DEPARTMENT OF THE ARMY
Omaha District, Corps of Engineers
106 South 15th Street
Omaha, Nebraska 68102-1618

:NOTICE: Failure to acknowledge :all amendments may cause rejec- :tion of the bid. See FAR :52.214-3 of Section 00100 :	Solicitation No. DACA45-03-B-0004 Date of Issue: 10 JUN 2003 Date of Opening: 16 JUL 2003 Amendment No. 0001 25 JUN 2003

SUBJECT: **Amendment No. 0001** to Specifications and Drawings for Construction of Fire/Crash Rescue Station, Offutt AFB, Nebraska Solicitation No. DACA45-03-B-0004.

TO: Prospective Bidders and Others Concerned

1. The specifications and drawings for subject project are hereby modified as follows (revise all specification indices, attachment lists, and drawing indices accordingly).

a. Specifications. (Descriptive Changes.)

(1) **Section 00100, Page 11**, delete contents of paragraph 25(b) and substitute the following:

"A Site Visit will be conducted on 10 July 03 at 1000 hrs. To facilitate entry into Offutt AFB, the group will meet at the Base Movie Theater located at 2506 Roman Hruska Drive, Offutt AFB, NE 68123. Air Force Transportation will be used to visit the construction site and the existing Fire Station. All contractors planning to attend the site visit must provide the requested information listed below for security review by the Air Force. Requests to attend the site visit must be made a minimum of seven (7) days in advance of the site visit date:

1) Person's Full given name
2) Company Name & Address
3) Phone Number
4) E-mail address (if possible)

Please send the requested information to the attention of Joel Flere by fax or e-mail only. Do not mail the information. See paragraph (c) for contact information. For any additional information please contact: Joel Flere P.E., U.S. Army Corps of Engineers, P.O. Box 13287, Offutt AFB, NE 68113. Telephone: (402) 293-2537. Fax: (402) 291-8177. E-mail: Joel.M.Flere@usace.army.mil"

(2) **Section 00800, Page 4**, paragraph 1.2(a), line 3, delete "$790.00" and substitute "$1185.00".

(3) **Section 00800, Page 9**, delete paragraph contents of paragraph 1.16.2 and substitute the following:

"(a) The contractor and all personnel, including all subcontractors and

suppliers, shall register with Base Security and the US Army Corps of Engineers (USACE) for personnel badges. The contractor shall submit the Contractor's Badge Request form to the USACE a minimum of 24 hours in advance of when the badge is needed. The person requesting the badge will need to be signed in at the Kenny Gate and escorted to the USACE Office in Castle Hall (by a Prime Contractor Employee with a Escort Badge), where the proper forms will be given to the requestee and Escort. The Prime Contractor Escort will then take the individual to the Pass and Registration Office were the Base will be issue a Contractor's Badge. Personnel access badges will be granted for periods not to exceed the number of calendar days needed to complete specific work activity by specific personnel. Badges will not be granted for personnel working on-site for less than a 30-day period, these individuals will require daily escort by a contractor with escort privileges. Registering for badges takes approximately one hour, but can take much longer. Note: Vehicle inspection will take place for all vehicles entering Offutt AFB. Commercial contractor vehicles will be searched every time they enter Offutt AFB. Entering shall be done at the Kenney Gate, expect a minimum of 15 minutes to complete a vehicle inspection for access.

(b) All commercial material deliveries to the site must be escorted at all times by a prime contractor's employee that has an approved badge with "Escort" privileges. Only the prime contractor's personnel can obtain an "Escort" Badge. No escorts will be provided by the Corps of Engineers or the Air Force."

(4) **Section 00800, Page 15**, delete paragraph contents of paragraph 1.27 and substitute the following:

"The Contractor shall furnish a temporary office facility approximately 10 feet x 20 feet with a minimum of 200 square feet of floor space. It shall be located where directed and shall be reserved for Government personnel only. Drinking water facilities, adequate lighting, local commercial telephone service (as indicated below), air-conditioning, heating equipment, and a partition enclosed chemical toilet shall be furnished and maintained by the Contractor. The office shall be furnished with one legal size filing cabinet with four drawers, one drafting table with stool, one plan rack, one desk, and three chairs. Used furniture, in good condition, will be acceptable. Entrance doors shall be equipped with a substantial lock. The Contractor shall provide janitor service, fuel for the heating facilities, electricity, telephone and water, all at no cost to the Government, except the Contractor will not be liable for Government long-distance calls. Provide one phone line for voice, and one high-speed data line (T1 or DSL) for computer use. The computer line should be provided through coordination with Contracting Officer. If high-speed data is not available through the Base, a second phone line shall be installed to the trailer for computer use. Provide an ANSI approved, 16-unit first aid kit, mounted on the wall of the trailer. The entire facility, including furniture, will remain the property of the Contractor and shall be removed from the site after completion of the work."

(5) Section 01040, Page 4, add the following to paragraph 1.2: "Design files in SDSFIE data format (Spatial Data Standards for Facilities, Infrastructure and Environment) shall be developed and support both AutoCADD and ESRI software platforms."

(6) Section 01040, Page 5,

a) Add the following to the end of paragraph 1.4.1:

"Preliminary design files in SDSFIE data format shall be sent on a CD-ROM to the Omaha District Office (ATTN: CENWO-ED-GD Bill Schwening)."

b) Paragraph 1.4.2, line 6, after "...***by Attachment 5 Standards.***" Add:

"***In addition, a follow on as-built survey and map update are required to reflect all as-built changes to design documents. All design documents will be edited electronically to reflect As-Built conditions, and will conform to all data and software platforms required by this document and user input. Deliverables for Spatial Data Standards for Facilities, Infrastructure and Environment, shall comply with Attachment 5 and the final as-built data shall be provided compliant with SDSFIE data format to support AutoCADD v.* and ESRI software.***"

(7) **Section 02722A, Page 6**, paragraph 1.4.2.4, add the following to the end of the paragraph:

"For every 10 density tests performed by ASTM D 2922, one ASTM D 1556 test shall also be performed."

(8) **Section 02722A, Page 8**, paragraph 2.1.3, Table I:

"Sieve Designation" delete column "No. 3" gradation and all its data.

(9) **Section 02754A, Page 10**, delete contents of paragraph 2.1.1 and substitute:

"Portland cement shall conform to ASTM C 150 Type I or II, low-alkali."

(10) **Section 02754A, Page 10**, paragraph 2.1.4, line 1, delete "all". Line 2, after "...physical requirements" add "for available alkalis (ASTM C 311), uniformity, and increased drying shrinkage".

(11) **Section 02754A, Page 10**, paragraph 2.2, starting at second paragraph, delete "In addition to...requirements." Delete all subsequent paragraphs "a." through "e." in entirety.

(12) **Section 02754A, Page 10**, paragraph 2.2.1, line 6, delete "1N, 4N...region, and the following limits:" and substitute "5S and the following exceptions:"

After contents of "d." add new line item as follows:
"e. Clay Lumps and Friable Particles 0.2 percent by mass (ASTM C 142)."

(13) **Section 02754A, Page 12**, add new paragraph as follows:

"2.4.1 Fabric Drag

Burlap shall be used for curing and shall conform to AASHTO M 182, Class 3 or 4. Materials shall be new or shall be clean materials never used for anything other then curing of concrete."

(14) **Section 02754A, Page 16**, paragraph 3.4.7.1, line 1, after "...1/8 inch per ft" add: "from the required horizontal or vertical alignment"

(15) **Section 02760A, Pages 5 & 6**, delete title and contents paragraphs 1.4.2.2 and 1.4.2.3 and substitute "Not Used".

(16) **Section 02760A, Page7**, delete title of paragraph 3.1.1 "Sawing" and substitute new title and contents as follows:

"Facing of Joints"

Facing of joints shall be accomplished using a concrete saw as specified in paragraph EQUIPMENT to enlarge the joint opening to the width and depth shown on the drawings. The blade shall be stiffened with sufficient number of dummy (used) blades or washers. Immediately following the sawing operations, the joint opening shall be thoroughly cleaned using a water jet to remove all saw cuttings and debris."

(17) **Section 02760A, Pages 7 & 8**, delete paragraph 3.1.1.1, in it's entirety.

(18) **Section 15181A Page 25**, paragraph 3.1.9.12, delete "15070A SEISMIC PROTECTION FOR MECHANICAL EQUIPMENT" and substitute "15070A SEISMIC PROTECTION AND ANTI-TERRORISM/FORCE PROTECTION (AT/FP) FOR MECHANICAL EQUIPMENT".

(19) **Section 15190A, Page 8**, add the following to paragraph 3.2:

"Piping, ductwork and attached valves shall be supported and braced to resist seismic loads as specified under Sections 13080 SEISMIC PROTECTION and ANTI-TERRORISM/FORCE PROTECTION (AT/FP) FOR MISCELLANEOUS EQUIPMENT and 15070A SEISMIC PROTECTION and ANTI-TERRORISM/FORCE PROTECTION (AT/FP) FOR MECHANICAL EQUIPMENT as shown on the drawings. Structural steel required for reinforcement to properly support piping, headers, and equipment but not shown shall be provided under this section. Material used for support shall be as specified under Section 05120 STRUCTURAL STEEL."

(20) **Section 15400A, Page 27**, add the following to paragraph 3.1:

"Piping, ductwork and attached valves shall be supported and braced to resist seismic loads as specified under Sections 13080 SEISMIC PROTECTION and ANTI-TERRORISM/FORCE PROTECTION (AT/FP) FOR MISCELLANEOUS EQUIPMENT and 15070A SEISMIC PROTECTION and ANTI-TERRORISM/FORCE PROTECTION (AT/FP) FOR MECHANICAL EQUIPMENT as shown on the drawings. Structural steel required for reinforcement to properly support piping, headers, and equipment but not shown shall be provided

under this section. Material used for support shall be as specified under Section 05120 STRUCTURAL STEEL."

(21) **Section 15400A, Page 47**, paragraph 3.10, P-19, add the following: "1. Dishwasher Liner A stainless steel liner with 2"-3" overlap shall be provided to house the under counter dishwasher."

(22) **Section 15620A, Page 10**, add the following to paragraph 2.4: "Manufacturer's standard hail guards shall be provided on exterior fin areas."

(23) **Section 15895A, Page 28**, add the following to paragraph 3.1:

"Piping, ductwork and attached valves shall be supported and braced to resist seismic loads as specified under Sections 13080 SEISMIC PROTECTION and ANTI-TERRORISM/FORCE PROTECTION (AT/FP) FOR MISCELLANEOUS EQUIPMENT and 15070A SEISMIC PROTECTION and ANTI-TERRORISM/FORCE PROTECTION (AT/FP) FOR MECHANICAL EQUIPMENT as shown on the drawings. Structural steel required for reinforcement to properly support piping, headers, and equipment but not shown shall be provided under this section. Material used for support shall be as specified under Section 05120 STRUCTURAL STEEL."

b. Specifications (New and/or Revised and Reissued). Delete and substitute or add specification pages as noted below. The substituted pages are revised and reissued with this amendment.

PAGES DELETED	PAGES SUBSTITUTED OR ADDED
Wage Determination NE020001 (Heavy)	Wage Determination NE030001 (Heavy)
Wage Determination NE020010 (Building)	Wage Determination NE030010 (Building)
Section 03300	Section 03300
Section 13080	Section 13080 (Revise all Section References found throughout specifications w/new title)
Section 15070A	Section 15070A (Revise all Section References found throughout specifications w/new title)
Section 16070A	Section 16070A (Revise all Section References found throughout specifications w/new title)

c. Drawings (Not Reissued). The following drawings sheets of drawing code AF-141-11-02 are revised with the date indicated on the drawing sheet. These drawings are not reissued with this amendment.

(1) **Sheet P1.0B:** Drawing coordinate C4, Leader Note, after "24 INCH C.I. MANHOLE COVER" add "PROVIDED TO WITHSTAND 20,225 POUNDS WHEEL LOAD"

(2) **Sheet P2.03:** Details B and E, delete “4” CONCRETE PAD” and substitute “6” CONCRETE PAD W/#4 E.W.”

(3) **Sheets M2.01, M2.02, M2.04 & M2.05:** add the following General Note to all the sheets:

“Add a strainer upstream of all control valves.”

(4) **Sheet M3.01:** Chiller Schedule, for Ambient Temperature (F), delete “95” and substitute “100”.

(5) **Sheet E1.01:** Room 127, delete fixtures “C6” and substitute “C1” (two places).

(6) **Sheet E2.02:** Hose Tower (Room 202), change two Disconnect Switches on Circuits R6-21 AND R6-23 to 30A, 125V/1P+GND.; LOCKABLE DISCONNECT SWITCHES.

(7) **Sheet E2.03:**

a) Hose Tower: delete “30A,125V/1P+GND. DISCONNECT SWITCH” replace with NEMA SIZE #00 STARTER. Two places for Tower Hoists.

b) SHEET E2.03: STARTER FOR H-1 SHALL BE NEMA SIZE #00.

c) SHEET E2.03: CHANGE STARTER FOR PW-1 FROM NEMA SIZE #00 TO NEMA #1.

d) SHEET E2.03: CHANGE STARTER FOR SAC-1 FROM NEMA SIZE #00 TO NEMA #1.

(8) **Sheet E7.02:** Detail A, delete Leader Note “TRANSITION FROM EMT (ABOVE) TO RGS (BELOW)”.

d. Drawings (Reissued). The following drawing sheets of drawing code AF 141-11-02 are revised with the revision date shown on the drawings and reissued with this amendment.

Sheets	
C2.01	REMOVAL PLAN - AREA A
C3.01	LAYOUT PLAN - AREA A
C3.02	LAYOUT PLAN - AREA B
C3.03	ENLARGED ENTRY PLANS
C4.01	GRADING PLAN - AREA A
C4.02	GRADING PLAN - AREA B
C4.03	STATIONING PLAN - AREA A
C4.04	STATIONING PLAN - AREA B
C5.01	GRADING SECTIONS
C5.02	TYPICAL ROAD AND PAVEMENT SECTIONS
C6.01	ROAD A PROFILE
C6.02	ROAD B, SLOTTED DRAIN D AND CULVERTS A & B PROFILES
C6.03	STORM DRAIN C AND PARKING LOT PROFILES
C7.01	JOINT LAYOUT PLAN - SOUTH AREA
C7.02	JOINT LAYOUT PLAN - NORTH AREA
C7.03	JOINT LAYOUT PLAN - WEST AREA
C8.02	DUMPSTER SCREEN WALL

Sheets

C8.05	PAVEMENT STRIPING DETAILS
C8.14	PAVEMENT JOINT DETAILS (WITH POURED JOINT SEALANT)
C8.17	TRAFFIC SIGNING AND STRIPING DETAILS
C8.19	DRAFT PIT DETAILS
L1.01	LANDSCAPE PLAN - AREA A
L2.04	LANDSCAPE NOTES, SCHEDULES
A1.03	MEZZANINE AND HOSE TOWER FLOOR PLANS
A2.00	COMPOSITE REFLECTED CEILING PLAN
A2.01	REFLECTED CEILING PLAN - AREA A
A4.01	BUILDING ELEVATIONS
A4.02	INTERIOR ELEVATIONS
A5.01	BUILDING SECTIONS
A5.02	WALL SECTIONS
A5.03	WALL SECTIONS
A5.04	WALL SECTIONS
A5.06	WALL SECTIONS
A6.01	ROOM MATERIAL AND FINISH SCHEDULE
A6.02	ROOM MATERIAL AND FINISH SCHEDULE
A6.03	DOOR SCHEDULE
A7.02	DOOR DETAILS
A8.02	ROOF DETAILS
A9.05	STAIR PLANS, SECTIONS AND DETAILS
A9.07	MISCELLANEOUS DETAILS
S0.1	DESIGN NOTES AND SCHEDULES
S1.1	FOUNDATION PLAN - AREA A
S1.2	FOUNDATION PLAN - AREA B
S1.3	SLAB PLAN-AREA A
S1.4	SLAB PLAN-AREA B
S1.5	MEZZANINE PLAN
S2.1	ROOF FRAMING PLAN-AREA A
S2.2	ROOF FRAMING PLAN-AREA B, HOSE TOWER FRAMING PLANS
S3.2	FOUNDATION SECTIONS AND DETAILS
S3.3	FOUNDATION SECTIONS
S3.4	FOUNDATION SECTIONS
S3.6	FOUNDATION SECTIONS AND DETAILS
S3.7	FOUNDATION SECTIONS
S3.8	FOUNDATION SECTIONS AND DETAIL
S4.2	TRUSS T-1 ELEVATIONS, SECTIONS & DETAILS
S4.3	TRUSS T-F ELEVATION, SECTIONS & DETAILS
S4.4	SECTIONS AND DETAILS
S4.11	TRUSS T-A, T-E, ELEVATIONS
S4.13	FRAMING SECTIONS AND DETAILS
S4.14	SECTIONS AND DETAILS
S4.16	SECTIONS
S4.17	SECTIONS
S4.18	SECTIONS
S4.19	SECTIONS
S4.23	TRUSS T-G ELEVATION, SECTION & DETAILS
S4.24	SECTIONS
S4.26	SECTIONS & DETAILS
S4.27	SECTIONS
S4.29	SECTIONS
S4.30	SECTIONS
S4.31	SECTIONS
S4.33	SECTIONS

Sheets	
S4.34	SECTIONS
S5.1	WALL ELEVATION KEY PLAN
S5.2	WALL ELEVATION 1
S5.3	WALL ELEVATIONS 2A, 2B, 36
S5.4	WALL ELEVATION 3 AND DETAIL
S5.5	WALL ELEVATION 4
S5.6	WALL ELEVATIONS 5, 31, 32, 33A, 33B, 33C
S5.7	WALL ELEVATIONS 6, 23, 24
S5.8	WALL ELEVATIONS 7, 25
S5.9	WALL ELEVATIONS 8 THRU 13, 34, 35
S5.10	WALL ELEVATION 14
S5.11	WALL ELEVATIONS 15, 17, 18
S5.12	WALL ELEVATIONS 16, 19
S5.13	WALL ELEVATIONS 20, 21, 22
S5.14	WALL ELEVATIONS26, 27
S5.15	WALL ELEVATIONS
MC.00	MECHANICAL COMPOSITE PLAN
MC.01	HVAC PIPING COMPOSITE PLAN
M1.01	HVAC PLAN - AREA A
M1.02	HVAC PLAN - AREA B
M1.03	HVAC MEZZANINE PLANS
M1.04	HVAC MECHANICAL ROOM PLAN
M1.05	HVAC PIPING PLAN AREA A

e. Drawings (New). The following new drawing sheets of drawing code AF 141-11-02 are dated with latest revision date shown on the drawings and are hereby added to the advertised drawing set and issued with this amendment.

Sheets	
C3.00	COMPOSITE LAYOUT PLAN
C8.11	TRAFFIC SIGNAL PLAN AND DETAILS
A9.08	GATE ELEVATION AND DETAILS
S0.2	STANDING SEAM METAL ROOF LIVE LOAD DIAGRAMS
S0.3	SECTIONS
S0.4	STANDING SEAM METAL ROOF WIND UPLIFT DIAGRAMS
S3.9	FOUNDATION SECTIONS
S3.10	FOUNDATION SECTIONS AND DETAILS
S4.44	ROOF FRAMING PLAN, ELEVATION AND SECTIONS
S4.45	TIRE STORAGE AREA, ELEVATION SECTION AND DETAILS
S4.46	SECTIONS AND DETAILS

2. This amendment is a part of the bidding papers and its receipt shall be acknowledged on the Standard Form 1442. All other conditions and requirements of the specifications remain unchanged. If the bids have been mailed prior to receiving this amendment, you will notify the office where bids are opened, in the specified manner, immediately of its receipt and of any changes in your bid occasioned thereby.

a. Hand-Carried Bids shall be delivered to the U.S. Army Corps of Engineers, Omaha District, Contracting Division (Room 301), 106 South 15th Street, Omaha, Nebraska 68102-1618.

b. Mailed Bids shall be addressed as noted in Item 8 on Page 00010-1 of Standard Form 1442.

3. Bids will be received until 2:00 p.m., local time at place of bid opening, 16 July 2003.

Attachments:
Spec Pages listed in 1.b. above
Dwgs. listed in 1.d. and 1.e. above

U.S. Army Engineer District, Omaha
Corps of Engineers
106 South 15th Street
Omaha, Nebraska 68102-1618

25 June 2003
mrp/4413

GENERAL DECISION NE030001 06/13/03 NE1

General Decision Number NE030001

Superseded General Decision No. NE020001

State: Nebraska

Construction Type:
HEAVY
HIGHWAY

County(ies):

DOUGLAS	SAUNDERS
SARPY	WASHINGTON

HEAVY CONSTRUCTION PROJECTS (does not include water well drilling); HIGHWAY CONSTRUCTION PROJECTS (excluding tunnels, building structures in rest area projects, and railroad construction; bascule, suspension & spandrel arch bridges; bridges designed for commercial navigation; bridges involving marine construction; other major bridges)

SAUNDERS COUNTY (EAST OF HWY. #109 EXTENDED NORTH AND SOUTH TO THE COUNTY LINE)

Modification Number	Publication Date
0	06/13/2003

COUNTY(ies):
DOUGLAS SAUNDERS
SARPY WASHINGTON

CARP0444B 10/01/2002

	Rates	Fringes
CARPENTER; PILEDRIVER	19.95	6.39

ELEC0022B 06/01/2002

	Rates	Fringes
DOUGLAS AND SARPY COUNTIES; SAUNDERS COUNTY (east of Hwy. #109 and north of U.S. Alternate Highway No. 30 (Route 92)); AND WASHINGTON COUNTY:		
ELECTRICIAN	25.00	9.17

ELEC0265A 07/01/2002

	Rates	Fringes
SAUNDERS COUNTY (east of Hwy. #109 and south of U.S. Alternate Hwy. No. 30 (Route 92)):		
ELECTRICIAN:		
Zone 1	20.63	4.5% + 6.13
Zone 2	20.93	4.5% + 6.13
Zone 3	21.23	4.5% + 6.13
Zone 4	21.63	4.5% + 6.13

FOOTNOTE:
Work on scaffolds, hanging scaffolds, boatswains chairs or ladders, etc., in any area where the worker is in a position to fall 40 ft. or more, or where objects above the worker can fall 40 ft. or more: to be paid one and one-half times the straight-time rate of pay.

ZONE DEFINITIONS:
Zone 1: 0 to 35 miles from the main Post Office in Lincoln, NE
Zone 2: 36 to 50 miles from the main Post Office in Lincoln, NE
Zone 3: 51 to 75 miles from the main Post Office in Lincoln, NE
Zone 4: 76 miles and over from the main Post Office in Lincoln, NE

ELEC1525A 01/01/2002

	Rates	Fringes
LINE CONSTRUCTION:		
LINE TECHNICIANS:		
Line technician	22.87	27.75%+2.45
Cable splicer; Line welder	24.59	27.75%+2.45

Line equipment operator	20.53	27.75%+2.45
Truck driver	16.42	27.75%+2.45
Ground person	14.80	27.75%+2.45

ELEC1525C 09/01/2000

	Rates	Fringes
TRAFFIC SIGNAL, STREET LIGHT AND UNDERGROUND WORK:		
Line technician	21.99	27.75%+2.00
Cable splicer; Line welder	23.64	27.75%+2.00
Equipment operator	19.74	27.75%+2.00
Truck driver	15.79	27.75%+2.00
Ground person	14.23	27.75%+2.00

ENGI0571C 04/01/2003

	Rates	Fringes
POWER EQUIPMENT OPERATORS:		
Oiler, greaser, air compressor, welding machine, pump, roller, forklift, hydrohammer, pug mill, concrete pump, cure and tyne machine, rubber-tired farm tractor	14.79	4.55
Off-road heavy hauler, Rough Roller dozer, rough blade, Ferguson-type tractors (Workbull with high tecco), asphalt roller	18.46	4.55
One and two drum hoists, tugger, trencher, concrete spreader & finishing machine, dozer loader, spread oiler, bantam-type tamper, rubber-tired tractor backhoe, oil distributor-finish roller dozer	20.01	4.55
Trimmer, crane, backhoe, mechanic, slip form paver, asphalt plant-concrete plant, laydown machine, concrete pump truck, finish blade, scraper	20.73	4.55

FOOTNOTES:

Operation of an articulating, Pitman type boom truck with single axle truck and lift capacity of less than 5,000 lbs., used to put construction materials in place: 90% of the group 2 rate.

When two (2) scraper units or two push cat units capable of operating separately are hooked together in tandem for single operation, the operator shall receive twenty-five cents ($0.25) over the classification worked.

When air compressors are used for operating the hammer when

pulling or driving pile and the compressor operator is required to operate the air valve for such hammer, such compressor operator shall receive the top wage rate.

Operators working in tunnels and caverns under compressed or free air shall receive forty cents ($0.40) above their classification.

Hazardous waste removal work requiring the wearing of personal protective equipment and/or suits, to be paid as follows:
Class A: $3.00 additional per hour
Class B: 2.00 additional per hour
Class C: 1.00 additional per hour
Class D: no premium pay.

IRON0021C 06/01/2002

	Rates	Fringes
IRONWORKER	21.45	7.02

LABO1140D 06/01/2002

DOUGLAS AND SARPY COUNTIES; SAUNDERS COUNTY (east of Hwy. #109):

	Rates	Fringes
LABORERS:		
Sanitary improvement work:		
General laborer	15.71	3.90
Mortar mixer, concrete saw operator, pipelayer and chain saw operator	16.00	3.90
Form setter, pre-cast manhole setter, inlet builder	16.44	3.90
All other work:		
General laborer	13.30	3.90
Mortar mixer, concrete saw operator, pipelayer and chain saw operator	13.59	3.90
Form setter, pre-cast manhole setter, inlet builder	14.05	3.90

LABO1140G 06/01/2002

WASHINGTON COUNTY:

	Rates	Fringes
LABORERS:		
General laborer	12.30	3.90

Mortar mixer, concrete saw operator, pipelayer and chain saw operator	12.59	3.90
Form setter, pre-cast manhole setter, inlet builder	13.05	3.90

PAIN0081J 06/01/2002

	Rates	Fringes
PAINTER	19.41	3.77

FOOTNOTES:

Work performed above 75 ft. on suspended staging: $.50 per hour additional.

Spray machine operator: $.50 per hour additional.

Nozzle operator for sandblasting and waterblasting (waterblasting more than 10,000 PSI) (including all side arm grinder operators engaged in removing paint or preparing for painting): $.50 per hour additional.

SUNE2001A 12/20/1988

	Rates	Fringes
CEMENT MASON	13.62	3.00

SUNE2005A 08/05/1993

	Rates	Fringes
SPRINKLER INSTALLER (LAWN)	5.15	

TEAM0554A 01/01/2003

	Rates	Fringes
TRUCK DRIVERS:		
Low boy driver	16.72	4.40
All other work	15.47	4.40

WELDERS - Receive rate prescribed for craft performing operation to which welding is incidental.

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Unlisted classifications needed for work not included within the scope of the classifications listed may be added after award only as provided in the labor standards contract clauses (29 CFR 5.5(a)(1)(ii)).

In the listing above, the "SU" designation means that rates listed under that identifier do not reflect collectively bargained wage and fringe benefit rates. Other designations indicate unions whose rates have been determined to be prevailing.

WAGE DETERMINATION APPEALS PROCESS

1.) Has there been an initial decision in the matter? This can be:

* an existing published wage determination
* a survey underlying a wage determination
* a Wage and Hour Division letter setting forth a position on a wage determination matter
* a conformance (additional classification and rate) ruling

On survey related matters, initial contact, including requests for summaries of surveys, should be with the Wage and Hour Regional Office for the area in which the survey was conducted because those Regional Offices have responsibility for the Davis-Bacon survey program. If the response from this initial contact is not satisfactory, then the process described in 2.) and 3.) should be followed.

With regard to any other matter not yet ripe for the formal process described here, initial contact should be with the Branch of Construction Wage Determinations. Write to:

Branch of Construction Wage Determinations
Wage and Hour Division
U. S. Department of Labor
200 Constitution Avenue, N. W.
Washington, D. C. 20210

2.) If the answer to the question in 1.) is yes, then an interested party (those affected by the action) can request review and reconsideration from the Wage and Hour Administrator (See 29 CFR Part 1.8 and 29 CFR Part 7). Write to:

Wage and Hour Administrator
U.S. Department of Labor
200 Constitution Avenue, N. W.
Washington, D. C. 20210

The request should be accompanied by a full statement of the interested party's position and by any information (wage payment data, project description, area practice material, etc.) that the requestor considers relevant to the issue.

3.) If the decision of the Administrator is not favorable, an interested party may appeal directly to the Administrative Review Board (formerly the Wage Appeals Board). Write to:

Administrative Review Board
U. S. Department of Labor

200 Constitution Avenue, N. W.

Washington, D. C. 20210

4.) All decisions by the Administrative Review Board are final.

END OF GENERAL DECISION

GENERAL DECISION NE030010 06/13/03 NE10

General Decision Number NE030010

Superseded General Decision No. NE020010

State: Nebraska

Construction Type:
BUILDING

County(ies):
SARPY

BUILDING CONSTRUCTION PROJECTS (does not include residential construction consisting of single family homes and apartments up to and including 4 stories)

Modification Number	Publication Date
0	06/13/2003

COUNTY(ies):
SARPY

ASBE0039B 06/01/2001

	Rates	Fringes
INSULATOR/ASBESTOS WORKER Includes the application of all insulating materials, protective coverings, coatings and finishings to all types of mechanical systems	23.51	8.19

FOOTNOTE:
Work performed from a boatswain chair, staging, or scaffolding suspended from a permanent structure, more than thirty (30) feet above the floor or the ground: $1.00 per hour additional.

BRNE0001A 06/01/2001

	Rates	Fringes
BRICKLAYER	21.24	6.56

FOOTNOTE:
Work on smoke stacks, chimneys and silos 50 ft. and higher: $2.00 per hour additional, to be paid from the footing.

CARP0444H 10/01/2002

	Rates	Fringes
CARPENTER (does not include concrete form work or overhead doors)	19.47	6.39

CARP1463A 06/01/2002

	Rates	Fringes
MILLWRIGHT	21.43	6.89

ELEC0022K 06/01/2002

	Rates	Fringes
ELECTRICIAN (includes low voltage wiring for fire alarm systems; does not include HVAC control wiring)	25.00	9.17

ELEC0022L 12/01/2002

	Rates	Fringes
ELECTRICIANS: Sound and voice transmission, transference systems;		

television and video systems; security systems; communication systems that transmit or receive information and/or control systems; energy management systems; and fire alarm systems (does not include raceway systems (excluding cable tray for the purpose of the above listed systems; Also, chases and/or nipples (not to exceed 10 ft.) may be installed on open wiring systems); Note: Fire alarm systems when installed in raceways in any new or remodel project when other building trades are present shall be the work of the inside electrician) (does not include HVAC control wiring) 18.10 5.44

ELEV0028A 07/01/2001

	Rates	Fringes
ELEVATOR MECHANIC	24.415	7.195 + a

FOOTNOTE:
a. Vacation Pay: 8% with 5 or more years of service, 6% for 6 months to 5 years service. Paid Holidays: New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day, Friday after Thanksgiving, and Christmas Day.

ENGI0571F 10/01/2002

	Rates	Fringes
POWER EQUIPMENT OPERATORS:		
Backhoe	20.23	6.06
Crane	22.08	6.06

IRON0021J 06/01/2002

	Rates	Fringes
IRONWORKER, STRUCTURAL (includes metal building erection)	21.45	7.02

PLUM0016I 06/01/2001

	Rates	Fringes
PLUMBER (does not include HVAC piping)	25.32	7.00

PLUM0464H 06/01/2001

	Rates	Fringes
PIPEFITTER/STEAMFITTER (includes HVAC piping)	24.29	8.60

ROOF0085A 07/01/2001

	Rates	Fringes
ROOFER	17.25	4.60

SFNE0669A 04/01/2003

	Rates	Fringes
SPRINKLER FITTER (FIRE)	27.66	7.60

SHEE0003F 07/01/2002

	Rates	Fringes
SHEET METAL WORKER (includes HVAC duct work, and setting the unit; does not include HVAC piping, HVAC wiring, or metal building erection)	25.05	6.66

SUNE1005B 09/13/2000

	Rates	Fringes
CEMENT MASON (includes concrete form work and rebar)	13.34	3.98
LABORER	10.50	
MASON TENDER	11.50	4.10
PAINTER (does not include wallpaper hanging)	12.50	
POWER EQUIPMENT OPERATOR: Loader	12.43	.04
SHEET METAL WORKER/ELECTRICIAN (HVAC wiring only)	20.21	6.09
TRUCK DRIVER/TANDEM DUMP	8.00	.03

WELDERS - Receive rate prescribed for craft performing operation to which welding is incidental.

Unlisted classifications needed for work not included within the scope of the classifications listed may be added after

award only as provided in the labor standards contract clauses (29 CFR 5.5(a)(1)(ii)).

In the listing above, the "SU" designation means that rates

listed under that identifier do not reflect collectively bargained wage and fringe benefit rates. Other designations indicate unions whose rates have been determined to be prevailing.

WAGE DETERMINATION APPEALS PROCESS

1.) Has there been an initial decision in the matter? This can be:

* an existing published wage determination
* a survey underlying a wage determination
* a Wage and Hour Division letter setting forth a position on a wage determination matter
* a conformance (additional classification and rate) ruling

On survey related matters, initial contact, including requests for summaries of surveys, should be with the Wage and Hour Regional Office for the area in which the survey was conducted because those Regional Offices have responsibility for the Davis-Bacon survey program. If the response from this initial contact is not satisfactory, then the process described in 2.) and 3.) should be followed.

With regard to any other matter not yet ripe for the formal process described here, initial contact should be with the Branch of Construction Wage Determinations. Write to:

Branch of Construction Wage Determinations
Wage and Hour Division
U. S. Department of Labor
200 Constitution Avenue, N. W.
Washington, D. C. 20210

2.) If the answer to the question in 1.) is yes, then an interested party (those affected by the action) can request review and reconsideration from the Wage and Hour Administrator (See 29 CFR Part 1.8 and 29 CFR Part 7). Write to:

Wage and Hour Administrator
U.S. Department of Labor
200 Constitution Avenue, N. W.
Washington, D. C. 20210

The request should be accompanied by a full statement of the interested party's position and by any information (wage payment data, project description, area practice material, etc.) that the requestor considers relevant to the issue.

3.) If the decision of the Administrator is not favorable, an interested party may appeal directly to the Administrative Review

Board (formerly the Wage Appeals Board). Write to:

Administrative Review Board
U. S. Department of Labor
200 Constitution Avenue, N. W.
Washington, D. C. 20210

4.) All decisions by the Administrative Review Board are final.

END OF GENERAL DECISION

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SECTION 03300

CAST-IN-PLACE STRUCTURAL CONCRETE
11/01

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

ACI INTERNATIONAL (ACI)

ACI 117/117R	(1990; Errata) Standard Tolerances for Concrete Construction and Materials
ACI 211.1	(1991) Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete
ACI 214.3R	(1988; R 1997) Simplified Version of the Recommended Practice for Evaluation of Strength Test Results of Concrete
ACI 305R	(1999) Hot Weather Concreting
ACI 318/318R	(1999) Building Code Requirements for Structural Concrete and Commentary

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

AASHTO M 182	(1991; R 1996) Burlap Cloth Made from Jute or Kenaf

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 1017/C 1017M	(1998) Chemical Admixtures for Use in Producing Flowing Concrete
ASTM C 1059	(1999) Latex Agents for Bonding Fresh to Hardened Concrete
ASTM C 1064/C 1064M	(1999) Temperature of Freshly Mixed Portland Cement Concrete
ASTM C 1077	(1998) Laboratories Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Laboratory Evaluation
ASTM C 1107	(1999) Packaged Dry, Hydraulic-Cement Grout(Nonshrink)

ASTM C 136	(1996a) Sieve Analysis of Fine and Coarse Aggregates
ASTM C 143/C 143M	(2000) Slump of Hydraulic Cement Concrete
ASTM C 150	(1999a) Portland Cement
ASTM C 171	(1997a) Sheet Materials for Curing Concrete
ASTM C 172	(1999) Sampling Freshly Mixed Concrete
ASTM C 173	(1994ael) Air Content of Freshly Mixed Concrete by the Volumetric Method
ASTM C 192/C 192M	(2000) Making and Curing Concrete Test Specimens in the Laboratory
ASTM C 231	(1997el) Air Content of Freshly Mixed Concrete by the Pressure Method
ASTM C 260	(2000) Air-Entraining Admixtures for Concrete
ASTM C 309	(1998a) Liquid Membrane-Forming Compounds for Curing Concrete
ASTM C 31/C 31M	(2000e1) Making and Curing Concrete Test Specimens in the Field
ASTM C 33	(1999ae1) Concrete Aggregates
ASTM C 39/C 39M	(2001) Compressive Strength of Cylindrical Concrete Specimens
ASTM C 42/C 42M	(1999) Obtaining and Testing Drilled Cores and Sawed Beams of Concrete
ASTM C 494/C 494M	(1999ae1) Chemical Admixtures for Concrete
ASTM C 578	(1995) Rigid, Cellular Polystyrene Thermal Insulation
ASTM C 591	(1994) Unfaced Preformed Rigid Cellular Polyisocyanurate Thermal Insulation
ASTM C 618	(2000) Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Concrete
ASTM C 78	(1994) Flexural Strength of Concrete (Using Simple Beam With Third-Point Loading)
ASTM C 881	(1999) Epoxy-Resin-Base Bonding Systems for Concrete
ASTM C 937	(1997) Grout Fluidifier for Preplaced-Aggregate Concrete

ASTM C 94/C 94M	(2000e2) Ready-Mixed Concrete
ASTM C 940	(1998a) Expansion and Bleeding of Freshly Mixed Grouts for Preplaced-Aggregate Concrete in the Laboratory
ASTM C 989	(1999) Ground Granulated Blast-Furnace Slag for Use in Concrete and Mortars
ASTM D 75	(1987; R 1997) Sampling Aggregates

NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY (NIST)

NIST HB 44	(1997) NIST Handbook 44: Specifications, Tolerances, and other Technical Requirements for Weighing and Measuring Devices

NATIONAL READY-MIXED CONCRETE ASSOCIATION (NRMCA)

NRMCA CPMB 100	(1996) Concrete Plant Standards \n/c\X
NRMCA QC 3	(1984) Quality Control Manual: Section 3, Plant Certifications Checklist: Certification of Ready Mixed Concrete Production Facilities
NRMCA TMMB 100	(1994) Truck Mixer Agitator and Front Discharge Concrete Carrier Standards

U.S. ARMY CORPS OF ENGINEERS (USACE)

COE CRD-C 104	(1980) Method of Calculation of the Fineness Modulus of Aggregate
COE CRD-C 400	(1963) Requirements for Water for Use in Mixing or Curing Concrete
COE CRD-C 521	(1981) Standard Test Method for Frequency and Amplitude of Vibrators for Concrete
COE CRD-C 94	(1995) Surface Retarders

1.2 LUMP SUM CONTRACT

Under this type of contract concrete items will be paid for by lump sum and will not be measured. The work covered by these items consists of furnishing all concrete materials, reinforcement, miscellaneous embedded materials, and equipment, and performing all labor for the forming, manufacture, transporting, placing, finishing, curing, and protection of concrete in these structures.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be

submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-03 Product Data

Mixture Proportions; G-DO

The results of trial mixture design studies along with a statement giving the maximum nominal coarse aggregate size and the proportions of ingredients that will be used in the manufacture of each strength or class of concrete, at least 14 days prior to commencing concrete placing operations. Aggregate weights shall be based on the saturated surface dry condition. The statement shall be accompanied by test results from an approved independent commercial testing laboratory, showing that mixture design studies have been made with materials proposed for the project and that the proportions selected will produce concrete of the qualities indicated. No substitutions shall be made in the materials used in the mixture design studies without additional tests to show that the quality of the concrete is satisfactory.

SD-04 Samples

Surface Retarder; G-AO

Sample of surface retarder material with manufacturer's instructions for application in conjunction with air-water cutting.

SD-06 Test Reports

Testing and Inspection for Contractor Quality Control; G-AO,

Certified copies of laboratory test reports, including mill tests and all other test data, for portland cement, blended cement, pozzolan, ground granulated blast furnace slag, silica fume, aggregate, admixtures, and curing compound proposed for use on this project.

SD-07 Certificates

Qualifications; G-AO

Written documentation for Contractor Quality Control personnel.

1.4 QUALIFICATIONS

Contractor Quality Control personnel assigned to concrete construction shall be American Concrete Institute (ACI) Certified Workmen in one of the following grades or shall have written evidence of having completed similar qualification programs:

Concrete Field Testing Technician, Grade I
Concrete Laboratory Testing Technician, Grade I or II
Concrete Construction Inspector, Level II

Concrete Transportation Construction Inspector or
Reinforced Concrete Special Inspector, Jointly certified by American Concrete Institute (ACI), Building Official and Code Administrators International (BOCA), International Conference of Building Officials (ICBO), and Southern Building Code Congress International (SBCCI).

The foreman or lead journeyman of the flatwork finishing crew shall have similar qualification for ACI Concrete Flatwork Technician/Finisher or equal, with written documentation.

1.5 FIELD TEST PANELS

Field test panels shall be constructed prior to beginning of work using the materials and procedures proposed for use on the job, to demonstrate the results to be attained. The quality and appearance of each panel shall be subject to the approval of the Contracting Officer, and, if not judged satisfactory, additional panels shall be constructed until approval is attained. Formed or finished surfaces in the completed structure shall match the quality and appearance of the approved field example.

1.5.1 Sample Panels

One sample wall panel at least 6 feet long by 4 feet wide by 8 inches thick shall be constructed to demonstrate Class A formed finish typical for concrete wall work. . An additional 24 inch diameter round panel by 6 feet high shall be constructed to demonstrate Class A formed finish and concrete color typical for exterior round concrete columns. Panels shall be constructed at locations as directed by the Contracting Officer. The panels shall be of typical wall thickness and constructed containing the full allocation of reinforcing steel that will be used in the structure, with a forming system that duplicates in every detail the one that will be used in construction of the structure. The same concrete mixture proportion and materials, the same placement techniques and equipment, and the same finishing techniques and timing shall be used that are planned for the structure. Construction of Class A finish will not be permitted until sample panels have been approved. Sample panels shall be protected from construction operations in a manner to protect approved finish, and are not to be removed until all Class A finish concrete has been accepted. In addition, each panel shall include a full length and full width joint line and shall have at least oneo void at least 12 inches by 12 inches by 3 inches deep either impressed in the concrete as placed or chipped in the hardened concrete. After the concrete is 7 days old, the voids shall be patched to demonstrate the effectiveness and the appearance of the Contractor's repair procedures.

1.6 SPECIAL REQUIREMENTS

A pre-installation meeting with the Contracting Officer will be required at least 10 days prior to start of construction. The Contractor shall be responsible for calling the meeting; the Project Superintendent and active installation personnel shall be present.

1.7 GENERAL REQUIREMENTS

1.7.1 Tolerances

Except as otherwise specified herein, tolerances for concrete batching, mixture properties, and construction as well as definition of terms and application practices shall be in accordance with ACI 117/117R. Level and grade tolerance measurements of slabs shall be made as soon as possible after finishing; when forms or shoring are used, the measurements shall be made prior to removal.

1.7.1.1 Floors

For the purpose of this Section the following terminology correlation between ACI 117/117R and this Section shall apply:

Floor Profile Quality Classification From ACI 117/117R	This Section
Conventional Bullfloated	Same
Conventional Straightedged	Same
Flat	Float Finish or Trowel Finish

Levelness tolerance shall not apply where design requires floors to be sloped to drains or sloped for other reasons.

1.7.1.2 Floors by the Straightedge System

The flatness of the floors shall be carefully controlled and the tolerances shall be measured by the straightedge system as specified in paragraph 4.5.7 of ACI 117/117R, using a 10 foot straightedge, within 72 hours after floor slab installation and before shores and/or forms are removed. The listed tolerances shall be met at any and every location at which the straightedge can be placed.

Bullfloated 1/2"
Straightedged 5/16"
Float Finish 3/16"
Trowel Finish 3/16"

1.7.2 Strength Requirements and w/c Ratio

1.7.2.1 Strength Requirements

Specified compressive strength (f'c) shall be as follows:

COMPRESSIVE STRENGTH	STRUCTURE OR PORTION OF STRUCTURE
4000 psi at 28 days	ALL WORK

Concrete made with high-early strength cement shall have a 7-day strength equal to the specified 28-day strength for concrete made with Type I or II portland cement. Compressive strength shall be determined in accordance with ASTM C 39/C 39M.

a. Evaluation of Concrete Compressive Strength. Compressive strength specimens (6 by 12 inch cylinders) shall be fabricated by the Contractor and laboratory cured in accordance with ASTM C 31/C 31M and tested in accordance with ASTM C 39/C 39M. The strength of the concrete will be considered satisfactory so long as the average of all sets of three consecutive test results equals or exceeds the specified compressive strength f'c and no individual test result falls below the specified strength f'c by more than 500 psi. A "test" is defined as the average of two companion cylinders, or if only one cylinder is tested, the results of the single cylinder test. Additional analysis or testing, including taking cores and/or load tests may be required at the Contractor's

expense when the strength of the concrete in the structure is considered potentially deficient.

b. Investigation of Low-Strength Compressive Test Results. When any strength test of standard-cured test cylinders falls below the specified strength requirement by more than 500 psi or if tests of field-cured cylinders indicate deficiencies in protection and curing, steps shall be taken to assure that the load-carrying capacity of the structure is not jeopardized. When the strength of concrete in place is considered potentially deficient, cores shall be obtained and tested in accordance with ASTM C 42/C 42M. At least three representative cores shall be taken from each member or area of concrete in place that is considered potentially deficient. The location of cores will be determined by the Contracting Officer to least impair the strength of the structure. Concrete in the area represented by the core testing will be considered adequate if the average strength of the cores is equal to at least 85 percent of the specified strength requirement and if no single core is less than 75 percent of the specified strength requirement. Non-destructive tests (tests other than test cylinders or cores) shall not be used as a basis for acceptance or rejection. The Contractor shall perform the coring and repair the holes. Cores will be tested by the Government.

c. Load Tests. If the core tests are inconclusive or impractical to obtain or if structural analysis does not confirm the safety of the structure, load tests may be directed by the Contracting Officer in accordance with the requirements of ACI 318/318R. Concrete work evaluated by structural analysis or by results of a load test as being understrength shall be corrected in a manner satisfactory to the Contracting Officer. All investigations, testing, load tests, and correction of deficiencies shall be performed by and at the expense of the Contractor and must be approved by the Contracting Officer, except that if all concrete is found to be in compliance with the drawings and specifications, the cost of investigations, testing, and load tests will be at the expense of the Government.

d. Evaluation of Concrete Flexural Strength. Flexural strength specimens (beams) shall be fabricated by the Contractor and laboratory cured in accordance with ASTM C 31/C 31M and tested in accordance with ASTM C 78. The strength of the concrete will be considered satisfactory so long as the average of all sets of three consecutive test results equals or exceeds the specified flexural strength and no individual test result falls below the specified flexural strength by more than 50 psi.A "test" is defined as the average of two companion beams. Additional analysis or testing, including taking cores and/or load tests may be required at the Contractor's expense when the strength of the concrete in the slab is considered potentially deficient.

1.7.2.2 Water-Cement Ratio

Maximum water-cement ratio (w/c) for normal weight concrete shall be 0.45 The w/c may cause higher strengths than that required above for compressive or flexural strength. The maximum w/c required will be the equivalent w/c as determined by conversion from the weight ratio of water to cement plus pozzolan, and ground granulated blast furnace slag (GGBF slag) by the weight equivalency method as described in ACI 211.1. In the case where

GGBF slag is used, the weight of the GGBF slag shall be included in the equations of ACI 211.1 for the term P which is used to denote the weight of pozzolan.

1.7.3 Air Entrainment

All normal weight concrete shall be air entrained to contain between 4 and 7 percent total air, except that when the nominal maximum size coarse aggregate is 3/4 inch or smaller it shall be between 4.5 and 7.5 percent. Specified air content shall be attained at point of placement into the forms. Air content for normal weight concrete shall be determined in accordance with ASTM C 231.

1.7.4 Slump

Slump of the concrete, as delivered to the point of placement into the forms, shall be within the following limits. Slump shall be determined in accordance with ASTM C 143/C 143M.

Structural Element	Slump Minimum	Slump Maximum
Walls, columns and beams	2 in.	4 in.
Foundation walls, substructure walls, footings, slabs	1 in.	3 in.
Any structural concrete approved for placement by pumping:		
At pump	2 in.	6 in.
At discharge of line	1 in.	4 in.

When use of a plasticizing admixture conforming to ASTM C 1017/C 1017M or when a Type F or G high range water reducing admixture conforming to ASTM C 494/C 494M is permitted to increase the slump of concrete, concrete shall have a slump of 2 to 4 inches before the admixture is added and a maximum slump of 8 inches at the point of delivery after the admixture is added.

1.7.5 Concrete Temperature

The temperature of the concrete as delivered shall not exceed 90 degrees F. When the ambient temperature during placing is 40 degrees F or less, or is expected to be at any time within 6 hours after placing, the temperature of the concrete as delivered shall be between 55 and 75 degrees F.

1.7.6 Size of Coarse Aggregate

The largest feasible nominal maximum size aggregate (NMSA) specified in paragraph AGGREGATES shall be used in each placement. However, nominal maximum size of aggregate shall not exceed any of the following: three-fourths of the minimum cover for reinforcing bars, three-fourths of the minimum clear spacing between reinforcing bars, one-fifth of the narrowest dimension between sides of forms, or one-third of the thickness of slabs or toppings.

1.8 MIXTURE PROPORTIONS

Concrete shall be composed of portland cement, other cementitious and pozzolanic materials as specified, aggregates, water and admixtures as specified.

1.8.1 Proportioning Studies for Normal Weight Concrete

Trial design batches, mixture proportioning studies, and testing requirements for various classes and types of concrete specified shall be the responsibility of the Contractor. Except as specified for flexural strength concrete, mixture proportions shall be based on compressive strength as determined by test specimens fabricated in accordance with ASTM C 192/C 192M and tested in accordance with ASTM C 39/C 39M. Samples of all materials used in mixture proportioning studies shall be representative of those proposed for use in the project and shall be accompanied by the manufacturer's or producer's test reports indicating compliance with these specifications. Trial mixtures having proportions, consistencies, and air content suitable for the work shall be made based on methodology described in ACI 211.1, using at least three different water-cement ratios for each type of mixture, which will produce a range of strength encompassing those required for each class and type of concrete required on the project. The maximum water-cement ratios required in subparagraph Water-Cement Ratio will be the equivalent water-cement ratio as determined by conversion from the weight ratio of water to cement plus pozzolan, and ground granulated blast furnace slag (GGBF slag) by the weight equivalency method as described in ACI 211.1. In the case where GGBF slag is used, the weight of the GGBF slag shall be included in the equations in ACI 211.1 for the term P, which is used to denote the weight of pozzolan. If pozzolan is used in the concrete mixture, the minimum pozzolan content shall be 15 percent by weight of the total cementitious material, and the maximum shall be 35 percent. Laboratory trial mixtures shall be designed for maximum permitted slump and air content. Separate sets of trial mixture studies shall be made for each combination of cementitious materials and each combination of admixtures proposed for use. No combination of either shall be used until proven by such studies, except that, if approved in writing and otherwise permitted by these specifications, an accelerator or a retarder may be used without separate trial mixture study. Separate trial mixture studies shall also be made for concrete for any conveying or placing method proposed which requires special properties and for concrete to be placed in unusually difficult placing locations. The temperature of concrete in each trial batch shall be reported. For each water-cement ratio, at least three test cylinders for each test age shall be made and cured in accordance with ASTM C 192/C 192M. They shall be tested at 7 and 28 days in accordance with ASTM C 39/C 39M. From these test results, a curve shall be plotted showing the relationship between water-cement ratio and strength for each set of trial mix studies. In addition, a curve shall be plotted showing the relationship between 7 day and 28 day strengths. Each mixture shall be designed to promote easy and suitable concrete placement, consolidation and finishing, and to prevent segregation and excessive bleeding.

1.8.2 Average Compressive Strength Required for Mixtures

The mixture proportions selected during mixture design studies shall produce a required average compressive strength (f'cr) exceeding the specified compressive strength (f'c) by the amount indicated below. This required average compressive strength, f'cr, will not be a required acceptance criteria during concrete production. However, whenever the daily average compressive strength at 28 days drops below f'cr during concrete production, or daily average 7-day strength drops below a strength correlated with the 28-day f'cr, the mixture shall be adjusted, as

approved, to bring the daily average back up to f'cr. During production, the required f'cr shall be adjusted, as appropriate, based on the standard deviation being attained on the job.

1.8.2.1 Computations from Test Records

Where a concrete production facility has test records, a standard deviation shall be established in accordance with the applicable provisions of ACI 214.3R. Test records from which a standard deviation is calculated shall represent materials, quality control procedures, and conditions similar to those expected; shall represent concrete produced to meet a specified strength or strengths (f'c) within 1,000 psi of that specified for proposed work; and shall consist of at least 30 consecutive tests. A strength test shall be the average of the strengths of two cylinders made from the same sample of concrete and tested at 28 days. Required average compressive strength f'cr used as the basis for selection of concrete proportions shall be the larger of the equations that follow using the standard deviation as determined above:

f'cr = f'c + 1.34S where units are in psi

f'cr = f'c + 2.33S - 500 where units are in psi

Where S = standard deviation

Where a concrete production facility does not have test records meeting the requirements above but does have a record based on 15 to 29 consecutive tests, a standard deviation shall be established as the product of the calculated standard deviation and a modification factor from the following table:

NUMBER OF TESTS	MODIFICATION FACTOR FOR STANDARD DEVIATION
15	1.16
20	1.08
25	1.03
30 or more	1.00

1.8.2.2 Computations without Previous Test Records

When a concrete production facility does not have sufficient field strength test records for calculation of the standard deviation, the required average strength f'cr shall be determined as follows:

a. If the specified compressive strength f'c is less than 3,000 psi,

f'cr = f'c + 1000 psi

b. If the specified compressive strength f'c is 3,000 to 5,000 psi,

f'cr = f'c + 1,200 psi

c. If the specified compressive strength f'c is over 5,000 psi,

f'cr = f'c + 1,400 psi

1.9 STORAGE OF MATERIALS

Cement and other cementitious materials shall be stored in weathertight buildings, bins, or silos which will exclude moisture and contaminants and keep each material completely separated. Aggregate stockpiles shall be arranged and used in a manner to avoid excessive segregation and to prevent contamination with other materials or with other sizes of aggregates. Aggregate shall not be stored directly on ground unless a sacrificial layer is left undisturbed. Reinforcing bars and accessories shall be stored above the ground on platforms, skids or other supports. Other materials shall be stored in such a manner as to avoid contamination and deterioration. Admixtures which have been in storage at the project site for longer than 6 months or which have been subjected to freezing shall not be used unless retested and proven to meet the specified requirements. Materials shall be capable of being accurately identified after bundles or containers are opened.

1.10 GOVERNMENT ASSURANCE INSPECTION AND TESTING

Day-to day inspection and testing shall be the responsibility of the Contractor Quality Control (CQC) staff. However, representatives of the Contracting Officer can and will inspect construction as considered appropriate and will monitor operations of the Contractor's CQC staff. Government inspection or testing will not relieve the Contractor of any of his CQC responsibilities.

1.10.1 Materials

The Government will sample and test aggregates, cementitious materials, other materials, and concrete to determine compliance with the specifications as considered appropriate. The Contractor shall provide facilities and labor as may be necessary for procurement of representative test samples. Samples of aggregates will be obtained at the point of batching in accordance with ASTM D 75. Other materials will be sampled from storage at the jobsite or from other locations as considered appropriate. Samples may be placed in storage for later testing when appropriate.

1.10.2 Fresh Concrete

Fresh concrete will be sampled as delivered in accordance with ASTM C 172 and tested in accordance with these specifications, as considered necessary.

1.10.3 Hardened Concrete

Tests on hardened concrete will be performed by the Government when such tests are considered necessary.

1.10.4 Inspection

Concrete operations may be tested and inspected by the Government as the project progresses. Failure to detect defective work or material will not prevent rejection later when a defect is discovered nor will it obligate the Government for final acceptance.

PART 2 PRODUCTS

2.1 CEMENTITIOUS MATERIALS

Cementitious Materials shall be portland cement, or portland cement in combination with pozzolan or ground granulated blast furnace slag and shall

conform to appropriate specifications listed below. Use of cementitious materials in concrete which will have surfaces exposed in the completed structure shall be restricted so there is no change in color, source, or type of cementitious material.

2.1.1 Portland Cement

ASTM C 150, Type I low alkali with a maximum 15 percent amount of tricalcium aluminate, or Type II low alkali including false set requirements. White portland cement shall meet the above requirements except that it may be Type I, Type II or Type III low alkali. White Type III shall be used only in specific areas of the structure, when approved in writing.

2.1.2 High-Early-Strength Portland Cement

ASTM C 150, Type III with tricalcium aluminate limited to 5 percent, low alkali. Type III cement shall be used only in isolated instances and only when approved in writing.

2.1.3 Pozzolan (Fly Ash)

ASTM C 618, Class C or F with the optional requirements for multiple factor, drying shrinkage, and uniformity from Table 3 of ASTM C 618. Requirement for maximum alkalies of ASTM C 311 shall not exceed 1.5%. If pozzolan is used, it shall never be less than 15 percent nor more than 35 percent by weight of the total cementitious material. The Contractor shall comply with EPA requirements in accordance with Section 01670 RECYCLED / RECOVERED MATERIALS.

2.1.4 Ground Granulated Blast-Furnace (GGBF) Slag

ASTM C 989, Grade 120.

2.2 AGGREGATES

Aggregates shall conform to the following.

2.2.1 Fine Aggregate

Fine aggregate shall conform to the quality and gradation requirements of ASTM C 33.

2.2.2 Coarse Aggregate

Coarse aggregate shall conform to ASTM C 33, Class 5S, size number 57 or 67.

2.3 CHEMICAL ADMIXTURES

Chemical admixtures, when required or permitted, shall conform to the appropriate specification listed. Admixtures shall be furnished in liquid form and of suitable concentration for easy, accurate control of dispensing.

2.3.1 Air-Entraining Admixture

ASTM C 260 and shall consistently entrain the air content in the specified ranges under field conditions.

2.3.2 Accelerating Admixture

ASTM C 494/C 494M, Type C or E, except that calcium chloride or admixtures containing calcium chloride shall not be used.

2.3.3 Water-Reducing or Retarding Admixture

ASTM C 494/C 494M, Type A, B, or D, except that the 6-month and 1-year compressive and flexural strength tests are waived.

2.3.4 High-Range Water Reducer

ASTM C 494/C 494M, Type F or G, except that the 6-month and 1-year strength requirements are waived. The admixture shall be used only when approved in writing, such approval being contingent upon particular mixture control as described in the Contractor's Quality Control Plan and upon performance of separate mixture design studies.

2.3.5 Surface Retarder

COE CRD-C 94.

2.3.6 Expanding Admixture

Aluminum powder type expanding admixture conforming to ASTM C 937.

2.4 CURING MATERIALS

2.4.1 Impervious-Sheet

Impervious-sheet materials shall conform to ASTM C 171, type optional, except, that polyethylene sheet shall not be used.

2.4.2 Membrane-Forming Compound

Membrane-Forming curing compound shall conform to ASTM C 309, Type 1-D or 2, except that only a styrene acrylate or chlorinated rubber compound meeting Class B requirements shall be used for surfaces that are to be painted or are to receive bituminous roofing, or waterproofing, or floors that are to receive adhesive applications of resilient flooring. The curing compound selected shall be compatible with any subsequent paint, roofing, waterproofing, or flooring specified. Nonpigmented compound shall contain a fugitive dye, and shall have the reflective requirements in ASTM C 309 waived.

2.4.3 Burlap and Cotton Mat

Burlap and cotton mat used for curing shall conform to AASHTO M 182.

2.5 WATER

Water for mixing and curing shall be fresh, clean, potable, and free of injurious amounts of oil, acid, salt, or alkali, except that non-potable water may be used if it meets the requirements of COE CRD-C 400.

2.6 NONSHRINK GROUT

Nonshrink grout shall conform to ASTM C 1107, Grade A, B, or C, and shall be a commercial formulation suitable for the proposed application.

2.7 LATEX BONDING AGENT

Latex agents for bonding fresh to hardened concrete shall conform to ASTM C 1059.

2.8 EPOXY RESIN

Epoxy resins for use in repairs shall conform to ASTM C 881, Type V, Grade 2. Class as appropriate to the existing ambient and surface temperatures.

2.9 EMBEDDED ITEMS

Embedded items shall be of the size and type indicated or as needed for the application. Dovetail slots shall be galvanized steel. Inserts for shelf angles and bolt hangers shall be of malleable iron or cast or wrought steel.

2.10 FLOOR HARDENER

Floor hardener shall be a colorless aqueous solution containing zinc silicofluoride, magnesium silicofluoride, or sodium silicofluoride. These silicofluorides can be used individually or in combination. Proprietary hardeners may be used if approved in writing by the Contracting Officer.

2.11 PERIMETER INSULATION

Perimeter insulation shall be polystyrene conforming to ASTM C 578, Type II or polyurethane conforming to ASTM C 591, Type II. The Contractor shall comply with EPA requirements in accordance with Section 01670 RECYCLED / RECOVERED MATERIALS.

2.12 VAPOR BARRIER

See Specification Section 02372a: GEOMEMBRANE VAPOR BARRIER.

2.13 JOINT MATERIALS

2.13.1 Joint Fillers, Sealers, and Waterstops

See Specification Section 03150: EXPANSION JOINTS, CONTRACTION JOINTS, AND WATERSTOPS.

2.13.2 Contraction Joints in Slabs

See Specification Section 03150: EXPANSION JOINTS, CONTRACTION JOINTS, AND WATERSTOPS.

PART 3 EXECUTION

3.1 PREPARATION FOR PLACING

Before commencing concrete placement, the following shall be performed. Surfaces to receive concrete shall be clean and free from frost, ice, mud, and water. Forms shall be in place, cleaned, coated, and adequately supported, in accordance with Section 03100 STRUCTURAL CONCRETE FORMWORK. Reinforcing steel shall be in place, cleaned, tied, and adequately supported, in accordance with Section 03200 CONCRETE REINFORCEMENT. Transporting and conveying equipment shall be in-place, ready for use, clean, and free of hardened concrete and foreign material. Equipment for consolidating concrete shall be at the placing site and in proper working

order. Equipment and material for curing and for protecting concrete from weather or mechanical damage shall be at the placing site, in proper working condition and in sufficient amount for the entire placement. When hot, windy conditions during concreting appear probable, equipment and material shall be at the placing site to provide windbreaks, shading, fogging, or other action to prevent plastic shrinkage cracking or other damaging drying of the concrete.

3.1.1 Foundations

3.1.1.1 Concrete on Earth Foundations

Earth (subgrade, base, or subbase courses) surfaces upon which concrete is to be placed shall be clean, damp, and free from debris, frost, ice, and standing or running water. Prior to placement of concrete, the foundation shall be well drained and shall be satisfactorily graded and uniformly compacted.

3.1.1.2 Preparation of Rock

Rock surfaces upon which concrete is to be placed shall be free from oil, standing or running water, ice, mud, drummy rock, coating, debris, and loose, semidetached or unsound fragments. Joints in rock shall be cleaned to a satisfactory depth, as determined by the Contracting Officer, and to firm rock on the sides. Immediately before the concrete is placed, rock surfaces shall be cleaned thoroughly by the use of air-water jets or sandblasting as specified below for Previously Placed Concrete. Rock surfaces shall be kept continuously moist for at least 24 hours immediately prior to placing concrete thereon. All horizontal and approximately horizontal surfaces shall be covered, immediately before the concrete is placed, with a layer of mortar proportioned similar to that in the concrete mixture. Concrete shall be placed before the mortar stiffens.

3.1.1.3 Excavated Surfaces in Lieu of Forms

Concrete for footings may be placed directly against the soil provided the earth or rock has been carefully trimmed, is uniform and stable, and meets the compaction requirements of Specification Section 02315EXCAVATION, FILLING, AND BACKFILLING FOR BUILDINGS. The concrete shall be placed without becoming contaminated by loose material, and the outline of the concrete shall be within the specified tolerances.

3.1.2 Previously Placed Concrete

3.1.2.1 Preparation of Previously Placed Concrete

Concrete surfaces to which other concrete is to be bonded shall be abraded in an approved manner that will expose sound aggregate uniformly without damaging the concrete. Laitance and loose particles shall be removed. Surfaces shall be thoroughly washed and shall be moist but without free water when concrete is placed.

3.1.3 Vapor Barrier

See Specification Section 02372a: GEOMEMBRANE VAPOR BARRIER.

3.1.4 Perimeter Insulation

Perimeter insulation shall be installed at locations indicated. Adhesive

shall be used where insulation is applied to the interior surface of foundation walls and may be used for exterior application.

3.1.5 Embedded Items

Before placement of concrete, care shall be taken to determine that all embedded items are firmly and securely fastened in place as indicated on the drawings, or required. Conduit and other embedded items shall be clean and free of oil and other foreign matter such as loose coatings or rust, paint, and scale. The embedding of wood in concrete will be permitted only when specifically authorized or directed. Voids in sleeves, inserts, and anchor slots shall be filled temporarily with readily removable materials to prevent the entry of concrete into voids.

3.2 CONCRETE PRODUCTION

3.2.1 Batching, Mixing, and Transporting Concrete

Concrete shall be furnished from a ready-mixed concrete plant. Ready-mixed concrete shall be batched, mixed, and transported in accordance with ASTM C 94/C 94M, except as otherwise specified. Truck mixers, agitators, and nonagitating transporting units shall comply with NRMCA TMMB 100. Ready-mix plant equipment and facilities shall be certified in accordance with NRMCA QC 3. Approved batch tickets shall be furnished for each load of ready-mixed concrete.

3.2.1.1 General

The batching plant shall be located off site and close to the project. The batching, mixing and placing system shall have a capacity of at least 100 cubic yards per hour. The batching plant shall conform to the requirements of NRMCA CPMB 100 and as specified; however, rating plates attached to batch plant equipment are not required.

3.2.1.2 Batching Equipment

The batching controls shall be semiautomatic or automatic, as defined in NRMCA CPMB 100. A semiautomatic batching system shall be provided with interlocks such that the discharge device cannot be actuated until the indicated material is within the applicable tolerance. The batching system shall be equipped with accurate recorder or recorders that meet the requirements of NRMCA CPMB 100. The weight of water and admixtures shall be recorded if batched by weight. Separate bins or compartments shall be provided for each size group of aggregate and type of cementitious material, to prevent intermingling at any time. Aggregates shall be weighed either in separate weigh batchers with individual scales or, provided the smallest size is batched first, cumulatively in one weigh batcher on one scale. Aggregate shall not be weighed in the same batcher with cementitious material. If both portland cement and other cementitious material are used, they may be batched cumulatively, provided that the portland cement is batched first, . Water may be measured by weight or volume. Water shall not be weighed or measured cumulatively with another ingredient. Filling and discharging valves for the water metering or batching system shall be so interlocked that the discharge valve cannot be opened before the filling valve is fully closed. Piping for water and for admixtures shall be free from leaks and shall be properly valved to prevent backflow or siphoning. Admixtures shall be furnished as a liquid of suitable concentration for easy control of dispensing. An adjustable, accurate, mechanical device for measuring and dispensing each admixture

shall be provided. Each admixture dispenser shall be interlocked with the batching and discharging operation of the water so that each admixture is separately batched and individually discharged automatically in a manner to obtain uniform distribution throughout the water as it is added to the batch in the specified mixing period. . Different admixtures shall not be combined prior to introduction in water and shall not be allowed to intermingle until in contact with the cement. Admixture dispensers shall have suitable devices to detect and indicate flow during dispensing or have a means for visual observation. The plant shall be arranged so as to facilitate the inspection of all operations at all times. Suitable facilities shall be provided for obtaining representative samples of aggregates from each bin or compartment, and for sampling and calibrating the dispensing of cementitious material, water, and admixtures. Filling ports for cementitious materials bins or silos shall be clearly marked with a permanent sign stating the contents.

3.2.1.3 Scales

The weighing equipment shall conform to the applicable requirements of CPMB Concrete Plant Standard, and of NIST HB 44, except that the accuracy shall be plus or minus 0.2 percent of scale capacity. The Contractor shall provide standard test weights and any other auxiliary equipment required for checking the operating performance of each scale or other measuring devices. The tests shall be made at the specified frequency in the presence of a Government inspector. The weighing equipment shall be arranged so that the plant operator can conveniently observe all dials or indicators.

3.2.1.4 Batching Tolerances

(A) Tolerances with Weighing Equipment

MATERIAL	PERCENT OF REQUIRED WEIGHT
Cementitious materials	0 to plus 2
Aggregate	plus or minus 2
Water	plus or minus 1
Chemical admixture	0 to plus 6

(B) Tolerances with Volumetric Equipment

For volumetric batching equipment used for water and admixtures, the following tolerances shall apply to the required volume of material being batched:

MATERIAL	PERCENT OF REQUIRED MATERIAL
Water:	plus or minus 1 percent
Chemical admixtures:	0 to plus 6 percent

3.2.1.5 Moisture Control

The plant shall be capable of ready adjustment to compensate for the varying moisture content of the aggregates and to change the weights of the materials being batched.

3.2.1.6 Concrete Mixers

Mixers shall be stationary mixers or truck mixers. Mixers shall be capable of combining the materials into a uniform mixture and of discharging this mixture without segregation. The mixers shall not be charged in excess of the capacity recommended by the manufacturer. The mixers shall be operated at the drum or mixing blade speed designated by the manufacturer. The mixers shall be maintained in satisfactory operating condition, and the mixer drums shall be kept free of hardened concrete. Should any mixer at any time produce unsatisfactory results, its use shall be promptly discontinued until it is repaired.

3.2.1.7 Stationary Mixers

Concrete plant mixers shall be drum-type mixers of tilting, nontilting, horizontal-shaft, or vertical-shaft type, or shall be pug mill type and shall be provided with an acceptable device to lock the discharge mechanism until the required mixing time has elapsed. The mixing time and uniformity shall conform to all the requirements in ASTM C 94/C 94M applicable to central-mixed concrete.

3.2.1.8 Truck Mixers

Truck mixers, the mixing of concrete therein, and concrete uniformity shall conform to the requirements of ASTM C 94/C 94M. A truck mixer may be used either for complete mixing (transit-mixed) or to finish the partial mixing done in a stationary mixer (shrink-mixed). Each truck shall be equipped with two counters from which it is possible to determine the number of revolutions at mixing speed and the number of revolutions at agitating speed. Or, if approved in lieu of this, the number of revolutions shall be marked on the batch tickets. Water shall not be added at the placing site unless specifically approved; and in no case shall it exceed the specified w/c. Any such water shall be injected at the base of the mixer, not at the discharge end.

3.3 TRANSPORTING CONCRETE TO PROJECT SITE

Concrete shall be transported to the placing site in truck mixers, agitators, nonagitating transporting equipment conforming to NRMCA TMMB 100 or by approved pumping equipment or conveyors. Nonagitating equipment, other than pumps, shall not be used for transporting lightweight aggregate concrete.

3.4 CONVEYING CONCRETE ON SITE

Concrete shall be conveyed from mixer or transporting unit to forms as rapidly as possible and within the time interval specified by methods which will prevent segregation or loss of ingredients using following equipment. Conveying equipment shall be cleaned before each placement.

3.4.1 Buckets

The interior hopper slope shall be not less than 58 degrees from the horizontal, the minimum dimension of the clear gate opening shall be at least 5 times the nominal maximum-size aggregate, and the area of the gate opening shall not be less than 2 square feet.The maximum dimension of the gate opening shall not be greater than twice the minimum dimension. The bucket gates shall be essentially grout tight when closed and may be

manually, pneumatically, or hydraulically operated except that buckets larger than 2 cubic yards shall not be manually operated. The design of the bucket shall provide means for positive regulation of the amount and rate of deposit of concrete in each dumping position.

3.4.2 Transfer Hoppers

Concrete may be charged into nonagitating hoppers for transfer to other conveying devices. Transfer hoppers shall be capable of receiving concrete directly from delivery vehicles and shall have conical-shaped discharge features. The transfer hopper shall be equipped with a hydraulically operated gate and with a means of external vibration to effect complete discharge. Concrete shall not be held in nonagitating transfer hoppers more than 30 minutes.

3.4.3 Trucks

Truck mixers operating at agitating speed or truck agitators used for transporting plant-mixed concrete shall conform to the requirements of ASTM C 94/C 94M. Nonagitating equipment shall be used only for transporting plant-mixed concrete over a smooth road and when the hauling time is less than 15 minutes. Bodies of nonagitating equipment shall be smooth, watertight, metal containers specifically designed to transport concrete, shaped with rounded corners to minimize segregation, and equipped with gates that will permit positive control of the discharge of the concrete.

3.4.4 Chutes

When concrete can be placed directly from a truck mixer, agitator, or nonagitating equipment, the chutes normally attached to this equipment by the manufacturer may be used. A discharge deflector shall be used when required by the Contracting Officer. Separate chutes and other similar equipment will not be permitted for conveying concrete.

3.4.5 Belt Conveyors

Belt conveyors shall be designed and operated to assure a uniform flow of concrete from mixer to final place of deposit without segregation of ingredients or loss of mortar and shall be provided with positive means, such as discharge baffle or hopper , for preventing segregation of the concrete at the transfer points and the point of placing. Belt conveyors shall be constructed such that the idler spacing shall not exceed 36 inches. The belt speed shall be a minimum of 300 feet per minute and a maximum of 750 feet per minute. If concrete is to be placed through installed horizontal or sloping reinforcing bars, the conveyor shall discharge concrete into a pipe or elephant truck that is long enough to extend through the reinforcing bars.

3.4.6 Concrete Pumps

Concrete may be conveyed by positive displacement pump when approved. The pumping equipment shall be piston or squeeze pressure type; pneumatic placing equipment shall not be used. The pipeline shall be rigid steel pipe or heavy-duty flexible hose. The inside diameter of the pipe shall be at least 3 times the nominal maximum-size coarse aggregate in the concrete mixture to be pumped but not less than 4 inches. Aluminum pipe shall not be used.

3.5 PLACING CONCRETE

Mixed concrete shall be discharged within 1-1/2 hours or before the mixer drum has revolved 300 revolutions, whichever comes first after the introduction of the mixing water to the cement and aggregates. When the concrete temperature exceeds 85 degrees F, the time shall be reduced to 45 minutes. Concrete shall be placed within 15 minutes after it has been discharged from the transporting unit. Concrete shall be handled from mixer or transporting unit to forms in a continuous manner until the approved unit of operation is completed. Adequate scaffolding, ramps and walkways shall be provided so that personnel and equipment are not supported by in-place reinforcement. Placing will not be permitted when the sun, heat, wind, or limitations of facilities furnished by the Contractor prevent proper consolidation, finishing and curing. Sufficient placing capacity shall be provided so that concrete can be kept free of cold joints.

3.5.1 Depositing Concrete

Concrete shall be deposited as close as possible to its final position in the forms, and there shall be no vertical drop greater than 5 feet except where suitable equipment is provided to prevent segregation and where specifically authorized. Depositing of the concrete shall be so regulated that it will be effectively consolidated in horizontal layers not more than 12 inches thick, except that all slabs shall be placed in a single layer. Concrete to receive other construction shall be screeded to the proper level. Concrete shall be deposited continuously in one layer or in layers so that fresh concrete is deposited on in-place concrete that is still plastic. Fresh concrete shall not be deposited on concrete that has hardened sufficiently to cause formation of seams or planes of weakness within the section. Concrete that has surface dried, partially hardened, or contains foreign material shall not be used. When temporary spreaders are used in the forms, the spreaders shall be removed as their service becomes unnecessary. Concrete shall not be placed in slabs over columns and walls until concrete in columns and walls has been in-place at least two hours or until the concrete begins to lose its plasticity. Concrete for beams, girders, brackets, column capitals, haunches, and drop panels shall be placed at the same time as concrete for adjoining slabs.

3.5.2 Consolidation

Immediately after placing, each layer of concrete shall be consolidated by internal vibrators, except for slabs 4 inches thick or less. The vibrators shall at all times be adequate in effectiveness and number to properly consolidate the concrete; a spare vibrator shall be kept at the jobsite during all concrete placing operations. The vibrators shall have a frequency of not less than 10,000 vibrations per minute, an amplitude of at least 0.025 inch, and the head diameter shall be appropriate for the structural member and the concrete mixture being placed. Vibrators shall be inserted vertically at uniform spacing over the area of placement. The distance between insertions shall be approximately 1-1/2 times the radius of action of the vibrator so that the area being vibrated will overlap the adjacent just-vibrated area by a reasonable amount. The vibrator shall penetrate rapidly to the bottom of the layer and at least 6 inches into the preceding layer if there is such. Vibrator shall be held stationary until the concrete is consolidated and then vertically withdrawn slowly while operating. Form vibrators shall not be used unless specifically approved and unless forms are constructed to withstand their use. Vibrators shall not be used to move concrete within the forms. Slabs 4 inches and less in thickness shall be consolidated by properly designed vibrating screeds or

other approved technique. Excessive vibration of lightweight concrete resulting in segration or flotation of coarse aggregate shall be prevented. Frequency and amplitude of vibrators shall be determined in accordance with COE CRD-C 521. Grate tampers ("jitterbugs") shall not be used.

3.5.3 Cold Weather Requirements

Special protection measures, approved by the Contracting Officer, shall be used if freezing temperatures are anticipated before the expiration of the specified curing period. The ambient temperature of the air where concrete is to be placed and the temperature of surfaces to receive concrete shall be not less than 40 degrees F. The temperature of the concrete when placed shall be not less than 50 degrees F nor more than 75 degrees F. Heating of the mixing water or aggregates will be required to regulate the concrete placing temperature. Materials entering the mixer shall be free from ice, snow, or frozen lumps. Salt, chemicals or other materials shall not be incorporated in the concrete to prevent freezing. Upon written approval, an accelerating admixture conforming to ASTM C 494/C 494M, Type C or E may be used, provided it contains no calcium chloride. Calcium chloride shall not be used.

3.5.4 Hot Weather Requirements

When the ambient temperature during concrete placing is expected to exceed 85 degrees F, the concrete shall be placed and finished with procedures previously submitted and as specified herein. The concrete temperature at time of delivery to the forms shall not exceed the temperature shown in the table below when measured in accordance with ASTM C 1064/C 1064M. Cooling of the mixing water or aggregates or placing concrete in the cooler part of the day may be required to obtain an adequate placing temperature. A retarder may be used, as approved, to facilitate placing and finishing. Steel forms and reinforcements shall be cooled as approved prior to concrete placement when steel temperatures are greater than 120 degrees F. Conveying and placing equipment shall be cooled if necessary to maintain proper concrete-placing temperature.

Maximum Allowable Concrete Placing Temperature

Relative Humidity, Percent, During Time of Concrete Placement	Maximum Allowable Concrete Temperature Degrees
Greater than 60	90 F
40-60	85 F
Less than 40	80 F

3.5.5 Prevention of Plastic Shrinkage Cracking

During hot weather with low humidity, and particularly with appreciable wind, as well as interior placements when space heaters produce low humidity, the Contractor shall be alert to the tendency for plastic shrinkage cracks to develop and shall institute measures to prevent this. Particular care shall be taken if plastic shrinkage cracking is potentially imminent and especially if it has developed during a previous placement. Periods of high potential for plastic shrinkage cracking can be anticipated by use of Fig. 2.1.5 of ACI 305R. In addition the concrete placement shall be further protected by erecting shades and windbreaks and by applying fog

sprays of water, sprinkling, ponding or wet covering. Plastic shrinkage cracks that occur shall be filled by injection of epoxy resin as directed, after the concrete hardens. Plastic shrinkage cracks shall never be troweled over or filled with slurry.

3.5.6 Placing Concrete in Congested Areas

Special care shall be used to ensure complete filling of the forms, elimination of all voids, and complete consolidation of the concrete when placing concrete in areas congested with reinforcing bars, embedded items, waterstops and other tight spacing. An appropriate concrete mixture shall be used, and the nominal maximum size of aggregate (NMSA) shall meet the specified criteria when evaluated for the congested area. Vibrators with heads of a size appropriate for the clearances available shall be used, and the consolidation operation shall be closely supervised to ensure complete and thorough consolidation at all points. Where necessary, splices of reinforcing bars shall be alternated to reduce congestion. Where two mats of closely spaced reinforcing are required, the bars in each mat shall be placed in matching alignment to reduce congestion. Reinforcing bars may be temporarily crowded to one side during concrete placement provided they are returned to exact required location before concrete placement and consolidation are completed.

3.6 JOINTS

Joints shall be located and constructed as approved. Joints not indicated on the drawings shall be located and constructed to minimize the impact on the strength of the structure. Joints in walls and columns shall be at the underside of floors, slabs, beams, or girders and at the tops of footings or floor slabs, unless otherwise approved. Joints shall be perpendicular to the main reinforcement. All reinforcement shall be continued across joints; except that reinforcement or other fixed metal items shall not be continuous through expansion joints, or through construction or contraction joints in slabs on grade. Reinforcement shall be 2 inches clear from each joint. Except where otherwise indicated, construction joints between interior slabs on grade and vertical surfaces shall consist of 30 pound asphalt-saturated felt, extending for the full depth of the slab. The perimeters of the slabs shall be free of fins, rough edges, spalling, or other unsightly appearance. Reservoir for sealant for construction and contraction joints in slabs shall be formed to the dimensions shown on the contract drawings by removing snap-out joint-forming inserts, by sawing sawable inserts, or by sawing to widen the top portion of sawed joints. Joints to be sealed shall be cleaned and sealed as indicated and in accordance with Section 07900 JOINT SEALING.

3.6.1 Construction Joints

For concrete other than slabs on grade, construction joints shall be located so that the unit of operation does not exceed 75 feet. Concrete shall be placed continuously so that each unit is monolithic in construction. Fresh concrete shall not be placed against adjacent hardened concrete until it is at least 24 hours old. Construction joints shall be located as indicated or approved. Where concrete work is interrupted by weather, end of work shift or other similar type of delay, location and type of construction joint shall be subject to approval of the Contracting Officer. Unless otherwise indicated and except for slabs on grade, reinforcing steel shall extend through construction joints. Construction joints in slabs on grade shall be keyed or doweled as shown on the contract drawings. Concrete columns, walls, or piers shall be in place at least 2

hours, or until the concrete begins to lose its plasticity, before placing concrete for beams, girders, or slabs thereon. In walls having door or window openings, lifts shall terminate at the top and bottom of the opening. Other lifts shall terminate at such levels as to conform to structural requirements or architectural details. Where horizontal construction joints in walls or columns are required, a strip of 1 inch square-edge lumber, bevelled and oiled to facilitate removal, shall be tacked to the inside of the forms at the construction joint. Concrete shall be placed to a point 1 inch above the underside of the strip. The strip shall be removed 1 hour after the concrete has been placed, and any irregularities in the joint line shall be leveled off with a wood float, and all laitance shall be removed. Prior to placing additional concrete, horizontal construction joints shall be prepared as specified in paragraph Previously Placed Concrete.

3.6.2 Contraction Joints in Slabs on Grade

Contraction joints shall be located and detailed as shown on the drawings. Reservoir for joint sealant, where required, shall be as shown on the contract drawings. Contraction Joints shall be produced by forming a weakened plane in the concrete slab by use of rigid inserts impressed in the concrete during placing operations,use of snap-out plastic joint forming inserts,orsawing a continuous slot with a concrete saw. Regardless of method used to produce the weakened plane, it shall be 1/4 the depth of the slab thickness and between 1/8 and 3/16 inch wide. For saw-cut joints, cutting shall be timed properly with the set of the concrete. Cutting shall be started as soon as the concrete has hardened sufficiently to prevent ravelling of the edges of the saw cut. Cutting shall be completed before shrinkage stresses become sufficient to produce cracking. Reservoir for joint sealant shall be formed as indicated on the contract drawings.

3.6.3 Expansion Joints

Installation of expansion joints and sealing of these joints shall conform to the requirements of Specification Section 03150 EXPANSION JOINTS, CONTRACTION JOINTS, AND WATERSTOPS and Section 07900 JOINT SEALING.

3.6.4 Waterstops

Waterstops shall be installed in conformance with the locations and details shown on the drawings using materials and procedures specified in Specification Section 03150 EXPANSION JOINTS, CONTRACTION JOINTS, AND WATERSTOPS.

3.6.5 Smooth Dowels

Smooth dowels shall be installed at the locations shown on the contract drawings and to the details shown, using materials and procedures specified in Specification Section 03200 CONCRETE REINFORCEMENT and herein. Conventional smooth "paving" dowels shall be installed in slabs using approved methods to hold the dowel in place during concreting within a maximum alignment tolerance of 1/8 inch in 12 inches. Care shall be taken during placing adjacent to and around dowels to ensure there is no displacement of the dowel and that the concrete completely embeds the dowel and is thoroughly consolidated.

3.7 FINISHING FORMED SURFACES

Forms, form materials, and form construction are specified in Specification

Section 03100 STRUCTURAL CONCRETE FORMWORK. Finishing of formed surfaces shall be as specified herein. Unless another type of architectural or special finish is specified, surfaces shall be left with the texture imparted by the forms except that defective surfaces shall be repaired. Unless painting of surfaces is required, uniform color of the concrete shall be maintained by use of only one mixture without changes in materials or proportions for any structure or portion of structure that requires a Class A finish. Except for major defects, as defined hereinafter, surface defects shall be repaired as specified herein within 24 hours after forms are removed. Repairs of the so-called "plaster-type" will not be permitted in any location. Tolerances of formed surfaces shall conform to the requirements of ACI 117/117R. These tolerances apply to the finished concrete surface, not to the forms themselves; forms shall be set true to line and grade. Form tie holes requiring repair and other defects whose depth is at least as great as their surface diameter shall be repaired as specified in paragraph Damp-Pack Mortar Repair. Defects whose surface diameter is greater than their depth shall be repaired as specified in paragraph Repair of Major Defects. Repairs shall be finished flush with adjacent surfaces and with the same surface texture. The cement used for all repairs shall be a blend of job cement with white cement proportioned so that the final color after curing and aging will be the same as the adjacent concrete. Concrete with excessive honeycomb, or other defects which affect the strength of the member, will be rejected. Repairs shall be demonstrated to be acceptable and free from cracks or loose or drummy areas at the completion of the contract and, for Class A Finishes, shall be inconspicuous. Repairs not meeting these requirements will be rejected and shall be replaced.

3.7.1 Class A Finish

Class A finish is required as given in Specification Section 03100 STRUCTURAL CONCRETE FORMWORK. Fins, ravelings, and loose material shall be removed, all surface defects over 1/2 inch in diameter or more than 1/2 inch deep, shall be repaired and, except as otherwise indicated or as specified in Specification Section 03100 STRUCTURAL CONCRETE FORMWORK, holes left by removal of form ties shall be reamed and filled. Defects more than 1/2 inch in diameter shall be cut back to sound concrete, but in all cases at least 1 inch deep. The Contractor shall prepare a sample panel for approval (as specified in PART 1) before commencing repair, showing that the surface texture and color match will be attained. Metal tools shall not be used to finish repairs in Class A surfaces.

3.7.2 Class C and Class D Finish

Class C and Class D finishes are required as given in Specification Section 03100 STRUCTURAL CONCRETE FORMWORK. Fins, ravelings, and loose material shall be removed, and, except as otherwise indicated or as specified in Section 03100 STRUCTURAL CONCRETE FORMWORK, holes left by removal of form ties shall be reamed and filled. Honeycomb and other defects more than 1/2 inch deep or more than 2 inches in diameter shall be repaired. Defects more than 2 inches in diameter shall be cut back to sound concrete, but in all cases at least 1 inch deep.

3.7.3 Architectural and Special Finishes

Architectural concrete finishes are specified in Section 03330 CAST-IN-PLACE ARCHITECTURAL CONCRETE. Special finishes shall conform to the requirements specified herein.

3.7.3.1 Smooth Finish

After other concrete construction is complete in each overall separate contiguous area of the structure, smooth finish shall be applied topermanently exposed concrete wall surfaces within the Apparatus Room of the Fire Station building as indicated on the contract drawings. A mortar mix consisting of one part portland cement and two parts well-graded sand passing a No. 30 sieve, with water added to give the consistency of thick paint, shall be used. Where the finished surface will not receive other applied surface, white cement shall be used to replace part of the job cement to produce an approved color, which shall be uniform throughout the surfaces of the structure. After the surface has been thoroughly wetted and allowed to approach surface dryness, the mortar shall be vigorously applied to the area by clean burlap pads or by cork or wood-floating, to completely fill all surface voids. Excess grout shall be scraped off with a trowel. As soon as it can be accomplished without pulling the mortar from the voids, the area shall be rubbed with burlap pads having on their surface the same sand-cement mix specified above but without any mixing water, until all of the visible grout film is removed. The burlap pads used for this operation shall be stretched tightly around a board to prevent dishing the mortar in the voids. The finish of any area shall be completed in the same day, and the limits of a finished area shall be made at natural breaks in the surface. The surface shall be continuously moist cured for 48 hours commencing immediately after finishing operations in each area. The temperature of the air adjacent to the surface shall be not less than 50 degrees F for 24 hours prior to, and 48 hours after, the application. In hot, dry weather the smooth finish shall be applied in shaded areas or at night, and shall never be applied when there is significant hot, dry wind.

3.8 REPAIRS

3.8.1 Damp-Pack Mortar Repair

Form tie holes requiring repair and other defects whose depth is at least as great as their surface diameter but not over 4 inches shall be repaired by the damp-pack mortar method. Form tie holes shall be reamed and other similar defects shall be cut out to sound concrete. The void shall then be thoroughly cleaned, thoroughly wetted, brush-coated with a thin coat of neat cement grout and filled with mortar. Mortar shall be a stiff mix of 1 part portland cement to 2 parts fine aggregate passing the No. 16 mesh sieve, and minimum amount of water. Only sufficient water shall be used to produce a mortar which, when used, will stick together on being molded into a ball by a slight pressure of the hands and will not exude water but will leave the hands damp. Mortar shall be mixed and allowed to stand for 30 to 45 minutes before use with remixing performed immediately prior to use. Mortar shall be thoroughly tamped in place in thin layers using a hammer and hardwood block. Holes passing entirely through walls shall be completely filled from the inside face by forcing mortar through to the outside face. All holes shall be packed full. Damp-pack repairs shall be moist cured for at least 48 hours.

3.8.2 Repair of Major Defects

Major defects will be considered to be those more than 1/2 inch deep or, for Class A finishes, more than 1/2 inch in diameter and, for Class C and D finishes, more than 2 inches in diameter. Also included are any defects of any kind whose depth is over 4 inches or whose surface diameter is greater than their depth. Major defects shall be repaired as specified below.

3.8.2.1 Surface Application of Mortar Repair

Defective concrete shall be removed, and removal shall extend into completely sound concrete. Approved equipment and procedures which will not cause cracking or microcracking of the sound concrete shall be used. If reinforcement is encountered, concrete shall be removed so as to expose the reinforcement for at least 2 inches on all sides. All such defective areas greater than 12 square inchesshall be outlined by saw cuts at least 1 inch deep. Defective areas less than 12 square inches shall be outlined by a 1 inch deep cut with a core drill in lieu of sawing. All saw cuts shall be straight lines in a rectangular pattern in line with the formwork panels. After concrete removal, the surface shall be thoroughly cleaned by high pressure washing to remove all loose material. Surfaces shall be kept continually saturated for the first 12 of the 24 hours immediately before placing mortar and shall be damp but not wet at the time of commencing mortar placement. The Contractor, at his option, may use either hand-placed mortar or mortar placed with a mortar gun. If hand-placed mortar is used, the edges of the cut shall be perpendicular to the surface of the concrete. The prepared area shall be brush-coated with a thin coat of neat cement grout. The repair shall then be made using a stiff mortar, preshrunk by allowing the mixed mortar to stand for 30 to 45 minutes and then remixed, thoroughly tamped into place in thin layers. If hand-placed mortar is used, the Contractor shall test each repair area for drumminess by firm tapping with a hammer and shall inspect for cracks, both in the presence of the Contracting Officer's representative, immediately before completion of the contract, and shall replace any showing drumminess or cracking. If mortar placed with a mortar gun is used, the gun shall be a small compressed air-operated gun to which the mortar is slowly hand fed and which applies the mortar to the surface as a high-pressure stream, as approved. Repairs made using shotcrete equipment will not be accepted. The mortar used shall be the same mortar as specified for damp-pack mortar repair. If gun-placed mortar is used, the edges of the cut shall be beveled toward the center at a slope of 1:1. All surface applied mortar repairs shall be continuously moist cured for at least 7 days. Moist curing shall consist of several layers of saturated burlap applied to the surface immediately after placement is complete and covered with polyethylene sheeting, all held closely in place by a sheet of plywood or similar material rigidly braced against it. Burlap shall be kept continually wet.

3.8.2.2 Repair of Deep and Large Defects

Deep and large defects will be those that are more than 6 inches deep and also have an average diameter at the surface more than 18 inches or that are otherwise so identified by the Project Office. Such defects shall be repaired as specified herein or directed, except that defects which affect the strength of the structure shall not be repaired and that portion of the structure shall be completely removed and replaced. Deep and large defects shall be repaired by procedures approved in advance including forming and placing special concrete using applied pressure during hardening. Preparation of the repair area shall be as specified for surface application of mortar. In addition, the top edge (surface) of the repair area shall be sloped at approximately 20 degrees from the horizontal, upward toward the side from which concrete will be placed. The special concrete shall be a concrete mixture with low water content and low slump, and shall be allowed to age 30 to 60 minutes before use. Concrete containing a specified expanding admixture may be used in lieu of the above mixture; the paste portion of such concrete mixture shall be designed to

have an expansion between 2.0 and 4.0 percent when tested in accordance with ASTM C 940. A full width "chimney" shall be provided at the top of the form on the placing side to ensure filling to the top of the opening. A pressure cap shall be used on the concrete in the chimney with simultaneous tightening and revibrating the form during hardening to ensure a tight fit for the repair. The form shall be removed after 24 hours and immediately the chimney shall be carefully chipped away to avoid breaking concrete out of the repair; the surface of the repair concrete shall be dressed as required.

3.9 FINISHING UNFORMED SURFACES

The finish of all unformed surfaces shall meet the requirements of paragraph Tolerances in PART 1, when tested as specified herein.

3.9.1 General

The ambient temperature of spaces adjacent to unformed surfaces being finished and of the base on which concrete will be placed shall be not less than 50 degrees F. In hot weather all requirements of paragraphs Hot Weather Requirements and Prevention of Plastic Shrinkage Cracking shall be met. Unformed surfaces that are not to be covered by additional concrete or backfill shall have a float finish, with additional finishing as specified below, and shall be true to the elevation shown on the drawings. Surfaces to receive additional concrete or backfill shall be brought to the elevation shown on the drawings, properly consolidated, and left true and regular. Unless otherwise shown on the drawings, exterior surfaces shall be sloped for drainage, as directed. Where drains are provided, interior floors shall be evenly sloped to the drains. Joints shall be carefully made with a jointing or edging tool. The finished surfaces shall be protected from stains or abrasions. Grate tampers or "jitterbugs" shall not be used for any surfaces. The dusting of surfaces with dry cement or other materials or the addition of any water during finishing shall not be permitted. If bleedwater is present prior to finishing, the excess water shall be carefully dragged off or removed by absorption with porous materials such as burlap. During finishing operations, extreme care shall be taken to prevent over finishing or working water into the surface; this can cause "crazing" (surface shrinkage cracks which appear after hardening) of the surface. Any slabs with surfaces which exhibit significant crazing shall be removed and replaced. During finishing operations, surfaces shall be checked with a 10 foot straightedge, applied in both directions at regular intervals while the concrete is still plastic, to detect high or low areas.

3.9.2 Rough Slab Finish

As a first finishing operation for unformed surfaces and as final finish for slabs to receive mortar setting beds, the surface shall receive a rough slab finish prepared as follows. The concrete shall be uniformly placed across the slab area, consolidated as previously specified, and then screeded with straightedge strikeoffs immediately after consolidation to bring the surface to the required finish level with no coarse aggregate visible. Side forms and screed rails shall be provided, rigidly supported, and set to exact line and grade. Allowable tolerances for finished surfaces apply only to the hardened concrete, not to forms or screed rails. Forms and screed rails shall be set true to line and grade. "Wet screeds" shall not be used.

3.9.3 Floated Finish

Slabs to receive more than a rough slab finish shall next be given a wood float finish. The screeding shall be followed immediately by darbying or bull floating before bleeding water is present, to bring the surface to a true, even plane. Then, after the concrete has stiffened so that it will withstand a man's weight without imprint of more than 1/4 inch and the water sheen has disappeared, it shall be floated to a true and even plane free of ridges. Floating shall be performed by use of suitable hand floats or power driven equipment. Sufficient pressure shall be used on the floats to bring a film of moisture to the surface. Hand floats shall be made of wood, magnesium, or aluminum. Concrete that exhibits stickiness shall be floated with a magnesium float. Care shall be taken to prevent over-finishing or incorporating water into the surface.

3.9.4 Troweled Finish

Exposed interior floor slabs shall be given a trowel finish. After floating is complete and after the surface moisture has disappeared, unformed surfaces shall be steel-troweled to a smooth, even, dense finish, free from blemishes including trowel marks. In lieu of hand finishing, an approved power finishing machine may be used in accordance with the directions of the machine manufacturer. Additional trowelings shall be performed, either by hand or machine until the surface has been troweled 2 times, with waiting period between each. Care shall be taken to prevent blistering and if such occurs, troweling shall immediately be stopped and operations and surfaces corrected. A final hard steel troweling shall be done by hand, with the trowel tipped, and using hard pressure, when the surface is at a point that the trowel will produce a ringing sound. The finished surface shall be thoroughly consolidated and shall be essentially free of trowel marks and be uniform in texture and appearance. The concrete mixture used for troweled finished areas shall be adjusted, if necessary, in order to provide sufficient fines (cementitious material and fine sand) to finish properly.

3.9.5 Non-Slip Finish

Non-slip floors shall be constructed in accordance with the following subparagraphs.

3.9.5.1 Broomed

Surfaces of exterior structural stoops shall be given a broomed finish. After floating, the surface shall be lightly steel troweled, and then carefully scored by pulling a hair or coarse fiber push-type broom across the surface. Brooming shall be transverse to traffic or at right angles to the slope of the slab. After the end of the curing period, the surface shall be vigorously broomed with a coarse fiber broom to remove all loose or semi-detached particles.

3.10 FLOOR HARDENER

All permanently exposed concrete floors shall be treated with floor hardener. Floor hardener shall be applied after the concrete has been cured and then air dried for28 days. Three coats shall be applied, each the day after the preceding coat was applied. For the first application, one pound of the silocofluoride shall be dissolved in one gallon of water. For subsequent applications, the solution shall be two pounds of silicofluoride to each gallon of water. Floor should be mopped with clear water shortly after the preceding application has dried to remove encrusted

salts. Proprietary hardeners shall be applied in accordance with the manufacturer's instructions. During application, area should be well ventilated. Precautions shall be taken when applying silicofluorides due to the toxicity of the salts. Any compound that contacts glass or aluminum should be immediately removed with clear water.

3.11 CURING AND PROTECTION

3.11.1 General

Concrete shall be cured by an approved method for the period of time given below:

Concrete with Type III cement	3 days
All other concrete	7 days

Immediately after placement, concrete shall be protected from premature drying, extremes in temperatures, rapid temperature change, mechanical injury and damage from rain and flowing water for the duration of the curing period. Air and forms in contact with concrete shall be maintained at a temperature above 50 degrees F for the first 3 days and at a temperature above 32 degrees F for the remainder of the specified curing period. Exhaust fumes from combustion heating units shall be vented to the outside of the enclosure, and heaters and ducts shall be placed and directed so as not to cause areas of overheating and drying of concrete surfaces or to create fire hazards. Materials and equipment needed for adequate curing and protection shall be available and at the site prior to placing concrete. No fire or excessive heat, including welding, shall be permitted near or in direct contact with the concrete at any time. Except as otherwise permitted by paragraph Membrane Forming Curing Compounds, moist curing shall be provided for any areas to receive floor hardener, any paint or other applied coating, or to which other concrete is to be bonded. Concrete containing silica fume shall be initially cured by fog misting during finishing, followed immediately by continuous moist curing. Except for plastic coated burlap, impervious sheeting alone shall not be used for curing.

3.11.2 Moist Curing

Concrete to be moist-cured shall be maintained continuously wet for the entire curing period, commencing immediately after finishing. If water or curing materials used stain or discolor concrete surfaces which are to be permanently exposed, the concrete surfaces shall be cleaned as approved. When wooden forms are left in place during curing, they shall be kept wet at all times. If steel forms are used in hot weather, nonsupporting vertical forms shall be broken loose from the concrete soon after the concrete hardens and curing water continually applied in this void. If the forms are removed before the end of the curing period, curing shall be carried out as on unformed surfaces, using suitable materials. Surfaces shall be cured by ponding, by continuous sprinkling, by continuously saturated burlap or cotton mats, or by continuously saturated plastic coated burlap. Burlap and mats shall be clean and free from any contamination and shall be completely saturated before being placed on the concrete. The Contractor shall have an approved work system to ensure that moist curing is continuous 24 hours per day.

3.11.3 Membrane Forming Curing Compounds

Concrete may be cured with a nonpigmented curing compound containing a

fugitive dye in lieu of moist curing. Membrane curing shall not be used on surfaces that are to receive any subsequent treatment depending on adhesion or bonding to the concrete, including surfaces to which a smooth finish is to be applied or other concrete to be bonded. However, a styrene acrylate or chlorinated rubber compound meeting ASTM C 309, Class B requirements, may be used for surfaces which are to be painted or are to receive bituminous roofing or waterproofing, or floors that are to receive adhesive applications of resilient flooring. The curing compound selected shall be compatible with any subsequent paint, roofing, waterproofing or flooring specified. Membrane curing compound shall not be used on surfaces that are maintained at curing temperatures with free steam. Curing compound shall be applied to formed surfaces immediately after the forms are removed and prior to any patching or other surface treatment except the cleaning of loose sand, mortar, and debris from the surface. All surfaces shall be thoroughly moistened with water. Curing compound shall be applied to slab surfaces as soon as the bleeding water has disappeared, with the tops of joints being temporarily sealed to prevent entry of the compound and to prevent moisture loss during the curing period. The curing compound shall be applied in a two-coat continuous operation by approved motorized power-spraying equipment operating at a minimum pressure of 75 psi, at a uniform coverage of not more than 400 square feet per gallon for each coat, and the second coat shall be applied perpendicular to the first coat. Concrete surfaces which have been subjected to rainfall within 3 hours after curing compound has been applied shall be resprayed by the method and at the coverage specified. Surfaces on which clear compound is used shall be shaded from direct rays of the sun for the first 3 days. Surfaces coated with curing compound shall be kept free of foot and vehicular traffic, and from other sources of abrasion and contamination during the curing period.

3.11.4 Ponding or Immersion

Concrete shall be continually immersed throughout the curing period. Water shall not be more than 20 degrees F less than the temperature of the concrete.

3.11.5 Cold Weather Curing and Protection

When the daily ambient low temperature is less than 32 degrees F the temperature of the concrete shall be maintained above 40 degrees F for the first seven days after placing. During the period of protection removal, the air temperature adjacent to the concrete surfaces shall be controlled so that concrete near the surface will not be subjected to a temperature differential of more than 25 degrees F as determined by suitable temperature measuring devices furnished by the Contractor, as required, and installed adjacent to the concrete surface and 2 inches inside the surface of the concrete. The installation of the thermometers shall be made by the Contractor as directed.

3.12 SETTING BASE PLATES AND BEARING PLATES

After being properly positioned, column base plates, bearing plates for beams and similar structural members, and machinery and equipment base plates shall be set to the proper line and elevation with nonshrink grout. Unless otherwise indicated, the thickness of the grout shall be approximately 1/24 the width of the plate, but not less than 3/4 inch. Concrete and metal surfaces in contact with grout shall be clean and free of oil and grease, and concrete surfaces in contact with grout shall be damp and free of laitance when grout is placed.

3.12.1 Nonshrink Grout

Nonshrink grout shall be a ready-mixed material requiring only the addition of water. Water content shall be the minimum that will provide a flowable mixture and completely fill the space to be grouted without segregation, bleeding, or reduction of strength.

3.12.1.1 Mixing and Placing of Nonshrink Grout

Mixing and placing shall be in conformance with the material manufacturer's instructions and as specified therein. Ingredients shall be thoroughly dry-mixed before adding water. After adding water, the batch shall be mixed for 3 minutes. Batches shall be of size to allow continuous placement of freshly mixed grout. Grout not used within 30 minutes after mixing shall be discarded. The space between the top of the concrete and the plate shall be filled solid with the grout. Forms shall be of wood or other equally suitable material for completely retaining the grout on all sides and on top and shall be removed after the grout has set. The placed grout shall be carefully worked by rodding or other means to eliminate voids; however, overworking and breakdown of the initial set shall be avoided. Grout shall not be retempered or subjected to vibration from any source. Where clearances are unusually small, placement shall be under pressure with a grout pump. Temperature of the grout, and of surfaces receiving the grout, shall be maintained at 65 to 85 degrees F until after setting.

3.12.1.2 Treatment of Exposed Surfaces

For metal-oxidizing nonshrink grout, exposed surfaces shall be cut back 1 inch and immediately covered with a parge coat of mortar consisting of 1 part portland cement and 2-1/2 parts fine aggregate by weight, with sufficient water to make a plastic mixture. The parge coat shall have a smooth finish. For other mortars or grouts, exposed surfaces shall have a smooth-dense finish and be left untreated. Curing shall comply with paragraph CURING AND PROTECTION.

3.13 TESTING AND INSPECTION FOR CONTRACTOR QUALITY CONTROL

The Contractor shall perform the inspection and tests described below and, based upon the results of these inspections and tests, shall take the action required and shall submit specified reports. When, in the opinion of the Contracting Officer, the concreting operation is out of control, concrete placement shall cease and the operation shall be corrected. The laboratory performing the tests shall be onsite and shall conform with ASTM C 1077. Materials may be subjected to check testing by the Government from samples obtained at the manufacturer, at transfer points, or at the project site. The Government will inspect the laboratory, equipment, and test procedures prior to start of concreting operations and at any time thereafter for conformance with ASTM C 1077.

3.13.1 Grading and Corrective Action

3.13.1.1 Fine Aggregate

At least once during each shift when the concrete plant is operating, there shall be one sieve analysis and fineness modulus determination in accordance with ASTM C 136 and COE CRD-C 104 for the fine aggregate or for each fine aggregate if it is batched in more than one size or

classification. The location at which samples are taken may be selected by the Contractor as the most advantageous for control. However, the Contractor is responsible for delivering fine aggregate to the mixer within specification limits. When the amount passing on any sieve is outside the specification limits, the fine aggregate shall be immediately resampled and retested. If there is another failure on any sieve, the fact shall immediately reported to the Contracting Officer, concreting shall be stopped, and immediate steps taken to correct the grading.

3.13.1.2 Coarse Aggregate

At least once during each shift in which the concrete plant is operating, there shall be a sieve analysis in accordance with ASTM C 136 for each size of coarse aggregate. The location at which samples are taken may be selected by the Contractor as the most advantageous for production control. However, the Contractor shall be responsible for delivering the aggregate to the mixer within specification limits. A test record of samples of aggregate taken at the same locations shall show the results of the current test as well as the average results of the five most recent tests including the current test. The Contractor may adopt limits for control coarser than the specification limits for samples taken other than as delivered to the mixer to allow for degradation during handling. When the amount passing any sieve is outside the specification limits, the coarse aggregate shall be immediately resampled and retested. If the second sample fails on any sieve, that fact shall be reported to the Contracting Officer. Where two consecutive averages of 5 tests are outside specification limits, the operation shall be considered out of control and shall be reported to the Contracting Officer. Concreting shall be stopped and immediate steps shall be taken to correct the grading.

3.13.2 Quality of Aggregates

Thirty days prior to the start of concrete placement, the Contractor shall perform all tests for aggregate quality required by ASTM C 33. In addition, after the start of concrete placement, the Contractor shall perform tests for aggregate quality at least every three months, and when the source of aggregate or aggregate quality changes. Samples tested after the start of concrete placement shall be taken immediately prior to entering the concrete mixer.

3.13.3 Scales, Batching and Recording

The accuracy of the scales shall be checked by test weights prior to start of concrete operations and at least once every three months. Such tests shall also be made as directed whenever there are variations in properties of the fresh concrete that could result from batching errors. Once a week the accuracy of each batching and recording device shall be checked during a weighing operation by noting and recording the required weight, recorded weight, and the actual weight batched. At the same time, the Contractor shall test and ensure that the devices for dispensing admixtures are operating properly and accurately. When either the weighing accuracy or batching accuracy does not comply with specification requirements, the plant shall not be operated until necessary adjustments or repairs have been made. Discrepancies in recording accuracies shall be corrected immediately.

3.13.4 Batch-Plant Control

The measurement of concrete materials including cementitious materials,

each size of aggregate, water, and admixtures shall be continuously controlled. The aggregate weights and amount of added water shall be adjusted as necessary to compensate for free moisture in the aggregates. The amount of air-entraining agent shall be adjusted to control air content within specified limits. A report shall be prepared indicating type and source of cement used, type and source of pozzolan or slag used, amount and source of admixtures used, aggregate source, the required aggregate and water weights per cubic yard, amount of water as free moisture in each size of aggregate, and the batch aggregate and water weights per cubic yard for each class of concrete batched during each day's plant operation.

3.13.5 Concrete Mixture

a. Air Content Testing. Air content tests shall be made when test specimens are fabricated. In addition, at least two tests for air content shall be made on randomly selected batches of each separate concrete mixture produced during each 8-hour period of concrete production. Additional tests shall be made when excessive variation in workability is reported by the placing foreman or Government inspector. Tests shall be made in accordance with ASTM C 231 for normal weight concrete and ASTM C 173 for lightweight concrete. Test results shall be plotted on control charts which shall at all times be readily available to the Government and shall be submitted weekly. Copies of the current control charts shall be kept in the field by testing crews and results plotted as tests are made. When a single test result reaches either the upper or lower action limit, a second test shall immediately be made. The results of the two tests shall be averaged and this average used as the air content of the batch to plot on both the air content and the control chart for range, and for determining need for any remedial action. The result of each test, or average as noted in the previous sentence, shall be plotted on a separate control chart for each mixture on which an "average line" is set at the midpoint of the specified air content range from paragraph Air Entrainment. An upper warning limit and a lower warning limit line shall be set 1.0 percentage point above and below the average line, respectively. An upper action limit and a lower action limit line shall be set 1.5 percentage points above and below the average line, respectively. The range between each two consecutive tests shall be plotted on a secondary control chart for range where an upper warning limit is set at 2.0 percentage points and an upper action limit is set at 3.0 percentage points. Samples for air content may be taken at the mixer, however, the Contractor is responsible for delivering the concrete to the placement site at the stipulated air content. If the Contractor's materials or transportation methods cause air content loss between the mixer and the placement, correlation samples shall be taken at the placement site as required by the Contracting Officer, and the air content at the mixer controlled as directed.

b. Air Content Corrective Action. Whenever points on the control chart for percent air reach either warning limit, an adjustment shall immediately be made in the amount of air-entraining admixture batched. As soon as practical after each adjustment, another test shall be made to verify the result of the adjustment. Whenever a point on the secondary control chart for range reaches the warning limit, the admixture dispenser shall be recalibrated to ensure that it is operating accurately and with good

reproducibility. Whenever a point on either control chart reaches an action limit line, the air content shall be considered out of control and the concreting operation shall immediately be halted until the air content is under control. Additional air content tests shall be made when concreting is restarted.

c. Slump Testing. In addition to slump tests which shall be made when test specimens are fabricated, at least four slump tests shall be made on randomly selected batches in accordance with ASTM C 143/C 143M for each separate concrete mixture produced during each 8-hour or less period of concrete production each day. Also, additional tests shall be made when excessive variation in workability is reported by the placing foreman or Government inspector. Test results shall be plotted on control charts which shall at all times be readily available to the Government and shall be submitted weekly. Copies of the current control charts shall be kept in the field by testing crews and results plotted as tests are made. When a single slump test reaches or goes beyond either the upper or lower action limit, a second test shall immediately be made. The results of the two tests shall be averaged and this average used as the slump of the batch to plot on both the control charts for slump and the chart for range, and for determining need for any remedial action. Limits shall be set on separate control charts for slump for each type of mixture. The upper warning limit shall be set at 1/2 inch below the maximum allowable slump specified in paragraph Slump in PART 1 for each type of concrete and an upper action limit line and lower action limit line shall be set at the maximum and minimum allowable slumps, respectively, as specified in the same paragraph. The range between each consecutive slump test for each type of mixture shall be plotted on a single control chart for range on which an upper action limit is set at 2 inches. Samples for slump shall be taken at the mixer. However, the Contractor is responsible for delivering the concrete to the placement site at the stipulated slump. If the Contractor's materials or transportation methods cause slump loss between the mixer and the placement, correlation samples shall be taken at the placement site as required by the Contracting Officer, and the slump at the mixer controlled as directed.

d. Slump Corrective Action. Whenever points on the control charts for slump reach the upper warning limit, an adjustment shall immediately be made in the batch weights of water and fine aggregate. The adjustments are to be made so that the total water content does not exceed that amount allowed by the maximum w/c ratio specified, based on aggregates which are in a saturated surface dry condition. When a single slump reaches the upper or lower action limit, no further concrete shall be delivered to the placing site until proper adjustments have been made. Immediately after each adjustment, another test shall be made to verify the correctness of the adjustment. Whenever two consecutive individual slump tests, made during a period when there was no adjustment of batch weights, produce a point on the control chart for range at or above the upper action limit, the concreting operation shall immediately be halted, and the Contractor shall take appropriate steps to bring the slump under control. Additional slump tests shall be made as directed.

e. Temperature. The temperature of the concrete shall be measured

when compressive strength specimens are fabricated. Measurement shall be in accordance with ASTM C 1064/C 1064M. The temperature shall be reported along with the compressive strength data.

f. Strength Specimens. At least one set of test specimens shall be made, for compressive or flexural strength as appropriate, on each different concrete mixture placed during the day for each 500 cubic yards or portion thereof of that concrete mixture placed each day. Additional sets of test specimens shall be made, as directed by the Contracting Officer, when the mixture proportions are changed or when low strengths have been detected. A truly random (not haphazard) sampling plan shall be developed by the Contractor and approved by the Contracting Officer prior to the start of construction. The plan shall assure that sampling is done in a completely random and unbiased manner. A set of test specimens for concrete with a 28-day specified strength per paragraph Strength Requirements in PART 1 shall consist of four specimens, two to be tested at 7 days and two at 28 days. Test specimens shall be molded and cured in accordance with ASTM C 31/C 31M and tested in accordance with ASTM C 39/C 39M for test cylinders and ASTM C 78 for test beams. Results of all strength tests shall be reported immediately to the Contracting Officer. Quality control charts shall be kept for individual strength "tests", ("test" as defined in paragraph Strength Requirements in PART 1) moving average of last 3 "tests" for strength, and moving average for range for the last 3 "tests" for each mixture. The charts shall be similar to those found in ACI 214.3R.

3.13.6 Inspection Before Placing

Foundations, construction joints, forms, and embedded items shall be inspected by the Contractor in sufficient time prior to each concrete placement in order to certify to the Contracting Officer that they are ready to receive concrete. The results of each inspection shall be reported in writing.

3.13.7 Placing

The placing foreman shall supervise placing operations, shall determine that the correct quality of concrete or grout is placed in each location as specified and as directed by the Contracting Officer, and shall be responsible for measuring and recording concrete temperatures and ambient temperature hourly during placing operations, weather conditions, time of placement, volume placed, and method of placement. The placing foreman shall not permit batching and placing to begin until it has been verified that an adequate number of vibrators in working order and with competent operators are available. Placing shall not be continued if any pile of concrete is inadequately consolidated. If any batch of concrete fails to meet the temperature requirements, immediate steps shall be taken to improve temperature controls.

3.13.8 Vibrators

The frequency and amplitude of each vibrator shall be determined in accordance with COE CRD-C 521 prior to initial use and at least once a month when concrete is being placed. Additional tests shall be made as directed when a vibrator does not appear to be adequately consolidating the concrete. The frequency shall be determined while the vibrator is operating in concrete with the tachometer being held against the upper end

of the vibrator head while almost submerged and just before the vibrator is withdrawn from the concrete. The amplitude shall be determined with the head vibrating in air. Two measurements shall be taken, one near the tip and another near the upper end of the vibrator head, and these results averaged. The make, model, type, and size of the vibrator and frequency and amplitude results shall be reported in writing. Any vibrator not meeting the requirements of paragraph Consolidation, shall be immediately removed from service and repaired or replaced.

3.13.9 Curing Inspection

a. Moist Curing Inspections. At least once each shift, and not less than twice per day on both work and non-work days, an inspection shall be made of all areas subject to moist curing. The surface moisture condition shall be noted and recorded.

b. Moist Curing Corrective Action. When a daily inspection report lists an area of inadequate curing, immediate corrective action shall be taken, and the required curing period for those areas shall be extended by 1 day.

c. Membrane Curing Inspection. No curing compound shall be applied until the Contractor has verified that the compound is properly mixed and ready for spraying. At the end of each operation, the Contractor shall estimate the quantity of compound used by measurement of the container and the area of concrete surface covered, shall compute the rate of coverage in square feet per gallon, and shall note whether or not coverage is uniform.

d. Membrane Curing Corrective Action. When the coverage rate of the curing compound is less than that specified or when the coverage is not uniform, the entire surface shall be sprayed again.

e. Sheet Curing Inspection. At least once each shift and once per day on non-work days, an inspection shall be made of all areas being cured using impervious sheets. The condition of the covering and the tightness of the laps and tapes shall be noted and recorded.

f. Sheet Curing Corrective Action. When a daily inspection report lists any tears, holes, or laps or joints that are not completely closed, the tears and holes shall promptly be repaired or the sheets replaced, the joints closed, and the required curing period for those areas shall be extended by 1 day.

3.13.10 Cold-Weather Protection

At least once each shift and once per day on non-work days, an inspection shall be made of all areas subject to cold-weather protection. Any deficiencies shall be noted, corrected, and reported.

3.13.11 Mixer Uniformity

a. Stationary Mixers. Prior to the start of concrete placing and once every 6 months when concrete is being placed, or once for every 75,000 cubic yards of concrete placed, whichever results in the shortest time interval, uniformity of concrete mixing shall be determined in accordance with ASTM C 94/C 94M.

b. Truck Mixers. Prior to the start of concrete placing and at least once every 6 months when concrete is being placed, uniformity of concrete mixing shall be determined in accordance with ASTM C 94/C 94M. The truck mixers shall be selected randomly for testing. When satisfactory performance is found in one truck mixer, the performance of mixers of substantially the same design and condition of the blades may be regarded as satisfactory.

c. Mixer Uniformity Corrective Action. When a mixer fails to meet mixer uniformity requirements, either the mixing time shall be increased, batching sequence changed, batch size reduced, or adjustments shall be made to the mixer until compliance is achieved.

3.13.12 Reports

All results of tests or inspections conducted shall be reported informally as they are completed and in writing daily. A weekly report shall be prepared for the updating of control charts covering the entire period from the start of the construction season through the current week. During periods of cold-weather protection, reports of pertinent temperatures shall be made daily. These requirements do not relieve the Contractor of the obligation to report certain failures immediately as required in preceding paragraphs. Such reports of failures and the action taken shall be confirmed in writing in the routine reports. The Contracting Officer has the right to examine all contractor quality control records.

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SECTION 13080

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SECTION 13080

SEISMIC PROTECTION AND ANTI-TERRORISM FORCE PROTECTION (AT/FP) FOR MISCELLANEOUS EQUIPMENT AND COMPONENTS
04/99

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)

AISC 316	(1989) ASD Manual of Steel Construction
AISC 325	LRFD Manual of Steel Construction
AISC 348	(1985) Allowable Stress Design Specification for Structural Joints Using ASTM A325 or A490 Bolts
AISC 348	(1988) Load and Resistance Factor Design Specifications for Structural Joints Using ASTM A325 or A490 Bolts

AMERICAN IRON AND STEEL INSTITUTE (AISI)

AISI COLD FORMED MANUAL	(1996) Cold-Formed Steel Design Manual

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 36/A 36M	(2001) Carbon Structural Steel
ASTM A 53	(1999) Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A 153/A 153M	(1998) Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A 307	(2000) Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength
ASTM A 325	(2002) Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength
ASTM A 500	(1999) Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
ASTM A 563	(1997) Carbon and Alloy Steel Nuts

ASTM A 572/A 572M	(1999) High-Strength Low-Alloy Columbium-Vanadium Structural Steel
ASTM A 603	(1998) Zinc-Coated Steel Structural Wire Rope
ASTM A 653/A 653M	(2001a) Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM E 488	(1996) Strength of Anchors in Concrete and Masonry Elements

ASME INTERNATIONAL (ASME)

ASME B18.2.1	(1996) Square and Hex Bolts and Screws, Inch Series
ASME B18.2.2	(1987; R 1999) Square and Hex Nuts (Inch Series)

INTERNATIONAL CODE COUNCIL (ICC)

1.2 SYSTEM DESCRIPTION

1.2.1 General Requirements

The requirements for seismic and anti-terrorism/force protection protection (AT/FP) measures described in this section shall be applied to the mechanical equipment and systems outlined in Specification Section 15070A SEISMIC PROTECTION AND ANTI-TERRORISM/FORCE PROTRECTION (AT/FP) FOR MECHANICAL EQUIPMENT, the electrical equipment and systems outlined in Specification Section 16070A SEISMIC PROTECTION AND ANTI-TERRORISM FORCE PROTECTION (AT/FP) FOR ELECTRICAL EQUIPMENT, and the miscellaneous equipment, systems, and components listed in this specification. Seismic protection requirements shall be in accordance with IBC 2000 and additional data furnished herein, and shall be provided in addition to any other requirements called for in other sections of these specifications. Resistance to lateral forces induced by earthquakes shall be accomplished without consideration of friction resulting from gravity loads. The following seismic parameters shall be applied:

Building Classification per Table 1604.5 of IBC 2000 (pg. 297)	=	III
Site Class per Table 1615.1.1 of IBC 2000(pg. 350)	=	D
S_{DS} design spectral response acceleration at short periods (as determined in para. 1615.1.3 of IBC 2000 pg. 350)	=	0.127
S_{Di} design spectral response acceleration at 1 sec. period (as determined in para. 1615.1.3 of IBC 2000 pg. 350)	=	0.068
Seismic Design Category per Tables 1616.3(1) and 1616.3(2) of IBC 2000 (pages 354-355)	=	C
I_p component importance factor (as determined in para. 1621.1.6 of IBC 2000 pg. 377)	=	1.5

Miscellaneous equipment, systems, and components shall be anchored or braced resist an AT/FP force of 0.5 times the equipment weight in any

horizontal direction as well as in the upward vertical direction. Miscellaneous equipment and systems shall be anchored or braced to resist an AT/FP force of 1.5 times the equipment weight in the downward vertical direction.

1.2.2 Seismic Protection For Miscellaneous Equipment and Systems

The bracing and anchorage for the following miscellaneous equipment, systems, and components shall be developed by the Contractor in accordance with the requirements of this specification:

Storage cabinets	Ornamentations
Storage Racks	Signs and Billboards
Shelving	Furnishings
Partitions	Suspended Ceilings

1.2.3 Anti-Terrorism/Force Protection (AT/FP) Protection For Miscellaneous Equipment and Systems

The bracing and anchorage for miscellaneous the following equipment, systems, and components shall be developed by the Contractor in accordance with the requirements of this specification: All items listed in paragraph 1.2.2 above weighing more than 31 pounds.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Bracing and anchorage; G-DO
Resilient Vibration Isolation Devices; G-DO
Equipment Requirements; G-DO

Detail drawings along with catalog cuts, templates, and erection and installation details, as appropriate, for the items listed. Submittals shall be complete in detail; shall indicate thickness, type, grade, class of metal, and dimensions; and shall show construction details, reinforcement, anchorage, and installation with relation to the building construction. The drawings shall be stamped by the registered engineer who stamps the calculations required above.

SD-03 Product Data

Bracing and anchorage; G-DO
Equipment Requirements; G-DO

Copies of the design calculations with the detail drawings. Calculations shall be stamped by a registered engineer and shall verify the capability of structural members to which bracing or anchorages are attached for carrying the load from the brace or anchorage.

1.4 DESIGN REQUIREMENTS

1.4.1 Seismic Protection

Anchorage and bracing for equipment, systems, and components as listed in this Specification Section, as well as in Specification Sections 15070A: SEISMIC PROTECTION AND ANTI-TERRORISM/FORCE PROTECTION (AT/FP) FOR MECHANICAL EQUIPMENT and 16070A: SEISMIC PROTECTION AND ANTI-TERRORISM/FORCE PROTECTION (AT/FP) FOR ELECTRICAL EQUIPMENT shall be designed for seismic forces per ICB 2000 in accordance with the parameters given in paragraph 1.2.1 above. Design of anchorage and bracing shall be in accordance with AISC 316 for Allowable Stress Design or AISC 325 for Strength Design. Bolting using A325 bolts shall be in accordance with AISC 348.

1.4.2 Anti-Terrorism/Force Protection (AT/FP) Protection

Anchorage and bracing for equipment, systems, and components as listed in this Specification Section, as well as in Specification Sections 15070A: SEISMIC PROTECTION AND ANTI-TERRORISM/FORCE PROTECTION (AT/FP) FOR MECHANICAL EQUIPMENT and 16070A: SEISMIC PROTECTION AND ANTI-TERRORISM/FORCE PROTECTION (AT/FP) FOR ELECTRICAL EQUIPMENT shall be designed for the forces given in paragraph 1.2.1 above. Structural steel design of anchorages and bracing shall be in accordance with AISC 316 for Allowable Stress Design or AISC 325 for Strength Design. Cold formed steel design of anchorages and bracing shall be in accordance with the AISI Cold formed Manual. When elected to be used, bolting using A325 bolts shall be in accordance with AISC 348. For strength design methodology of anchorage and bracing components for AT/FP forces, all load factors may be removed and all phi factors set to one for flexure, compression, tension, and torsion. Load factors and phi factors shall be retained for shear. For allowable stress design methodology of anchorage and bracing components for AT/FP forces, all safety factors may be removed for flexure, compression, tension, and torsion. Safety factors shall be retained for shear. For both strength design and allowable stress design, unbraced length considerations shall be retained, and a 10 percent increase in the specified yield, ultimate, and compressive strength of steel and concrete may be assumed. This 10 percent increase shall not be applied to masonry.

PART 2 PRODUCTS

2.1 BOLTS AND NUTS

Squarehead and hexhead bolts, and heavy hexagon nuts, ASME B18.2.1, ASME B18.2.2, or ASTM A 307 for bolts and ASTM A 563 for nuts or ASTM A 325 for bolts and nuts. Bolts and nuts used underground and/or exposed to weather shall be galvanized in accordance with ASTM A 153/A 153M.

2.2 BRACING

Material used for members listed in this section and on the drawings, shall be structural steel conforming with the following:

a. Plates, rods, and rolled shapes, ASTM A 36/A 36M or ASTM A 572/A 572M.

b. Wire rope, ASTM A 603.

c. Tubes, ASTM A 500, Grade B.

d. Pipes, ASTM A 53, Type E or S, Grade B.

e. Light gauge angles, less than 1/4 inch thickness, ASTM A 653/A 653M.

PART 3 EXECUTION

3.1 BRACING

Bracing shall conform to the arrangements shown. Trapeze-type hanger shall be secured with not less than two 1/2 inch bolts.

3.2 BUILDING DRIFT

Braces for a piping run shall not be attached to two dissimilar structural elements of a building that may respond differentially during an earthquake unless a flexible joint is provided.

3.3 ANCHOR BOLTS

3.3.1 Cast-In-Place

Floor or pad mounted equipment shall use cast-in-place anchor bolts, except as specified below. One nut shall be provided on each bolt. Anchor bolts shall conform to ASTM A 307. Anchor bolts shall have an embedded straight length equal to at least 12 times nominal diameter of the bolt. Anchor bolts that exceed the normal depth of equipment foundation piers or pads shall either extend into concrete floor or the foundation shall be increased in depth to accommodate bolt lengths.

3.3.2 Expansion or Chemically Bonded Anchors

Expansion or chemically bonded anchors shall not be used unless test data in accordance with ASTM E 488 has been provided to verify the adequacy of the specific anchor and application. Chemically bonded anchors shall not be used to resist pull-out in overhead and wall installations if the adhesive is manufactured with temperature sensitive epoxies and the location is accessible to a building fire. Expansion and chemically bonded anchors shall be installed in accordance with the manufacturer's recommendations. The allowable forces shall be adjusted for the spacing between anchor bolts and the distance between the anchor bolt and the nearest edge, as specified by the manufacturer.

3.4 RESILIENT VIBRATION ISOLATION DEVICES

Where the need for these devices is determined, based on the magnitude of the design seismic forces, selection of anchor bolts for vibration isolation devices and/or snubbers for equipment base and foundations shall follow the same procedure as in paragraph ANCHOR BOLTS, except that an equipment weight equal to five times the actual equipment weight shall be used.

3.4.1 Resilient and Spring-Type Vibration Devices

Vibration isolation devices shall be selected so that the maximum movement of equipment from the static deflection point shall be 0.5 inches.

3.5 BRACES FOR PIPING

Transverse sway bracing for steel and copper pipe shall be provided at intervals not to exceed those shown on the drawings. Transverse sway bracing for pipes of materials other than steel and copper shall be provided at intervals not to exceed the hanger spacing as specified in Section 15400 PLUMBING, GENERAL PURPOSE. Bracing shall consist of at least one vertical angle 2 x 2 x 16 gauge and one diagonal angle of the same size.

3.5.1 Longitudinal Sway Bracing

Longitudinal sway bracing shall be provided in accordance with Section 15070 SEISMIC PROTECTION AND ANTI-TERRORISM/FORCE PROTECTION (AT/FP) FOR MECHANICAL EQUIPMENT.

3.5.2 Anchor Rods, Angles, and Bars

Anchor rods, angles, and bars shall be bolted to either pipe clamps or pipe flanges at one end and cast-in-place concrete or masonry insert or clip angles bolted to the steel structure on the other end. Rods shall be solid metal or pipe as specified below. Anchor rods, angles, and bars shall not exceed lengths given in the tabulation below.

3.5.3 Maximum Length for Anchor Braces

Type	Size (Inches)	Maximum Length* (Feet/Inches)
Angles	1-1/2 x 1-1/2 x 1/4	4-10
	2 x 2 x 1/4	6-6
	2-1/2 x 1-1/2 x 1/4	8-0
	3 x 2-1/2 x 1/4	8-10
	3 x 3 x 1/4	9-10
Rods	3/4	3-1
	7/8	3-8
Flat Bars	1-1/2 x 1/4	1-2
	2 x 1/4	1-2
	2 x 3/8	1-9
Pipes (40S)	1	7-0
	1-1/4	9-0
	1-1/2	10-4
	2	13-1

3.5.4 Bolts

Bolts used for attachment of anchors to pipe and structure shall be not less than 1/2 inch diameter.

3.6 EQUIPMENT SWAY BRACING

3.6.1 Suspended Equipment and Light Fixtures

Equipment sway bracing shall be provided for items supported from overhead floor or roof structural systems, including light fixtures. Braces shall

consist of angles, rods, wire rope, bars, or pipes arranged as shown and secured at both ends with not less than 1/2 inch bolts. Details of equipment bracing shall be submitted for acceptance. In lieu of bracing with vertical supports, these items may be supported with hangers inclined at 45 degrees directed up and radially away from equipment and oriented symmetrically in 90-degree intervals on the horizontal plane, bisecting the angles of each corner of the equipment, provided that supporting members are properly sized to support operating weight of equipment when hangers are inclined at a 45-degree angle.

3.6.2 Floor or Pad Mounted Equipment

3.6.2.1 Shear Resistance

Floor mounted equipment shall be bolted to the floor. Requirements for the number and installation of bolts to resist shear forces shall be in accordance with paragraph ANCHOR BOLTS.

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DIVISION 15 - MECHANICAL

SECTION 15070A

SEISMIC PROTECTION AND ANTI-TERRORISM/FORCE PROTECTION (AT/FP) FOR MECHANICAL EQUIPMENT

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SECTION 15070A

SEISMIC PROTECTION AND ANTI-TERRORISM/FORCE PROTECTION (AT/FP) FOR MECHANICAL EQUIPMENT
01/02

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

INTERNATIONAL CODE COUNCIL (ICC)

IBC 2000	(2000) International Building Code

SHEET METAL & AIR CONDITIONING CONTRACTORS' NATIONAL ASSOCIATION (SMACNA)

SMACNA Seismic Restraint Mnl	(1998) Seismic Restraint Manual Guidelines for Mechanical Systems

1.2 SYSTEM DESCRIPTION

1.2.1 General Requirements

The requirements for seismic protection and anti-terrorism/force protection (AT/FP) measures described in this section shall be applied to the mechanical equipment and systems listed below. Structural requirements shall be in accordance with Specification Section 13080 SEISMIC PROTECTION AND ANTI-TERRORISM/FORCE PROTECTION (AT/FP) FOR MISCELLANEOUS EQUIPMENT AND COMPONENTS.

Mechanical equipment shall be anchored or braced to resist a seismic design force as calculated using all applicable provisions of IBC 2000, Section 1621 - ARCHITECTURAL, MECHANICAL AND ELECTRICAL COMPONENT SEISMIC DESIGN REQUIREMENTS with the following parameters:

Building Classification per Table 1604.5 of IBC 2000 (pg. 297)	=	III
Site Class per Table 1615.1.1 of IBC 2000(pg. 350)	=	D
S_{DS} design spectral response acceleration at short periods (as determined in para. 1615.1.3 of IBC 2000 pg. 350)	=	0.127
S_{Di} design spectral response acceleration at 1 sec. period (as determined in para. 1615.1.3 of IBC 2000 pg. 350)	=	0.068
Seismic Design Category per Tables 1616.3(1) and 1616.3(2) of IBC 2000 (pages 354-355)	=	C
I_p component importance factor (as determined in para. 1621.1.6 of IBC 2000 pg. 377)	=	1.5

Mechanical equipment shall be anchored or braced to resist an AT/FP force of 0.5 times the equipment weight in any horizontal direction as well as in the upward vertical direction. Electrical equipment shall be anchored or braced to resist an AT/FP force of 1.5 times the equipment

weight in the downward vertical direction.

1.2.2 Mechanical Equipment

Mechanical equipment to be seismically protected shall include the following items to the extent required on the drawings or in other sections of these specifications:

Boilers	Storage Tanks for Oil and Water
Water Heaters	Oil and Gas Piping
Expansion Air Separator Tanks	Valves and Fittings for Piping
Water Chiller Units	Air Handling Units
Pumps with Motors Ducts	
Unit Heaters	Exhaust and Return Fans

Mechanical equipment requiring AT/FP protection includes all mechanical equipment and components weighing over 31 pounds.

1.2.3 Mechanical Systems

The following mechanical systems shall be installed as required on the drawings and other sections of these specifications and shall be seismically protected in accordance with this specification:

All Piping Inside the Building Except as Specifically Stated Below Under "Items Not Covered By This Section".
Chilled Water Distribution Systems Outside of Buildings
Fuel Piping Outside of Buildings
All Water Supply Systems
Storm and Sanitary Sewer Systems
Fuel Storage Tanks
Water Storage Tanks

Mechanical systems requiring AT/FP protection includes all mechanical systems listed above which are located inside of buildings.

1.2.4 Not Used

1.2.5 Items Not Covered By This Section

1.2.5.1 Fire Protection Systems

Seismic protection of piping for fire protection systems shall be installed as specified in Sections 13930A WET PIPE SPRINKLER SYSTEM, FIRE PROTECTION, and 13935A DRY PIPE SPRINKLER SYSTEM, FIRE PROTECTION.

1.2.5.2 Items Requiring No Seismic Restraints

As given in section 1621 of IBC 2000

1.3 EQUIPMENT REQUIREMENTS

1.3.1 Rigidly Mounted Equipment

The following specific items of equipment below to be furnished under this contract shall be constructed and assembled to withstand the seismic forces specified in SMACNA Seismic Restraint Mnl. Each item of rigid equipment

shall be entirely located and rigidly attached on one side only of a building expansion joint.

Boilers
Chillers
Air-Handling Units

1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Bracing; G-DO.
Equipment Requirements; G-DO.
Contractor Designed Bracing; G-DO.

Detail drawings along with catalog cuts, templates, and erection and installation details, as appropriate, for the items listed. Submittals shall be complete in detail; shall indicate thickness, type, grade, class of metal, and dimensions; and shall show construction details, reinforcement, anchorage, and installation with relation to the building construction.

SD-03 Product Data

Bracing; G-DO.
Equipment Requirements; G-DO.

Copies of the design calculations with the detail drawings. Calculations shall be stamped by a registered engineer and shall verify the capability of structural members to which bracing is attached for carrying the load from the brace.

Contractor Designed Bracing; G-DO.

Copies of the design calculations with the drawings. Calculations shall be approved, certified, stamped and signed by a registered Professional Engineer. Calculations shall verify the capability of structural members to which bracing is attached for carrying the load from the brace.

PART 2 PRODUCTS

2.1 NOT USED
2.2 NOT USED
2.3 NOT USED
2.4 NOT USED

2.5 SWAY BRACING MATERIALS

Sway bracing materials (e.g. rods, plates, rope, angles, etc.) shall be as specified in Specification Section 13080 SEISMIC PROTECTION AND ANTI-TRRORISM/FORCE PROTECTION (AT/FP) FOR MISCELLANEOUS EQUIPMENT.

PART 3 EXECUTION

3.1 BRACING

Provisions of this paragraph apply to all piping within a 5 foot line around outside of building unless buried in the ground. Piping grouped for support on trapeze-type hangers shall be braced at the most frequent interval as determined by applying the requirements of this specification to each piping run on the common support. Bracing components shall be sized as required for the total load carried by the common supports. Bracing rigidly attached to pipe flanges, or similar, shall not be used where it would interfere with thermal expansion of piping.

3.2 BUILDING DRIFT

Joints capable of accommodating seismic displacements shall be provided for vertical piping between floors of the building, where pipes pass through a building seismic or expansion joint, or where rigidly supported pipes connect to equipment with vibration isolators. Horizontal piping across expansion joints shall accommodate the resultant of the drifts of each building unit in each orthogonal direction. For threaded piping, swing joints made of the same piping material shall be provided. For piping with manufactured ball joints the seismic drift shall be 0.015 feet per foot of height above the base where the seismic separation occurs; this drift value shall be used in place of the expansion given in the manufacturer's selection table.

3.3 NOT USED

3.4 PIPE SLEEVES

Pipe sleeves in interior non-fire rated walls shall be sized as indicated on the drawings to provide clearances that will permit differential movement of piping without the piping striking the pipe sleeve. Pipe sleeves in fire rated walls shall conform to the requirements in Section 07840A FIRESTOPPING.

3.5 SPREADERS

Spreaders shall be provided between adjacent piping runs to prevent contact during seismic activity whenever pipe or insulated pipe surfaces are less than 4 inches apart. Spreaders shall be applied at same interval as sway braces at an equal distance between the sway braces. If rack type hangers are used where the pipes are restrained from contact by mounting to the rack, spreaders are not required for pipes mounted in the rack. Spreaders shall be applied to surface of bare pipe and over insulation on insulated pipes utilizing high-density inserts and pipe protection shields in accordance with the requirements of Section 15080A THERMAL INSULATION FOR MECHANICAL SYSTEMS.

3.6 SWAY BRACES FOR PIPING

Sway braces shall be provided to prevent movement of the pipes under seismic loading. Braces shall be provided in both the longitudinal and transverse directions, relative to the axis of the pipe. The bracing shall not interfere with thermal expansion requirements for the pipes as described in other sections of these specifications.

3.6.1 Transverse Sway Bracing

Transverse sway bracing for steel and copper pipe shall be provided as specified in Section 13080 SEISMIC PROTECTION AND ANTI-TERRORISM/FORCE PROTECTION (AT/FP) FOR MISCELLANEOUS EQUIPMENT AND COMPONENTS. All runs (length of pipe between end joints) shall have a minimum of two transverse braces. Transverse sway bracing for pipes of materials other than steel and copper shall be provided at intervals not to exceed the hanger spacing as specified in Section 15400A PLUMBING, GENERAL PURPOSE.

3.6.2 Longitudinal Sway Bracing

Longitudinal sway bracing shall be provided at 40 foot intervals unless otherwise indicated. All runs (length of pipe between end joints) shall have one longitudinal brace minimum. Sway braces shall be constructed in accordance with the drawings. Branch lines, walls, or floors shall not be used as sway braces.

3.6.3 Vertical Runs

Run is defined as length of pipe between end joints. Vertical runs of piping shall be braced at not more than 10 foot vertical intervals. Braces for vertical runs shall be above the center of gravity of the segment being braced. All sway braces shall be constructed in accordance with the drawings. Sway branches shall not be connected to branch lines, walls, or floors.

3.6.4 Clamps and Hangers

Clamps or hangers on uninsulated pipes shall be applied directly to pipe. Insulated piping shall have clamps or hangers applied over insulation in accordance with Section 15080A THERMAL INSULATION FOR MECHANICAL SYSTEMS.

3.7 SWAY BRACES FOR DUCTS

3.7.1 Braced Ducts

Bracing details and spacing for rectangular and round ducts shall be in accordance with *, including Appendix E. However, the design seismic loadings for these items shall not be less than loadings obtained using the procedures in SMACNA Seismic Restraint Mnl.

3.7.2 Unbraced Ducts

Hangers for unbraced ducts shall be attached to the duct within 2 inches of the top of the duct in accordance with SMACNA Seismic Restraint Mnl. Unbraced ducts shall be installed with a 6 inch minimum clearance to vertical ceiling hanger wires.

-- End of Section --

SECTION TABLE OF CONTENTS

DIVISION 16 - ELECTRICAL

SECTION 16070A

SEISMIC PROTECTION AND ANTI-TERRORISM/FORCE PROTECTION (AT/FP) FOR ELECTRICAL EQUIPMENT

04/99

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SECTION 16070A

SEISMIC PROTECTION AND ANTI-TERRORISM/FORCE PROTECTION (AT/FP) FOR ELECTRICAL EQUIPMENT

04/99

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM E 580	(2000) Application of Ceiling Suspension Systems for Acoustical Tile and Lay-In Panels in Areas Requiring Moderate Seismic Restraint

INTERNATIONAL CODE COUNCIL (ICC)

IBC 2000	(2000) International Building Code

UNDERWRITERS LABORATORIES (UL)

UL 1570	(1995; Rev thru Nov 1999) Fluorescent Lighting Fixtures
UL 1571	(1995; Rev thru Nov 1999) Incandescent Lighting Fixtures

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Lighting Fixtures in Buildings; G-DO
Equipment Requirements; G-DO

Detail drawings along with catalog cuts, templates, and erection and installation details, as appropriate, for the items listed. Submittals shall be complete in detail; shall indicate thickness, type, grade, class of metal, and dimensions; and shall show construction details, reinforcement, anchorage, and installation with relation to the building construction.

SD-03 Product Data

Lighting Fixtures in Buildings; G-DO

Equipment Requirements; G-DO

Copies of the design calculations with the detail drawings. Calculations shall be stamped by a registered engineer and shall verify the capability of structural members to which bracing is attached for carrying the load from the brace.

Contractor Designed Bracing; G-DO

Copies of the Design Calculations with the Drawings. Calculations shall be approved, certified, stamped and signed by a Registered Professional Engineer. Calculations shall verify the capability of structural members to which bracing is attached for carrying the load from the brace.

1.3 SYSTEM DESCRIPTION

1.3.1 General Requirements

The requirements for seismic protection and anti-terrorism/force protection (AT/FP) measures described in this section shall be applied to the electrical equipment and systems listed below. Structural requirements shall be in accordance with Specification Section 13080 SEISMIC PROTECTION AND ANTI-TERRORISM FORCE PROTECTION (AT/FP) FOR MISCELLANEOUS EQUIPMENT AND COMPONENTS.

Electrical equipment shall be anchored or braced to resist a seismic design force as calculated using all applicable provisions of IBC 2000, Section 1621 - ARCHITECTURAL, MECHANICAL AND ELECTRICAL COMPONENT SEISMIC DESIGN REQUIREMENTS with the following parameters:

Building Classification per Table 1604.5 of IBC 2000 (pg. 297)	=	III
Site Class per Table 1615.1.1 of IBC 2000(pg. 350)	=	D
S_{DS} design spectral response acceleration at short periods (as determined in para. 1615.1.3 of IBC 2000 pg. 350)	=	0.127
S_{Di} design spectral response acceleration at 1 sec. period (as determined in para. 1615.1.3 of IBC 2000 pg. 350)	=	0.068
Seismic Design Category per Tables 1616.3(1) and 1616.3(2) of IBC 2000 (pages 354-355)	=	C
I_p component importance factor (as determined in para. 1621.1.6 of IBC 2000 pg. 377)	=	1.5

Electrical equipment shall be anchored or braced to resist an AT/FP force of 0.5 times the equipment weight in any horizontal direction as well as in the upward vertical direction. Electrical equipment shall be anchored or braced to resist an AT/FP force of 1.5 times the equipment weight in the downward vertical direction.

1.3.2 Electrical Equipment

Electrical equipment requiring seismic protection shall include the following items to the extent required on the drawings or in other sections of these specifications:

Control Panels	Air Handling Units
Pumps with Motors	Switchgear
Light Fixtures	Conduit
Transformers	
Switchboards (Floor Mounted)	Communication Racks

Automatic Transfer Switches

Electrical equipment requiring AT/FP protection includes all electrical equipment and components weighing over 31 pounds.

1.3.3 Contractor Designed Bracing

The Contractor shall design the bracing in accordance with IBC 2000 and additional data furnished herein. Resistance to lateral forces induced by earthquakes shall be accomplished without consideration of friction resulting from gravity loads.

1.3.4 Conduits Requiring No Special Seismic Restraints

Seismic restraints may be omitted from electrical conduit less than 2-1/2 inches trade size. All other interior conduit, shall be seismically protected as specified.

1.4 EQUIPMENT REQUIREMENTS

1.4.1 Rigidly Mounted Equipment

The following specific items of equipment to be furnished under this contract shall be constructed and assembled to withstand the seismic forces specified in IBC 2000. Each item of rigid electrical equipment shall be entirely located and rigidly attached on one side only of a building expansion joint. Piping, electrical conduit, etc., which cross the expansion joint shall be provided with flexible joints that are capable of accommodating displacements equal to the full width of the joint in both orthogonal directions.

Automatic Transfer Switches
Engine-Generators
Transformers
Switch Boards and Switch Gears
Free Standing Electric Motors

PART 2 PRODUCTS

2.1 LIGHTING FIXTURE SUPPORTS

Lighting fixtures and supports shall conform to UL 1570 or UL 1571 as applicable.

2.2 SWAY BRACING MATERIALS

Sway bracing materials (e.g. rods, plates, rope, angles, etc.) shall be as specified in Specification Section 13080 SEISMIC PROTECTION AND ANTI-TERRORISM FORCE PROTECTION (AT/FP) FOR MISCELLANEOUS EQUIPMENT.

PART 3 EXECUTION

3.1 SWAY BRACES FOR CONDUIT

Conduit shall be braced as for an equivalent weight pipe in accordance with Specification Section 15070A SEISMIC PROTECTION AND ANTI-TERRORISM FORCE PROTECTION (AT/FP) FOR MECHANICAL EQUIPMENT.

3.2 LIGHTING FIXTURES IN BUILDINGS

Lighting fixtures and supports shall conform to the following:

3.2.1 Pendant Fixtures

Pendant fixtures shall conform to the requirements of IBC 2000.

3.2.2 Ceiling Attached Fixtures

3.2.2.1 Recessed Fluorescent Fixtures

Recessed fluorescent individual or continuous-row mounted fixtures shall be supported by a seismic-resistant suspended ceiling support system built in accordance with ASTM E 580. Seismic protection for the fixtures shall conform to the requirements of IBC 2000. Recessed lighting fixtures not over 56 pounds in weight may be supported by and attached directly to the ceiling system runners using screws or bolts, number and size as required by the seismic design. Fixture accessories, including louvers, diffusers, and lenses shall have lock or screw attachments.

3.2.2.2 Surface-Mounted Fluorescent Fixtures

Surface-mounted fluorescent individual or continuous-row fixtures shall be attached to a seismic-resistant ceiling support system built in accordance with ASTM E 580. Seismic protection for the fixtures shall conform to the requirements of IBC 2000.

3.2.3 Assembly Mounted on Outlet Box

A supporting assembly, that is intended to be mounted on an outlet box, shall be designed to accommodate mounting features on 4 inch boxes, plaster rings, and fixture studs.

3.2.4 Lateral Force

Structural requirements for light fixture bracing shall be in accordance with Specification Section 13080 SEISMIC PROTECTION AND ANTI-TERORISM AND FORCE PROTECTION (AT/FP) FOR MISCELLANEOUS EQUIPMENT AND COMPONENTS.

-- End of Section --