freezing and thawing are required, but tests for bleeding, bond strength and volume change will not be required.

(b) Other Chemical Admixtures: In the event that concrete properties are specified that require the use of additional admixtures, or the Contractor proposes the use of additional admixtures to facilitate placement, the admixtures shall conform to the requirements of AASHTO M194M/M, including the 1 year performance data.

M.03.02 – Mix Design Requirements

1. Standard ConnDOT Mix Designs: Standard Mix Designs shall be designed in accordance with applicable sections of ACI 211 and ACI 318. The mixtures shall consist of Portland cement, fine aggregate, coarse aggregate, admixtures¹, and water proportioned in accordance with Table M.03.02-1. The mixtures shall also be designed to obtain the physical properties of plastic concrete as specified in Article 6.01.03.

Table M.03.02-1

TYPE	28-day Minimum Compressive Strength psi (megapascals)	Water / Cement; or Water / Cement plus other approved Cementitious Material, by weight (mass), Maximum	Minimum Cement² Required lbs/cy (kg/cm)	Maximum Aggregate Size Required Section M.01.01
Class "A"	3300 (23)	0.53	615 (365)	No. 4
Class "C"	3300 (23)	0.53	658 (390)	No. 6
Class "F"	4400 (30)	0.44	658 (390)	No. 6
Pavement	3500 (24)	0.49	615 (365)	No. 4
Slope Paving	2200 (15)	0.69	455 (270)	No. 3
¹ Approved admixtures may be used in proportions recommended by the manufacturer.				
² Portland Cement may be partially replaced within a Standard Mix Design by other approved cementitious material meeting the requirements of Article M.03.01-3(b) if permitted by the Engineer.				

Mix designs shall indicate the dosage of admixtures anticipated to provide plastic properties required in the Project specification. Properties of standard classes of concrete in the plastic state are listed in Article 6.01.03

Standard Mix Designs are required to be designed and submitted by the concrete producers, and are approved by the Department on a standing basis. Submittal or re-approval of these Standard Mix Designs on an annual basis is not required. Previously approved producer-designed Standard Mixes that have a record of satisfactory performance may be utilized on Department projects unless there is a change in the gravimetric properties or the sources of any materials. Revisions to the Standard Mix Designs, which include changes in component sources, can be submitted at any time to the TDC, but must be approved prior to use on Department projects.

2. Non-Standard ConnDOT Mix Designs: Any proposed Mix Designs that do not comply with Table M.03.02-1 are required to be submitted 15 days prior to use on a project-by-project basis and be approved by the TDC prior to use. The use of an approved admixture with an otherwise approved Standard Mix Design is not considered non-standard.

All Non-standard Mix Designs used for load-bearing structures shall contain a minimum of 658 lbs/cubic yard (390 kg/cubic meter) of cementitious materials.

Concrete used in applications such as flowable fill or controlled low-strength material may be designed with less than 658 lbs/cubic yard (390 kg/cubic meter) of cementitious materials.

M.03.03 - Producer Equipment and Production Requirements

1. General Requirements: The source of the concrete must be approved by the Engineer prior to use on Department projects. Specifically the location and capacity of the central mix or dry batch plant, and complement of truck mixers/haulers, shall be adequate for continuous placement of concrete on a typical Department project. Approval may be revoked at any time in accordance with Section 1.06.01.

- (a) Inspection:** The production facility supplying hydraulic cement concrete shall have a current Certification of Ready Mixed Concrete Production Facilities from the National Ready Mixed Concrete Association (NRMCA), or equivalent certification approved by the Engineer.
- (b)** In addition to the requirements of approved third party certification, the facility shall produce batch tickets that conform to Subarticle 6.01.03-3(a).
- (c) Quality Control:** The Contractor is responsible for all aspects of Quality Control (QC). As determined by the Engineer, should material delivered to a project not meet specification, the Contractor may be required to submit to the Engineer a corrective procedure for approval within 3 calendar days. The procedure shall address any minor adjustments or corrections made to the equipment or procedures at the facility.
- (d) Suspension:** As determined by the Engineer, repeated or frequent delivery of deficient material to a Department project may be grounds for suspension of that source of material. A detailed QC plan that describes all QC policies and procedures for that facility may be required to formally address quality issues. This plan must be approved by the Engineer and fully implemented, prior to reinstatement of that facility.

2. Hand Mixed Concrete: Hand mixing shall be permitted only with the permission of the Engineer. Hand mixed batches shall not exceed 1/2 cubic yard (0.5 cubic meter) in volume. Hand mixing will not be permitted for concrete to be placed under water.

M.03.04 - Curing Materials

1. Water: Any water source deemed acceptable by the Engineer for mixing concrete may be used to provide water for curing purposes. Surface water may be used if classified as Class C or Class D on the Department of Energy and Environmental Protection (DEEP) Water Quality Classification mapping and accommodations have been made to prevent contaminants from entering the supply to the satisfaction of the Engineer.

In general, water shall not be taken from shallow or muddy sources. In cases where sources of supply are relatively shallow, the intake pipe shall be enclosed to exclude silt, mud, grass, etc.; and the water in the enclosure shall be maintained at a depth of not less than 2 feet (610 mm) under the intake pipe.

2. Mats: Mats for curing concrete shall be capable of maintaining moisture uniformly on the surface of the concrete. The mats shall not contain any materials such as dyes, sugar, etc., that may be injurious to the concrete.

The length or width of the mats shall be sufficient to cover all concrete surfaces being cured. Should more than one mat be required, sufficient overlap shall be provided by the Contractor as determined by the Engineer.

3. Liquid Membrane-Forming Compound: Liquid membrane-forming compound shall conform to the requirements of AASHTO M 148 Type 2, Class B, or shall be a water-soluble linseed oil-based compound conforming to the requirements of AASHTO M 148, Type 2.

4. White Polyethylene Sheeting (Film): White polyethylene sheeting (film) shall conform to the requirements of AASHTO M 171.

M.03.05 - Non Shrink, Non Staining Grout

1. Bagged (pre-mixed): Bagged (pre-mixed) formulations of non-shrink grout shall meet the requirements of ASTM C 1107. The grout shall be mixed with potable water for use. The grout shall be mixed to a flowable consistency as determined by ASTM C 230. All bagged material shall be clearly marked with the manufacturer's name, date of production, batch number, and written instructions for proper mixing, placement and curing of the product.

2. Bulk: The Contractor may formulate and design a grout mix for use on the Project in lieu of using a pre-bagged product. The Contractor shall obtain prior written approval of the Engineer for any such proposed Mix Design. Any such Mix Design shall include the proportions of hydraulic cement, potable water, fine aggregates, expansive agent, and any other necessary additive or admixture. This material shall meet all of the same chemical and physical requirements as shall the pre-bagged grout, in accordance with ASTM C 1107.

M.03.06 – Expansive Cement for Anchoring

The premixed anchoring cement shall be non-metallic, concrete gray in color and prepackaged. The mix shall consist of hydraulic cement, fine aggregate, expansive admixtures and water conforming to the following requirements:

1. The anchoring cement shall have a minimum 24 hour compressive strength of 2,600 psi (18 megapascals) when tested in accordance with ASTM C 109.
2. The water content of the anchoring cement shall be as recommended by the manufacturer. Water shall conform to the requirements of Subarticle M.03.01-4.

The Contractor shall provide a Certified Test Report and Materials Certificate for the premixed anchoring cement in conformance with Article 1.06.07. The Contractor shall also provide, when requested by the Engineer, samples of the premixed anchoring cement for testing and approval.

M.03.07 – Chemical Anchors

Chemical anchor material must be listed on the Departments' Qualified Products List and approved by the Engineer for the specified use.

The chemical anchor material shall be epoxy or polyester polymer resin. It shall not contain any metals or other products that promote corrosion of steel. The Contractor shall supply the Engineer with a Certified Test Report and Materials Certificate for the chemical anchor material in conformance with Article 1.06.07. When requested by the Engineer, the Contractor shall also provide samples of the chemical anchor material.

M.03.08 – Joint Materials

1. **Transverse Joints for Concrete Pavement:** Transverse joints shall consist of corrosion resistant load transfer devices, poured joint seal and in addition, in the case of expansion joints, expansion joint filler all conforming to the following requirements:
 - (a) The corrosion resistant load transfer device shall be coated steel or sleeved steel or be made of corrosion resistant material. The dimensions of any devices used shall be as shown on the plans, exclusive of any coating or sleeving. Core material of coated or sleeved metallic devices shall be steel meeting the requirements of AASHTO M 255M/M 255 Grade 520, or steel having equal or better properties and approved by the Engineer. Nonmetallic devices shall meet the various strength requirements applicable to metallic devices as well as all other requirements stated herein.
 - (b) All coated load transfer devices shall conform to the requirements of AASHTO M 254. Uncoated or sleeved load transfer devices shall meet the applicable physical requirements of AASHTO M 254. The use of field applied bond breakers will not be permitted.

- (c) The basis of acceptance for corrosion resistant load transfer devices shall be the submission by the Contractor of a minimum of 2 samples accompanied by Certified Test Reports conforming to the requirements of Article 1.06.07 demonstrating that the load transfer device conforms to the requirements of AASHTO M 254 for the type of device supplied. The Engineer reserves the right to reject any load transfer device which he deems unsatisfactory for use.
2. **Joint Filler for Concrete Curbing:** Expansion joint filler shall be either preformed expansion joint filler or wood joint filler as indicated on the plans and shall conform to the following requirements:
- (a) Preformed expansion joint filler shall be the bituminous cellular type and shall conform to the requirements of AASHTO M 213.
 - (b) Boards for wood joint filler shall have 2 planed sides and shall be redwood, cypress or white pine. Redwood and cypress boards shall be of sound heartwood. White pine boards shall be of sound sapwood. Occasional small, sound knots and medium surface checks will be permitted provided the board is free of any defects that will impair its usefulness for the purpose intended. The joint filler may be composed of more than one length of board in the length of the joint, but no board of a length less than 6 feet (1.9 meters) shall be used; and the separate boards shall be held securely to form a straight joint. Boards composed of pieces that are jointed and glued shall be considered as one board.
 - (c) Dimensions shall be as specified or shown on the plans; and tolerances of plus 1/16-inch (1.6 millimeters) thickness, plus 1/8-inch (3.2 millimeters) depth and plus 1/4-inch (6.4 millimeters) length will be permitted.
 - (d) All wood joint filler boards shall be given a preservative treatment by brushing with creosote oil conforming to AASHTO M 133. After treatment, the boards shall be stacked in piles, each layer separated from the next by spacers at least 1/4 inch (6.4 millimeters) thick; and the boards shall not be used until 24 hours after treatment. Prior to concreting, all exposed surfaces of the wood filler shall be given a light brush coating of form oil.
 - (e) Testing of board expansion joint filler shall be in accordance with pertinent sections of AASHTO T 42.
3. **Longitudinal Joint Devices:** The metal used in the fabrication of longitudinal joint devices shall conform to ASTM requirements for each type of metal used. The dimensions shall be as shown on the plans.
4. **Expansion Joint Fillers for Bridges and Bridge Bearings:**
- (a) Preformed expansion joint filler for bridges shall conform to the requirements of AASHTO M 153, Type I or Type II.
 - (b) Pre-molded expansion joint filler for bridge bearings shall conform to the requirements of AASHTO M 33.
5. **Joint Sealants:**
- (a) **Joint Sealer for Pavement:** The joint sealer for pavement shall be a rubber compound of the hot-poured type and shall conform to the requirements of AASHTO M 324 Type II unless otherwise noted on the plans or in the special provisions.
 - (b) **Joint Sealer for Structures:** Structure joint sealers shall be one of the following type sealants:
 - 1. Where "Joint Seal" is specified on the plans, it shall conform to the Federal Specifications SS-S-200-E (Self-leveling type), TT-S-0227E (COM-NBS) Type II-Class A (Non-sag type), or 1 component polyurethane-base elastomeric sealants conforming to FS TT-S-00230C Type II-Class A or an approved equal.
A Certified Test Report will be required in accordance with Article 1.06.07, certifying the conformance of the sealant to the requirements set forth in the Federal Specification. Should the consignee noted on a Certified Test Report be other than the Prime Contractor, a Materials Certificate shall be required to identify the shipment.

2. Where "Silicone Joint Sealant" is specified on the plans, it shall be one of the following or an approved equal:
 - Sealant, manufactured by the Dow Corning Corporation, Midland, Michigan Dow Corning 888 Silicone Joint Sealant or
 - Dow Corning 888-SL Self-Leveling Silicone Joint 48686-0994
6. **Closed Cell Elastomer:** The closed cell elastomer shall conform to the requirements of ASTM D1056, Grade RE-41 B2. The elastomer shall have a pressure-sensitive adhesive backing on one side.

The Contractor shall deliver the closed cell elastomer to the job site a minimum of 30 days prior to installation. Prior to the delivery of the closed cell elastomer, the Contractor shall notify the Engineer of the date of shipment and the expected date of delivery. Upon delivery of the closed cell elastomer to the job site, the Contractor shall immediately notify the Engineer.

Each separate length, roll or container shall be clearly tagged or marked with the manufacturer's name, trademark and lot number. A lot is defined as that amount of closed cell elastomer manufactured at one time from one batch of elastomer. A batch is defined as that amount of elastomer prepared and compounded at one time. The Contractor shall furnish a Certified Test Report in accordance with Article 1.06.07, confirming the conformance of the closed cell elastomer to the requirements set forth in these specifications. Should the co-signee noted on a Certified Test Report be other than the Prime Contractor, a Materials Certificate shall be required to identify shipment.

The Contractor shall furnish a 1 foot (305 millimeter) length of closed cell elastomer in each lot for purposes of inspection and testing by the Engineer. The Engineer will cut a 1 foot (305 millimeter) sample from each lot and inspect the sample for conformance to size, and perform physical tests on the sample as deemed necessary.

The Engineer shall reject any lot or portion of a lot that does not conform to the requirements stated herein. A rejected lot or portion of a lot may be resubmitted provided the Contractor has removed or corrected, in a manner acceptable to the Engineer, all non-conforming material.

M.03.09 – Protective Compound/Sealers

The brand and type of material must be listed on the Department's Qualified Products List and approved by the Engineer for the specified use.

M.03.10 – Formwork

1. **Stay-in-place Forms:** Material for stay-in-place metal forms shall be made of zinc-coated (galvanized) steel sheet conforming to ASTM Specification A653 (Structural Steel (SS) Grade 33 through 80). The minimum thickness shall be 20 gage (810 micrometers). Coating weight shall conform to ASTM A924, Class G235, and shall otherwise meet all requirements relevant to steel stay-in-place metal forms and the placing of concrete as specified herein and as noted in the Contract documents.

Form supports shall either be fabricated and conform to the same material requirements as the forms, or be fabricated from structural steel conforming to the requirements of ASTM A36 and shall be hot-dip galvanized in accordance with ASTM A123.

Lightweight filler material for forms shall be as recommended by the form manufacturer.

2. **Temporary Forms and Falsework:** Forms and Falsework shall be of wood, steel or other material approved by the Engineer. This approval does not relieve the Contractor from employing adequately sized materials of sufficient rigidity to prevent objectionable distortion of the formed concrete surfaces caused by pressure of the plastic concrete and other loads incidental to the construction operations.

**CONNECTICUT
SUPPLEMENTAL SPECIFICATION
SECTION M.06
METALS**

M.06.01 – Reinforcing Steel:

1. Bar Reinforcement:

Delete the third paragraph and replace it with:

“Epoxy coated bar reinforcement shall conform to the requirements of ASTM A 615/A 615M, Grade 60 (420) and shall be epoxy coated to the requirements of ASTM A 775/A 775M. All field repairs of the epoxy coating shall conform to the requirements of ASTM D 3963/D 3963M.”

M.06.02—Structural Steel and Other Structural Materials:

Delete the entire article and replace it with the following:

"M.06.02—Structural Steel: The materials for this work shall conform to the following requirements:

1. Structural Steel:

Structural steel for bridges shall conform to the designation shown on the plans. Unless otherwise indicated in the plans or specifications, structural steel for non-bridge related members or components shall conform to ASTM A709/A709M, Grade 36 (250).

All surfaces of steel plates and shapes used in the fabrication of bridge girders shall be blast cleaned and visually inspected by the Contractor prior to any fabrication or preparation for fabrication. Blast cleaning shall conform to the requirements of SSPC-SP-6-Commercial Blast.

All steel plates and shapes used in the fabrication of bridge girders shall be substantially free from pitting and gouges, regardless of the cause. Substantially free is defined as:

- The measured surface area of all pits and gouges regardless of depth represent less than 1% of the surface area of the plate or shape.
- No pit or gouge greater than 1/32 (0.08mm) inch deep.
- No pit or gouge closer than six inches (15.25 cm) from another.

Any repair of plates or shapes will be performed in accordance with ASTM A6/A 6M.

2. Anchor Bolts:

Unless otherwise designated on the plans, anchor bolts, including suitable nuts and washers, shall conform to the following requirements:

Anchor bolt assemblies shall conform to the requirements of ASTM F1554, Grade 36 (250). All components of the bolt assembly shall be galvanized in conformance with ASTM A 153/A 153M.

Certified Test Reports and Material Samples: The Contractor shall submit notarized copies of Certified Test Reports in conformance with Article 1.06.07. Prior to incorporation into the work, the Contractor shall submit samples of the anchor bolt assemblies to the Engineer for testing in accordance with the latest edition of the "Schedule of Minimum Requirements for Acceptance Testing". One sample shall be submitted for each diameter, material designation, grade or coating of anchor bolt assembly.

3. High Strength Bolts: High strength bolts, including suitable nuts and hardened washers, shall conform to the following requirements:

- a) High strength bolts shall conform to ASTM A325 or ASTM A490 as shown on the plans. High-strength bolts used with coated steel shall be mechanically galvanized, unless otherwise specified. High-strength bolts used with uncoated weathering grades of steel shall be Type 3.

Nuts for ASTM A325 bolts shall conform to ASTM A563, grades DH, DH3, C, C3 and D. Where galvanized high-strength bolts are used, the nuts shall be galvanized, heat treated grade DH or DH3. Where Type 3 high-strength bolts are used, the nuts shall be grade C3 or DH3.

Nuts for ASTM A490 bolts shall conform to the requirements of ASTM A563, grades DH and DH3. Where Type 3 high-strength bolts are used, the nuts shall be grade DH3.

All galvanized nuts shall be lubricated with a lubricant containing a visible dye of any color that contrasts with the color of the galvanizing. Black bolts must be oily to the touch when delivered and installed.

Circular flat and square or rectangular beveled, hardened steel washers shall conform to ASTM F436. Unless otherwise specified, galvanized washers shall be furnished when galvanized high-strength bolts are specified, and washers with atmospheric corrosion resistance and weathering characteristics shall be furnished when Type 3 high-strength bolts are specified.

Compressible-washer-type direct tension indicator washers, used in conjunction with high strength bolts, shall conform to ASTM F959. Where galvanized high-strength bolts are used, the washers shall be galvanized in accordance with ASTM B695, Class 50. Where Type 3 high-strength bolts are used, the washers shall be galvanized in accordance with ASTM B695, Class 50 and coated with epoxy.

- b) Identifying Marks:** ASTM A325 for bolts and the specifications referenced therein for nuts require that bolts and nuts manufactured to the specification be identified by specific markings on the top of the bolt head and on one face of the nut. Head markings must identify the grade by the symbol "A325", the manufacturer and the type, if Type 2 or 3. Nut markings must identify the grade, the manufacturer and if Type 3, the type. Markings on direct tension indicators must identify the manufacturer and Type "325". Other washer markings must identify the manufacturer and if Type 3, the type.

ASTM A490 for bolts and the specifications reference therein for nuts require that bolts and nuts manufactured to the specifications be identified by specific markings on the top of the bolt head and on one face of the nut. Head markings must identify the grade by the symbol "A490", the manufacturer and the type, if Type 2 or 3. Nut markings must identify the grade, the manufacturer and if Type 3, the type. Markings on direct tension indicators must identify the manufacturer and Type "490". Other washer markings must identify the manufacturer and if Type 3, the type.

- c) Dimensions:** Bolt and nuts dimensions shall conform to the requirements for Heavy Hexagon Structural Bolts and for Heavy Semi-Finished Hexagon Nuts given in ANSI Standard B18.2.1 and B18.2.2, respectively.
- d) Galvanized Bolts:** Galvanized bolts shall conform to ASTM A325, Type 1. The bolts shall be hot-dip galvanized in accordance with ASTM A153, Class C or mechanically galvanized in accordance with ASTM B695, Class 50. Bolts, nuts, and washers of any assembly shall be galvanized by the same process. The nuts shall be overtapped to the minimum amount required for the fastener assembly, and shall be lubricated with a lubricant containing a visible dye so a visual check can be made for the lubricant at the time of field installation. Galvanized bolts shall be tension tested after galvanizing. ASTM A 490 bolts shall not be galvanized.
- e) Test Requirements:** The maximum hardness of A325 bolts 1" or less in diameter shall be 33 HRC.

Plain, ungalvanized nuts shall have a minimum hardness of 89 HRB.

Proof load tests, in accordance with the requirements of ASTM F606 Method 1, shall be required for the bolts. Wedge tests of full-size bolts are required in accordance with Section 8.3 of ASTM A325. Galvanized bolts shall be wedge tested after galvanizing. Proof load tests of ASTM A563 are required for nuts. Proof load tests for nuts used with galvanized bolts shall be performed after galvanizing, overtapping and lubricating.

Rotational-capacity tests are required and shall be performed on all plain or galvanized (after galvanizing) bolt, nut and washer assemblies by the manufacturer or distributor prior to shipping and by the Contractor at the job site.

The thickness of galvanizing on bolts, nuts and washers shall be measured. On bolts, it shall be measured on the wrench flats or on top of the bolt head, and on nuts it shall be measured on the wrench flats.

f) Certified Test Reports and Materials Certificates: The Contractor shall submit notarized copies of Certified Test Reports and Materials Certificates in conformance with Article 1.06.07 for fastener assemblies. In addition the Certified Test Reports and Materials Certificates shall include the following:

- a. Mill test reports shall indicate the place where the material was melted and manufactured.
- b. Test reports for proof load tests, wedge tests, and rotational-capacity tests shall indicate where the tests were performed, date of tests, location of where the components were manufactured and lot numbers.
- c. The test report for galvanized components shall indicate the thickness of the galvanizing.

g) Material Samples: Prior to incorporation into the work, the Contractor shall submit samples of the bolt assemblies to the Engineer for testing in accordance with the latest edition of the "Schedule of Minimum Requirements for Acceptance Testing". Samples shall be submitted for each diameter, length, material designation, grade, coating and manufacturer of bolt assembly.

4. Welded Stud Shear Connectors:

a) Materials: Stud shear connectors shall conform to the requirements of ASTM A 108, cold-drawn bar, Grades 1015, 1018 or 1020, either semi- or fully-killed. If flux-retaining caps are used, the steel for the caps shall be of a low carbon grade suitable for welding and shall comply with ASTM A 109.

Stud shear connectors shall be of a design suitable for electrically end-welding to steel with automatically timed stud welding equipment. The studs shall be of the sizes and dimensions noted on the plans. Flux for welding shall be furnished with each stud, either attached to the end of the stud or combined with the arc shield for automatic application in the welding operation. Each stud shall be furnished with a disposable ferrule of sufficient strength to remain intact during the welding operation and not crumble or break; it shall not be detrimental to the weld or create excessive slag.

Tensile properties, as determined by tests of bar stock after drawing or of finished studs, shall conform to the following requirements in which the yield strength is as determined by the 0.2% offset method:

Tensile strength (min.)	60,000 psi (415 megapascals)
Yield strength (min.)	50,000 psi (345 megapascals)
Elongation (min.)	20% in 2 inches (50 millimeters)
Reduction of area (min.)	50%

- b) Test Methods:** Tensile properties shall be determined in accordance with the applicable sections of ASTM A 370. Tensile tests of finished studs shall be made on studs welded to test plates using a test fixture similar to that shown in Figure 7.2 of the current AASHTO/AWS D1.5 – Bridge Welding Code. If fracture occurs outside of the middle half of the gage length, the test shall be repeated.
- c) Finish:** Finished studs shall be of uniform quality and condition, free from injurious laps, fins, seams, cracks, twists, bends or other injurious defects. Finish shall be as produced by cold-drawing, cold-rolling or machining.
- d) Certified Test Reports and Materials Certificates:** The Contractor shall submit a certified copy of the in-plant quality control test report in conformance with Article 1.06.07. The Contractor shall submit a Materials Certificate in conformance with Article 1.06.07 for the welded studs.
- e) Sample Materials for Testing:** Prior to incorporation into the work, the Contractor shall submit samples of the stud shear connectors to the Engineer for testing in accordance with the latest edition of the "Schedule of Minimum Requirements for Acceptance Testing". One sample shall be submitted for each diameter and length of welded stud."

**CONNECTICUT
SUPPLEMENTAL SPECIFICATION
SECTION M.08
DRAINAGE**

Delete the entire Section and replace with the following:

**SECTION M.08
DRAINAGE**

M.08.01 – Pipe

General

Iron/Steel

1. Cast Iron Pipe
2. Coated Corrugated Metal Pipe and Coated Corrugated Metal Pipe Elbows
3. Perforated or Plain Coated Metal Pipe for Underdrains or Outlets
4. Coated Corrugated Metal Pipe Arches
5. Corrugated Structural Plates and Bolts
6. Metal Culvert Ends

Concrete

7. Reinforced Concrete Pipe
8. Reinforced Concrete Elliptical Pipe
9. Perforated Reinforced Concrete Pipe for Underdrains and Outlets
10. Slotted Drain Pipe
11. Reinforced Concrete Culvert Ends

Aluminum

12. Corrugated Aluminum Pipe
13. Corrugated Aluminum Pipe for Underdrains and Outlets
14. Corrugated Aluminum Pipe Arches

Sealers/Gaskets

15. Cold-Applied Bituminous Sealer
16. Preformed Plastic Gaskets
17. Flexible, Watertight, Rubber-Type Gaskets

Plastic

18. Corrugated Polyethylene Pipe
19. Geotextiles
20. Polyvinyl Chloride Plastic Pipe
21. Polyvinyl Chloride Gravity Pipe

M.08.02 – Catch Basins, Manholes, and Drop Inlets

M.08.03 – Aggregates

1. Bedding Material
2. Aggregates for Underdrains

M.08.01 – Pipe

General

The Contractor shall submit manufacturer's material certifications for all metal and plastic pipes other than PVC, metal pipe-arches, metal fittings and metal coupling bands in accordance with Section 1.06.07.

IRON/STEEL

1. Cast Iron Pipe: This material shall conform to the requirements of AASHTO M 64 for Extra-Heavy Cast Iron Culvert Pipe.

2. Coated Corrugated Metal Pipe and Coated Corrugated Metal Pipe Elbows:
This material shall conform to the following:

Pipe fabricated from zinc-coated steel sheet and aluminum-coated (Type 2) steel sheet must conform to AASHTO M 36, Type 1 or IR.

Pipe fabricated from metallic-coated and polymer-precoated steel sheet must conform to AASHTO M 245, Type 1.

Unless otherwise indicated on the plans, the corrugation size and sheet thickness shall conform to the following:

Nominal Inside Diameter (inches)	Corrugations	Minimum Specified Sheet Thickness (inches)	
		Steel	Aluminum
6	1 1/2" X 1/4"	.052	
8, 10	1 1/2" X 1/4"	.064	
12, 15, 18 & 21	2 2/3" X 1/2"	.064	
24, 30 , 36	2 2/3" X 1/2"	.079	
42, 48	2 2/3" X 1/2"	.109	
54, 60	3" X 1" or 5" X 1"	.064	
66, 72	3" X 1" or 5" X 1"	.079	
78, 84, 90, & 96	3" X 1" or 5" X 1"	.109	
18, 24, 30	Helical Rib 3/4" X 3/4" X 7 1/2"	.064	.060
36	Helical Rib 3/4" X 3/4" X 7 1/2"	.064	.075
42, 48 & 54	Helical Rib 3/4" X 3/4" X 7 1/2"	.079	.105
60, 66, 72, 78, 84	Helical Rib 3/4" X 3/4" X 7 1/2"	.109	.135

Aluminum pipe sheet thickness may be .004 inch less than specified above for 1 1/2-inch x 1/4-inch, 2 2/3-inch x 1/2-inch and 3-inch x 1-inch or 5-inch x 1-inch corrugations. Helical Rib shall be as specified above.

Zinc coated steel pipe, fittings, and coupling bands shall be coated with bituminous material as specified in AASHTO M 190 Type C. Pipe, fittings and coupling bands

fabricated from aluminum coated steel sheet (Type 2) does not require coating of bituminous material or paved invert.

Metallic-coated and polymer-precoated steel pipe, fittings, and coupling bands shall be coated as specified in AASHTO M 246, Type B. The thicker polymeric coating shall be on the inside of the pipe.

Only one type of coating will be allowed for any continuously connected run of pipe.

If elongation of the pipe is required, it shall be done by the manufacturer.

3. Perforated or Plain Coated Metal Pipe for Underdrains or Outlets: This material shall conform to the requirements of AASHTO M 36, Type III or AASHTO M 245, Type III.

(a) Perforations: The minimum diameter of perforations after asphalt coating shall be 1/4 inch.

(b) Coating: All requirements of M.08.01-2 shall apply except that the minimum thickness of the bituminous coating on zinc coated steel pipe, fittings, and coupling bands pipe shall be 0.03 inches instead of 0.05 inches.

4. Coated Corrugated Metal Pipe-Arches: This material shall conform to the requirements of AASHTO M 36, Type II, Type IIR or AASHTO M 245, Type II. All coating requirements of M.08.01-1 shall apply.

Unless otherwise indicated on the plans, the corrugation size and sheet thickness shall conform to the following:

Pipe-Arch Equivalent Diameter (Inches)	Corrugations	Minimum Sheet Thickness (Inches)
15, 18, 21	2 2/3" X 1/2"	.064
24, 30	2 2/3" X 1/2"	.079
36, 42, 48	2 2/3" X 1/2"	.109
54, 60	2 2/3" X 1/2"	.138
60, 66, 72	3" X 1" or 5" X 1"	.079
78, 84, 90, 96	3" X 1" or 5" X 1"	.109
18, 21, 24	Helical Rib 3/4" X 3/4" X 7 1/2"	.064
30, 36	Helical Rib 3/4" X 3/4" X 7 1/2"	.079
42, 48, 54, 60	Helical Rib 3/4" X 3/4" X 7 1/2"	.109

5. Corrugated Structural Plates and Bolts: These plates and bolts are for use in the construction of metal pipe of the large diameter and for metal plate arches or pipe arches to be assembled in the field, and they shall conform to the requirements of AASHTO M 167 for corrugated metal pipe.

The dimensions of plates and details of fabrication shall conform to the requirements of the manufacturer. Where the plans call for a heavier gage for the bottom of the pipe than for the remainder of the pipe circumference, the lower fourth of the circumference shall be the minimum width of the heavier gage material.

The coating shall conform to the requirements of AASHTO M 243.

6. Metal Culvert End: The materials used in this work shall meet the pertinent requirements of Articles M.08.01-2 and M.08.01-4.

Bolts and fittings shall conform to the requirements of ASTM A 307 and shall be galvanized to conform to the requirements of ASTM A 153.

The units shall be coated as specified in Articles M.08.01-2, M.08.01-4 or M.08.01-5.

Fabrication: These units shall be formed from a rectangular sheet of metal by cutting and bending to form the desired shape. Two or more sheets may be fastened together by riveting or bolting so as to form a rectangular sheet of the required width. Skirt extensions and a top plate, as needed to complete the unit, shall be separately formed. Skirt extensions shall be riveted or bolted to the skirt.

All edges, which will be exposed above the surface of the ground, shall be reinforced before forming the unit by either of the following means:

- (1) The edge shall be bent to form a semicircular roll with an exterior diameter of 1 inch, as shown in the detail drawing on the plans.
- (2) A split tube of 1 inch outside diameter and not lighter than 14 gage, shall be slipped over a row of rivets spaced not more than 6 inches apart, as shown in the detail drawing on the plans.

One corrugation, matching the corrugations of the pipe or pipe-arch to which the unit is to be attached, shall be formed in the unit to insure secure and accurate alignment.

Attachment: The unit may be shop-riveted to a length of the appropriate pipe or pipe-arch, or may be field attached to the pipe or pipe arch by either of the other attachment systems shown on the plans, or by other means acceptable to the Engineer. If the unit is shop-riveted to a length of pipe or pipe-arch, this length shall be sufficient to permit proper use of standard coupling bands.

CONCRETE

7. Reinforced Concrete Pipe: Unless otherwise specified, this material shall conform to the requirements of AASHTO M 170, Class IV, as supplemented and modified by the following:

- (a) Reinforcement:** In circular pipe, only circular reinforcement will be allowed.
- (b) Laps and Welds:** The reinforcement shall be lapped not less than 2 inches and welded with an electric welding machine.
- (c) Quality Assurance Testing:** Circular and elliptical reinforced concrete pipe shall be tested by the three-edge bearing method prescribed in AASHTO T 280, except as follows:
- 1) Modified or special design pipe shall be tested to the 0.01-inch load and the ultimate load requirements as per AASHTO M 170 and M 207.
 - 2) At the discretion of the Engineer, pipe of standard design, as specified in AASHTO M 170 and M 207, may be tested to the 0.01-inch requirement plus 10% additional load in lieu of ultimate load testing. Test pipe attaining a 0.01-inch crack will not be acceptable for use on Department projects.
 - 3) Cores for absorption and determination of steel reinforcement shall be taken on a random basis as determined by the Engineer. The cores shall be at least 6 inches in diameter.
- (d) Inspection:** The pipe plant, materials, processes of manufacture and the finished pipe shall be subject to inspection and approval by the Department. The pipe manufacturer's records related to component materials, production and shipment of pipe for Department use shall be made available to the Department on request. The equipment and labor necessary for inspection, sampling and testing as required by the Department shall be furnished by the pipe manufacturer. Test equipment shall be calibrated at least once each 12 months, or as directed by the Engineer. The plant cement and aggregate scales shall be inspected and sealed by the approved agency at least once every twelve months.
- (e) Preliminary Tests and Tests for Extended Deliveries:** As directed by the Engineer, the Department shall select for test from the stock of any manufacturer proposing to supply pipe to the Department, 2 of each size pipe up through 30-inch diameter and 1 of each size greater than 30-inch diameter. These sample pipes shall be tested under Department supervision by the three-edge bearing method. For pipe that fails, it shall be necessary for the manufacturer to either physically isolate the rejected pipe at his plant or to provide some means to clearly indicate the unacceptability of the pipe. Either method shall be performed to the satisfaction of the Engineer. When production is resumed on any size, wall thickness or class previously rejected, preliminary tests shall be required. If 95% of all pipe tested at a particular plant from the first of the calendar year to September 30 meet specifications, including both preliminary and extended tests, it will not be necessary to perform the Fall three-edge bearing tests at this plant.

Use of compression tests on representative cylinders or cores to determine the compressive strength of the concrete incorporated into the pipe products will be at the discretion of the Engineer.

(f) **Shipping:** Pipe shall not be shipped until it is at least 7 days old unless earlier shipment is authorized by the Engineer on the basis of tests.

(g) **Certification:** Pipe will be accepted by the Department on the basis of manufacturer's certification. The manufacturer shall certify each shipment of pipe on Department Form MAT-073(PC-1), "Certification of Precast Concrete Products." Two (2) copies of this certification shall be furnished with the shipment to the Engineer at the project site.

8. Reinforced Concrete Elliptical Pipe: This material shall conform to the requirements of AASHTO M 207, Class HE IV and supplemented as follows:

(a) Manufacturing and testing shall conform to Subarticle M.08.01-7.

9. Perforated Reinforced Concrete Pipe for Underdrains and Outlets: This material shall conform to the requirements of Subarticle M.08.01-7 and shall be slotted in accordance with AASHTO M 175, Type 2, or as shown on the plans. Pipe for outlets shall not be perforated.

10. Slotted Drain Pipe: The pipe shall be asphalt coated and conform to Subarticle M.08.01-2. Concrete shall conform to Article M.03.01, Class "A" or pavement type. Concrete shall be cured in conformance with M.03. The inlet aperture shall be longitudinal on top of the pipe and may be continuous or intermittent. The opening in the pipe wall may be fabricated in the form of continuous bar risers and spacers or of intermittent cut-out segments with structural members supporting a continuous grating as indicated in the plans. End caps shall be as provided by the manufacturer.

Elastomeric polymer sealer shall meet the physical requirements of ASTM D 3406 and be accepted on manufacturer's certification.

The pipe shall be helically corrugated with a continuous welded or lock seam. Pipe ends shall have 2 rolled annular corrugations on each end for jointing.

Bar Riser and Spacer Type: Riser assemblies shall be fabricated from structural steel, in accordance with the dimensions on the plans. The riser assemblies shall be hot dipped galvanized according to ASTM A123. The assemblies shall be welded to the corrugated pipe on each side of the riser at the location of the solid web spacers. The riser shall terminate 1 inch from the ends of each pipe length to allow clearance for single bolt coupling bands. The ends of the riser shall be closed with a suitable welded plate where solid web spacers do not come to the ends of the riser.

The maximum deviation from straight in both the vertical and horizontal plane of the riser assembly shall not exceed 3/4 inch in a 20-foot length.

Continuous Grating Type: The cut-out pipe segments shall provide a 2-inch wide slot of maximum length between the lock seams. The slot shall be left intact 1 inch on each side of the lock seam and this material shall be utilized to fasten the reinforcing bar in place.

A bent epoxy coated reinforcing bar shall cross the slotted opening on 6-inch centers.

The reinforcing bar shall be an ASTM A 615, No. 13, deformed bar epoxy coated with 7 mils of fusion bonded epoxy powder conforming to AASHTO M 284.

Grating shall be furnished unless noted in the contract documents. Grating and all bearing bars, cross bars, and bent connecting bars shall be welding quality, mild carbon steel conforming to ASTM A 569 and to the dimensions shown on the plans.

Tie down bolts shall be J-Type bolts, plated, ASTM A 307 steel supplied with self-locking nuts.

Concrete forms shall be of cellular foam plastic base, fabricated as an integral part of the pipe and reinforcing bar assembly. The form shall be capped with a thick wood or plastic cap resting on top of the foam plastic and reinforcing bar.

The maximum deviation from straight in both the vertical and horizontal plane of the completed assembly shall not exceed 3/4 inch in a 20-foot length. All grating and hardware shall be galvanized in conformance with Article M.06.03. Expansion joint filler shall conform to M.03.

11. Reinforced Concrete Culvert End: The barrel shall conform to the requirements of AASHTO M 170, Class II, except that the three-edge bearing tests will not be required. The flare shall be of the same thickness and materials as the barrel and shall have steel reinforcement equaling or exceeding the amount shown on the table for the pertinent size.

Tongues and grooves shall be compatible with tongues and grooves of pipe meeting AASHTO M 170, Class IV.

Air entrainment shall be added to these units so as to maintain 5 to 8% entrained air.

ALUMINUM

12. Corrugated Aluminum Pipe: This material shall conform to the requirements of AASHTO M 196 Type I or Type IR. Sheet thickness shall conform to the requirements of M.08.01-2.

13. Corrugated Aluminum Pipe for Underdrains and Outlets: This material shall conform to the requirements of AASHTO M 196, Type III or Type IIIR. Sheet thickness shall conform to the requirements of M.08.01-2. Pipe for outlets shall not be perforated.

14. Corrugated Aluminum Pipe Arches: These pipe arches shall conform to the requirements of AASHTO M 196, Type II or Type IIR. Sheet thickness shall conform to the requirements of M.08.01-4.

SEALERS/GASKETS

15. Cold-Applied Bituminous Sealer: This material, for use in sealing of joints in concrete pipes, shall be free of asbestos and shall meet the following requirements:

It shall be of such consistency that it may be spread on the joints with a trowel when

the temperature of the air is between -20° F and 100° F. The bituminous material shall adhere to the concrete pipe so as to make a watertight seal and shall not flow, crack or become brittle when exposed to the atmosphere.

Unless otherwise specified, sampling shall be done in accordance with AASHTO T 40.

The bituminous sealer shall be delivered to the project in suitable containers for handling and shall be sealed or otherwise protected from contamination. The container shall show the brand name, net mass or volume, and the requirements for application.

16. Preformed Plastic Gaskets: This material for use in sealing of joints in concrete pipe shall conform to the requirements of ASTM C 1478.

17. Flexible, Watertight, Rubber-Type Gaskets: This material for use in sealing concrete pipe joints shall conform to the requirements of ASTM C 443.

PLASTIC

18. Corrugated Polyethylene Pipe: Corrugated Polyethylene Pipe, either corrugated interior surface (Type C) or smooth interior surface (Type S) without perforations or with perforations (Type CP or SP), shall conform to AASHTO M 252 or M 294. Type D pipe shall have a smooth interior surface braced circumferentially or spirally with projections or ribs joined to a smooth outer wall. Both surfaces shall be fused to, or be continuous with, the internal supports. Type D shall conform to AASHTO M 294.

19. Geotextiles: The geotextile shall be non-rotting, acid and alkali resistant, and have sufficient strength and permeability for the purpose intended including handling and backfilling operations. Fibers shall be low water absorbent. The fiber network must be dimensionally stable and resistant to delamination. The geotextile shall be free of any chemical treatment or coating that will reduce its permeability. The geotextile shall also be free of any flaws or defects which will alter its physical properties. Torn or punctured geotextiles shall not be used. For each specific use, only geotextiles that are already on the Connecticut Department of Transportation's Qualified Products List for the geotextile type will be used. The Engineer reserves the right to reject any geotextile he deems unsatisfactory for a specific use. The brand name shall be labeled on the geotextile or the geotextile container. Geotextiles that are susceptible to damage from sunlight or heat shall be so identified by suitable warning information on the packaging material.

Geotextiles susceptible to sunlight damage shall not be used in any installations where exposure to light will exceed 30 days, unless specifically authorized in writing by the Engineer.

20. Polyvinyl Chloride Plastic Pipe: The pipe shall conform to the requirements of ASTM D 1785. Couplings and elbows shall conform to the requirements of ASTM D 2466 or D 2467.

21. Polyvinyl Chloride Gravity Pipe: This pipe shall conform to one of the following specifications: ASTM F789, ASTM F 679, or ASTM F 794.

M.08.02—Catch Basins, Manholes, and Drop Inlets: The materials to be used in the construction shall conform to the following:

1. Brick for Catch Basins, Manholes or Drop Inlets: Brick for catch basins, manholes or drop inlets shall conform to the requirements of ASTM C 32, except that the depth shall be 2 1/4 inches, the width 3 5/8 inches, and the length 8 inches, and except that the maximum water-absorption by 5-hour boiling shall not exceed the following limits:

Average of 5 bricks	15%
Individual brick	18%

2. Concrete Building Brick for Catch Basins, Manholes, or Drop Inlets: Concrete building brick for catch basins, manholes, or drop inlets shall conform to the requirements of ASTM C 55, Grade S II.

3. Masonry Concrete Units for Catch Basins, Manholes, or Drop Inlets: Masonry concrete units for catch basins, manholes, or drop inlets shall conform to the requirements of ASTM C 139.

4. Precast Units for Drainage Structures: Precast units for drainage structures may be used except where particular conditions require building or casting structures in place.

Fabrication plants shall have a quality control plan approved by the Division Chief of Materials Testing that is demonstrated to the satisfaction of the Engineer. The facility, the quality of materials, the process of fabrication, and the finished precast units shall be subject to inspection by the Engineer.

Precast manholes shall conform to the requirements of AASHTO M 199 (ASTM C 478).

Circular precast catch basins and drop inlets shall conform to AASHTO M 199 (ASTM C 478) as supplemented below. Rectangular precast catch basins and drop inlets shall conform to ASTM C 913 as supplemented below:

All materials used for concrete shall conform to the requirements of Section M.03.

The provisions of Subarticle 4.01.03 (A) shall apply except that the concrete shall contain 5.0%-8.0% entrained air. Water-absorption of individual cores taken from precast units shall be not more than 7%.

Reinforcement shall conform to the requirements of Article M.06.01.

Suitable provision shall be made in casting the units for convenient handling of the completed casting, and additional reinforcement steel shall be provided to allow for such handling in the casting yard and during transportation and placement. Each completed unit shall be identified with the name of manufacturer and date of the concrete pour from which it was cast, either by casting this information into an exposed face of the unit or by suitable stencil. For each day's production of precast units, the

fabricator shall mold, cure, and test standard cylinders, or cylinders compacted in a similar manner to the parent precast units, for the purpose of determining the compressive strength of the concrete incorporated into the precast units. Concrete used in molding the cylinders shall be representative of the concrete incorporated into the precast units during the production period. Cylinders shall be molded in accordance with AASHTO T 23, cured by the same method as the units they represent, and tested as prescribed in AASHTO T 22.

The fabricator shall determine the air content of the concrete used in the day's production of precast units by performing tests as prescribed in AASHTO T 152.

The equipment and personnel necessary to perform the required testing shall be furnished by the fabricator and approved by the Engineer. All testing equipment shall be calibrated at least once each 12 months or as directed by the Engineer. The fabricator shall maintain records relative to the production, testing, and shipment of precast units supplied to the Department. Said records shall be available to a representative of the Department upon his request.

The Department may accept precast concrete units on the basis of fabricator's certification. The fabricator shall certify each shipment of precast concrete units on Department Form MAT 314 (PC-1), "Certification of Precast Concrete Products." Two (2) copies of this certification shall be furnished with the shipment to the Engineer at the Project site.

Precast units that are cracked, show evidence of honeycomb, or have over 10% of their surface area patched may be subject to rejection, even though meeting other requirements.

5. Metal for Drainage Structures: Metal for catch basins, drop inlet and manhole frames, extensions, covers, and gratings shall be cast iron, cast steel, structural steel or malleable iron conforming to the requirements of the plans. Covers and gratings shall bear uniformly on their supports.

Extensions shall be designed so that the existing manhole cover or catch basin grate, when set in place, will have substantially the same bearing, fit, and load carrying capacity as in the existing frame. The extension shall be designed to fit into the original frame, resting specifically on the flange and rim area. The extension shall accept the existing cover or grate so that the cover or grate is seated firmly without movement.

Ladder rungs for manholes shall conform to AASHTO M 199 (ASTM C 478).

Cast iron shall conform to the requirements of AASHTO M 105, Class 25 for the frames and Class 30 for gratings.

Cast steel shall conform to the requirements of ASTM A 27, Grade optional, and shall be thoroughly annealed.

Structural Steel shall conform to the requirements of ASTM A 36, or A 283, Grade B or better, as to quality and details of fabrication, except that in the chemical composition of the steel, the 2/10 of 1% of copper may be omitted.

Malleable iron shall conform to the requirements of ASTM A 47, Grade 22010.

The materials and method of manufacture for drop inlets shall conform to the requirements as stated on the plans or as ordered.

M.08.03—Aggregates

1. Bedding Material: Material for pipe bedding shall be sand or sandy soil, all of which passes a 3/8-inch sieve and not more than 10% passes a No. 200 sieve.

When ground water is encountered, the Engineer may allow No. 6 stone conforming to Article M.01.01 to be used instead of sand or sandy soil.

2. Aggregates for Underdrains: Materials for filling the trench shall consist of well-graded, clean, non-plastic sands or well-graded, clean, durable broken stone or screened gravel. Unless otherwise noted, the type of material to be used shall be sand.

Sand: This material shall meet the requirements of Subarticle M.03.01-2

Broken Stone or Screened Gravel: This material shall conform to the gradation requirements for Size No. 8 under Article M.01.01.

**CONNECTICUT
SUPPLEMENTAL SPECIFICATION
SECTION M.11
MASONRY FACING
CEMENT AND DRY RUBBLE MASONRY
BRICK
MORTAR**

M.11.01 – Masonry Facing:

1. Masonry Facing Stone:

Delete the third sentence:

“Preferably, the stone shall be from a quarry the product of which is known to be of satisfactory quality.”

Delete “2. : Vacant:”

M.11.04—Mortar:

Delete the entire article and replace it with the following:

M.11.04—Mortar: Mortar shall be either Pre-blended or Pre-packaged material conforming to:

ASTM C1714 - Standard Specification for Pre-blended Dry Mortar Mix for Unit Masonry;

ASTM C387 - Standard Specification for Packaged, Dry, Combined Materials for Concrete and High Strength Mortar;

or be composed of one part Portland cement and two parts, by volume, of surface dry fine aggregate blended on site.

Hydrated lime, in an amount not to exceed 4 pounds (1.8 kilograms) of lime to each bag of cement, may be added when the material is blended on site at the option of the Engineer. Cement and hydrated lime shall conform to the following requirements:

(a) Portland cement, Types I, II or IS, and water shall conform to the requirements of Article M.03.

(b) Hydrated lime shall conform to the requirements of ASTM C 6.

When mortar is mixed on the project site, **fine aggregate** shall conform to Grading A or B as indicated in the table below, and to the requirements of Section M.03. For laying stone, precast units, or for shotcrete, fine aggregate shall conform to Grading A. For pointing stone or the precast units and for laying brick or sealing pipe joints, the fine aggregate shall conform to Grading B.

Table of Gradation, Fine Aggregate for Mortar

<u>Square Mesh Sieves</u>	<u>Grading</u>	
	A	B
	Percentage Passing by weight (mass)	
Pass 3/8 inch (9.5 millimeters)	100	
Pass #4 (4.75 millimeters)	95-100	
Pass #8 (2.36 millimeters)	80-100	100
Pass #16 (1.18 millimeters)	50-85	
Pass #30 (600 microns)	25-60	
Pass #50 (300 microns)	10-30	10-40
Pass #100 (150 microns)	2-10	0-10

**CONNECTICUT
SUPPLEMENTAL SPECIFICATION
SECTION M.13
ROADSIDE DEVELOPMENT**

M.13.01—Topsoil:

Delete the entire article and replace it with the following:

“ M.13.01 – Topsoil: The term topsoil used herein shall mean a soil meeting the soil textural classes established by the USDA Classification System based upon the proportion of sand, silt, and clay size particles after passing a No. 10 (2 millimeter) sieve and subjected to a particle size analysis. The topsoil shall contain 5% to 20% organic matter as determined by loss on ignition of oven-dried samples dried at 221° F (105° C). The pH range of the topsoil shall be 5.5 to 7.0.

The following textural classes shall be acceptable:

Loamy sand, including coarse, loamy fine, and loamy very fine sand, with not more than 80% sand

Sandy loam, including coarse, fine and very fine sandy loam

Loam

Clay loam, with not more than 30% clay

Silt loam, with not more than 60% silt

Sandy clay loam, with not more than 30% clay

All textural classes of topsoil with greater than 80% sand content will be rejected.

The topsoil furnished by the Contractor shall be a natural, workable soil that is screened and free of subsoil, refuse, stumps, roots, brush, weeds, rocks and stones over 1 1/4 inches (30 millimeters) in diameter, and any other foreign matter that would be detrimental to the proper development of plant growth.

The Contractor shall notify the Engineer of the location of the topsoil at least 15 calendar days prior to delivery. The topsoil and its source shall be inspected and approved by the Engineer before the material is delivered to the project. Any material delivered to the project, which does not meet specifications or which has become mixed with undue amounts of subsoil during any operation at the source or during placing and spreading, will be rejected and shall be replaced by the Contractor with acceptable material.

When topsoil is not furnished by the Contractor, it shall be material that is stripped in accordance with Section 2.02 or is furnished by the State, and will be tested as determined by the Engineer.

1. Planting Soil: Soil Material to be used for plant backfill shall be one of the following textural classes:

- Loamy sand, with not more than 80% sand
- Sandy loam
- Loam
- Clay loam, with not more than 30% clay
- Silt loam, with not more than 60% silt
- Sandy clay loam, with not more than 30% clay

Planting soil shall be premixed, consisting of approximately 50 % topsoil, 25 % compost or peat, and 25% native soil. Planting soil shall be loose, friable, and free from refuse, stumps, roots, brush, weeds, rocks and stones 2 inches (50 millimeters) in diameter. In addition, the material shall be free from any material that will prevent proper development and plant growth.

- (a) For ericaceous plants and broad-leaved evergreens requiring an acid soil, planting soil shall have a true pH of 4.5 to 5.5. If it has not, it shall be amended by the Contractor at his own expense to the proper pH range by mixing with sulphur.
- (b) Planting soil for general planting of nonacid-loving plants shall have a true pH value of 5.6 to 6.5. If it has not, it shall be amended by the Contractor at his own expense to the proper pH range by mixing with dolomitic limestone.

The amount of either sulphur or limestone required to adjust the planting soil to the proper pH range (above) shall be determined by the Engineer based on agronomic tests. The limestone shall conform to the requirements of Article M.13.02. The sulphur shall be commercial or flour sulphur, unadulterated, and shall be delivered in containers with the name of the manufacturer, material, analysis, and net weight (mass) appearing on each container.

The Engineer reserves the right to draw such samples and to perform such tests as he deems necessary to ensure that these specifications are met.”

M.13.03 – Fertilizer:

In the last sentence of the first paragraph change “AOAC International.” to “AOAC.”

M.13.04 – Seed Mixture:

Replace Subarticle (a) with the following:

“(a) The grass seed mixture shall conform to the following:

<u>Species</u>	<u>Proportion By Weight (Mass) Pounds (kilograms)</u>	<u>Minimum Purity (Percent)</u>	<u>Minimum Germination (Percent)</u>
VELVET BENTGRASS, (<u>AGROSTIS CANINA</u>) CERTIFIED VARIETY: OR EQUAL CERTIFIED VARIETY;	25 (9.1)	96	85
RED FESCUE (<u>FESTUCA RUBRA L. SSP. RUBRA</u>) CERTIFIED VARIETY: OR EQUAL CERTIFIED VARIETY	35 (15.9)	97	80
PARTRIDGE PEA (<u>CHAMAECRISTA FASCICULATA</u>) CERTIFIED VARITEY	10 (4.5)	95	90
INDIAN GRASS (<u>SORGHASTRUM NUTANS</u>) CERTIFIED VARIETY:	15 (5.45)	95	90
CANADA WILDRYE (<u>ELYMUS CANADENSIS</u>) CERTIFIED VARIETY:	5 (2.3)	95	90
KENTUCKY BLUE GRASS (<u>POA PRATENSIS</u>) CERTIFIED VARIETY:	10 (4.5)	95	90

Under no circumstances should annual Ryegrass, Italian Rye, or any other seed be added to the seed mixture.”

M.13.06 – Compost:

In the third to last sentence, replace “DEP” with “DEEP”.

**CONNECTICUT
SUPPLEMENTAL SPECIFICATION
SECTION M.16
TRAFFIC CONTROL SIGNALS**

M.16.04 – Poles:

1. Steel Poles:

(i) Wire Entrance Fitting:

In the second sentence, delete “required to accept the cables”.

M.16.06 – Traffic Signals:

9. Painting:

In the first sentence, replace “MIL” with “MILSPEC”.

Subsection Third Coat:

Replace the first two sentences with the following:

“Dark Green Enamel: Shall be Dark Green exterior baked enamel and shall comply with FS A-A 2962. The color shall be No. 14056, FS No. 595.”

and in the third sentence replace “MIL” with “MILSPEC”.

M.16.08 – Pedestrian Push Button

In the last sentence of the second paragraph, change “Americans With Disabilities Act (ADA)” to “ADA”.

Subarticle Painting

Subsection Third Coat:

Delete the entire paragraph and replace it with the following:

“**Third Coat:** Dark Green Enamel, shall be DARK GREEN exterior-baking enamel and shall comply with Federal Specifications A-A 2962. The color shall be No. 14056, Federal Standard No. 595.”

M.16.10 – Flasher Cabinet:

1. Cabinet:

In subsection (f), change “Underwriter’s Laboratory” to “UL”.

M.16.15 – Messenger and Span Wire:

Delete the entire article and replace it with the following:

“M.16.15 – Messenger and Span Wire: The materials for this work shall conform to the following requirements:

1. Messenger wire shall be made of double-galvanized 7-strand utilities-grade steel wire cable, not less than 3/16 inch (4.8 millimeters) in diameter, with at least a 2,400-pound (10.7-kilonewton) breaking strength.
2. Span wire:
 - (a) “Span wire” shall be made of double-galvanized 7-strand utilities-grade steel wire cable, not less than 3/8 inch (9.5 millimeters) in diameter, with at least an 11,200-pound (50-kilonewton) breaking strength.
 - (b) “Span wire (high strength)” shall be made of double-galvanized 7-strand extra-high-strength-grade steel wire cable, not less than 7/16 inch (11.1 millimeters) in diameter, with at least a 20,800-pound (94-kilonewton) breaking strength.
3. All hardware accessories shown on the plans to be used in span wire or messenger mounting shall be made of high-strength, double-galvanized, first-quality materials.”

**CONNECTICUT
SUPPLEMENTAL SPECIFICATION
SECTION M.17
ELASTOMERIC MATERIALS**

M.17.01 – Elastomeric Bearing Pads:

2. Laminae:

In the last sentence of Subsection (a), replace “AAA 6061-T6” with “AA 6061-T6”.

4. Adhesive for Bonding:

In the 2nd paragraph of Subsection (b), replace “MS MIL” with “MILSPEC”.

**CONNECTICUT
SUPPLEMENTAL SPECIFICATION
SECTION M.18
SIGNING**

M.18.10 – Demountable Copy:

2. Type III Reflective Sheeting:

In the first paragraph, second sentence replace “Section M.18.09.01” with “Subarticle M.18.09-1.”

3. Non-Reflective Plastic Sheeting:

H. Solvent and Chemical Resistance:

In the chart under this subsection, replace “MIL” with “MILSPEC.”