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SECTION 03100

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SECTION 03100

STRUCTURAL CONCRETE FORMWORK

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 347R (1994) Guide to Formwork for Concrete

AMERICAN HARDBOARD ASSOCIATION (AHA)

AHA ANSI/AHA A135.4 (1995) Basic Hardboard

DEPARTMENT OF COMMERCE (DOC)

DOC PS 1 (1996) Voluntary Product Standard -
Construction and Industrial Plywood

1.2 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-01 Data

Design; FIO

Design analysis and calculations for form design and methodology used in the design.

Form Materials; FIO

Manufacturer's data including literature describing form materials, accessories, and form releasing agents.

Form Releasing Agents; FIO

Manufacturer's recommendation on method and rate of application of form releasing agents.

SD-04 Drawings

Formwork; FIO

Drawings showing details of formwork, including dimensions of fiber voids, joints, supports, studding and shoring, and sequence of form and shoring removal.

1.3 DESIGN

Formwork shall be designed in accordance with methodology of ACI 347R for anticipated loads, lateral pressures, and stresses. Forms shall be capable of producing a surface which meets the requirements of the class of finish specified in Section 03300 CAST-IN-PLACE STRUCTURAL CONCRETE. Forms shall be capable of withstanding the pressures resulting from placement and vibration of concrete.

1.4 STORAGE AND HANDLING

Fiber voids shall be stored above ground level in a dry location. Fiber voids shall be kept dry until installed and overlaid with concrete.

PART 2 PRODUCTS

2.1 FORM MATERIALS

See Section 03360 SIMULATED STONE MASONRY for architectural form liner requirements.

2.1.1 Forms For Class A and Class B Finish

Forms for Class A and Class B finished surfaces shall be plywood panels conforming to DOC PS 1, Grade B-B concrete form panels, Class I or II. Other form materials or liners may be used provided the smoothness and appearance of concrete produced will be equivalent to that produced by the plywood concrete form panels. Forms for round columns shall be the prefabricated seamless type.

2.1.2 Forms For Class C Finish

Forms for Class C finished surfaces shall be shiplap lumber; plywood conforming to DOC PS 1, Grade B-B concrete form panels, Class I or II; tempered concrete form hardboard conforming to AHA ANSI/AHA A135.4; other approved concrete form material; or steel, except that steel lining on wood sheathing shall not be used. Forms for round columns may have one vertical seam.

2.1.3 Forms For Class D Finish

Forms for Class D finished surfaces, except where concrete is placed against earth, shall be wood or steel or other approved concrete form material.

2.1.4 Retain-In-Place Metal Forms

Retain-in-place metal forms for concrete slabs and roofs shall be as specified in Section 05300 STEEL DECKING.

2.1.5 Pan-Form Units

Pan-form units for one-way or two-way concrete joist and slab construction shall be factory-fabricated units of the approximate section indicated. Units shall consist of steel or molded fiberglass concrete form pans.

Closure units shall be furnished as required.

2.1.6 Form Ties

Form ties shall be factory-fabricated metal ties, shall be of the removable or internal disconnecting or snap-off type, and shall be of a design that will not permit form deflection and will not spall concrete upon removal. Solid backing shall be provided for each tie. Except where removable tie rods are used, ties shall not leave holes in the concrete surface less than 1/4 inch nor more than 1 inch deep and not more than 1 inch in diameter. Removable tie rods shall be not more than 1-1/2 inches in diameter.

2.1.7 Form Releasing Agents

Form releasing agents shall be commercial formulations that will not bond with, stain or adversely affect concrete surfaces. Agents shall not impair subsequent treatment of concrete surfaces depending upon bond or adhesion nor impede the wetting of surfaces to be cured with water or curing compounds.

PART 3 EXECUTION

3.1 INSTALLATION

3.1.1 Formwork

Forms shall be mortar tight, properly aligned and adequately supported to produce concrete surfaces meeting the surface requirements specified in Section 03300 CAST-IN-PLACE STRUCTURAL CONCRETE and conforming to construction tolerance given in TABLE 1. Where concrete surfaces are to have a Class A or Class B finish, joints in form panels shall be arranged as approved. Where forms for continuous surfaces are placed in successive units, the forms shall fit over the completed surface to obtain accurate alignment of the surface and to prevent leakage of mortar. Forms shall not be reused if there is any evidence of surface wear and tear or defects which would impair the quality of the surface. Surfaces of forms to be reused shall be cleaned of mortar from previous concreting and of all other foreign material before reuse. Form ties that are to be completely withdrawn shall be coated with a nonstaining bond breaker.

3.2 CHAMFERING

Except as otherwise shown, external corners that will be exposed shall be chamfered, beveled, or rounded by moldings placed in the forms.

3.3 COATING

Forms for Class A and Class B finished surfaces shall be coated with a form releasing agent before the form or reinforcement is placed in final position. The coating shall be used as recommended in the manufacturer's printed or written instructions. Forms for Class C and D finished surfaces may be wet with water in lieu of coating immediately before placing concrete, except that in cold weather with probable freezing temperatures, coating shall be mandatory. Surplus coating on form surfaces and coating on reinforcing steel and construction joints shall be removed before placing concrete.

3.4 REMOVAL OF FORMS

Forms shall be removed preventing injury to the concrete and ensuring the complete safety of the structure. Formwork for columns, walls, side of beams and other parts not supporting the weight of concrete may be removed when the concrete has attained sufficient strength to resist damage from the removal operation but not before at least 24 hours has elapsed since concrete placement. Supporting forms and shores shall not be removed from beams, floors and walls until the structural units are strong enough to carry their own weight and any other construction or natural loads. Supporting forms or shores shall not be removed before the concrete strength has reached 70 percent of design strength, as determined by field cured cylinders or other approved methods. This strength shall be demonstrated by job-cured test specimens, and by a structural analysis considering the proposed loads in relation to these test strengths and the strength of forming and shoring system. The job-cured test specimens for form removal purposes shall be provided in numbers as directed and shall be in addition to those required for concrete quality control. The specimens shall be removed from molds at the age of 24 hours and shall receive, insofar as possible, the same curing and protection as the structures they represent.

TABLE 1

TOLERANCES FOR FORMED SURFACES

1.	Variations from the plumb:	In any 10 feet of length ----- 1/4 inch
a.	In the lines and surfaces of columns, piers, walls and in arises	Maximum for entire length ----- 1 inch
b.	For exposed corner columns, control-joint grooves, and other conspicuous lines	In any 20 feet of length ----- 1/4 inch Maximum for entire length----- 1/2 inch
2.	Variation from the level or from the grades indicated on the drawings:	In any 10 feet of length -----1/4 inch In any bay or in any 20 feet of length----- 3/8 inch
a.	In slab soffits, ceilings, beam soffits, and in arises, measured before removal of supporting shores	Maximum for entire length ----- 3/4 inch
b.	In exposed lintels, sills, parapets, horizontal grooves, and other conspicuous lines	In any bay or in any 20 feet of length ----- 1/4 inch Maximum for entire length----- 1/2 inch
3.	Variation of the linear building lines from established position in plan	In any 20 feet ----- 1/2 inch Maximum -----1 inch

TABLE 1

TOLERANCES FOR FORMED SURFACES

4.	Variation of distance between walls, columns, partitions	1/4 inch per 10 feet of distance, but not more than 1/2 inch in any one bay, and not more than 1 inch total variation
5.	Variation in the sizes and locations of sleeves, floor openings, and wall opening	Minus ----- 1/4 inch Plus ----- 1/2 inch
6.	Variation in cross-sectional dimensions of columns and beams and in the thickness of slabs and walls	Minus ----- 1/4 inch Plus ----- 1/2 inch
7.	Footings:	
a.	Variation of dimensions in plan	Minus ----- 1/2 inch Plus ----- 2 inches when formed or plus 3 inches when placed against unformed excavation
b.	Misplacement of eccentricity	2 percent of the footing width in the direction of misplacement but not more than 2 inches
c.	Reduction in thickness of specified thickness	Minus ----- 5 percent
8.	Variation in steps:	Riser ----- 1/8 inch
a.	In a flight of stairs	Tread ----- 1/4 inch
b.	In consecutive steps	Riser ----- 1/16 inch Tread ----- 1/8 inch

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SECTION 03150

EXPANSION JOINTS, CONTRACTION JOINTS, AND WATERSTOPS

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 HARDBOARD ASSOCIATION (AHA)

AHA A135.4 (1995) Basic Hardboard

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

- ASTM C 919 (1984; R 1998) Use of Sealants in Acoustical Applications
- ASTM C 920 (1998) Elastomeric Joint Sealants
- ASTM D 412 (1998a) Vulcanized Rubber and Thermoplastic Rubbers and Thermoplastic Elastomers - Tension
- ASTM D 1751 (1999) Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types)
- ASTM D 1752 (1984; R 1996e1) Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction
- ASTM D 2000 (1999) Rubber Products in Automotive Applications
- ASTM D 2628 (1991; R 1998) Preformed Polychloroprene Elastomeric Joint Seals for Concrete Pavements
- ASTM D 2835 (1989; R 1998) Lubricant for Installation of Preformed Compression Seals in Concrete Pavements
- ASTM D 3542 (1998) Preformed Polychloroprene Elastomeric Joint Seals for Bridges
- ASTM D 5249 (1995) Backer Material for Use With Cold and Hot-Applied Joint Sealants in Portland-Cement Concrete and Asphalt Joints

CORPS OF ENGINEERS (COE)

COE CRD-C 513

(1974) Corps of Engineers Specifications
for Rubber Waterstop

1.2 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-01 Data

Preformed Expansion Joint Filler; FIO
Sealant; FIO
Waterstops; FIO

Manufacturer's literature, including safety data sheets, for preformed fillers and the lubricants used in their installation; field-molded sealants and primers (when required by sealant manufacturer); preformed compression seals; and waterstops.

SD-04 Drawings

Waterstops; FIO

Shop drawings and fabrication drawings provided by the manufacturer or prepared by the Contractor.

SD-13 Certificates

Waterstops; FIO

Certificates of compliance stating that the joint filler and sealant materials and waterstops conform to the requirements specified.

SD-14 Samples

Lubricant for Preformed Compression Seals; FIO

Specimens identified to indicate the manufacturer, type of material, size and quantity of material, and shipment or lot represented. Each sample shall be a piece not less than 9 ft of 1 inch nominal width or wider seal or a piece not less than 12 ft of compression seal less than 1 inch nominal width. One quart of lubricant shall be provided. Sample compression seals shall be submitted in the proposed color.

Non-metallic Materials; FIO

Specimens identified to indicate manufacturer, type of material, size, quantity of material, and shipment or lot represented. Each sample shall be a piece not less than 12 inch long cut from each 200 ft of finished waterstop furnished, but not less than a total of 4 ft of each type, size, and lot furnished. One splice sample of each size and type for every 50 splices made in the factory and every 10 splices made at the job site. The splice samples shall

be made using straight run pieces with the splice located at the mid-length of the sample and finished as required for the installed waterstop. The total length of each splice shall be not less than 12 inches long.

1.3 DELIVERY AND STORAGE

Material delivered and placed in storage shall be stored off the ground and protected from moisture, dirt, and other contaminants. Sealants shall be delivered in the manufacturer's original unopened containers. Sealants whose shelf life has expired shall be removed from the site.

PART 2 PRODUCTS

2.1 CONTRACTION JOINT STRIPS

Contraction joint strips shall be 1/8 inch thick tempered hardboard conforming to AHA A135.4, Class 1. In lieu of hardboard strips, rigid polyvinylchloride (PVC) or high impact polystyrene (HIPS) insert strips specifically designed to induce controlled cracking in slabs on grade may be used. Such insert strips shall have removable top section.

2.2 PREFORMED EXPANSION JOINT FILLER

Expansion joint filler shall be preformed material conforming to ASTM D 1751 or ASTM D 1752. Unless otherwise indicated, filler material shall be 3/8 inch thick and of a width applicable for the joint formed. Backer material, when required, shall conform to ASTM D 5249.

2.3 SEALANT

Joint sealant shall conform to the following:

2.3.1 Preformed Polychloroprene Elastomeric Type

ASTM D 2628.

2.3.2 Lubricant for Preformed Compression Seals

ASTM D 2835.

2.3.3 Field-Molded Type

ASTM C 920, Type M for horizontal joints or Type NS for vertical joints, Class 25, and Use NT. Bond breaker material shall be polyethylene tape, coated paper, metal foil or similar type materials. The back-up material shall be compressible, non-shrink, nonreactive with sealant, and non-absorptive material type such as extruded butyl or polychloroprene rubber.

2.4 WATERSTOPS

Intersection and change of direction waterstops shall be shop fabricated.

2.4.1 Non-Metallic Materials`

Non-metallic waterstops shall be manufactured from a prime virgin resin; reclaimed material is not acceptable. The compound shall contain plasticizers, stabilizers, and other additives to meet specified

requirements. Rubber waterstops shall conform to COE CRD-C 513.

2.4.2 Non-Metallic Hydrophilic

Swellable strip type compound of polymer modified chloroprene rubber that swells upon contact with water shall conform to ASTM D 412 as follows: Tensile strength 420 psi minimum; ultimate elongation 600 percent minimum. Hardness shall be 50 minimum on the type A durometer and the volumetric expansion ratio in distilled water at 70 degrees F shall be 3 to 1 minimum.

2.5 COMPRESSION SEALS

Compression seals shall be manufactured from extruded elastomeric neoprene materials or thermo-rubber EPDM materials to blend with the color of the adjacent concrete or brick veneer wall treatment. Neoprene sealer shall meet the requirements of ASTM D 3542, exclusive of recovery and force-deflection material. Sealers made from the EPDM-based material shall meet ASTM D 2000.

PART 3 EXECUTION

3.1 JOINTS

Joints shall be installed at locations indicated and as authorized.

3.1.1 Contraction Joints

Contraction joints may be constructed by inserting tempered hardboard strips or rigid PVC or HIPS insert strips into the plastic concrete using a steel parting bar, when necessary, or by cutting the concrete with a saw after concrete has set. Joints shall be approximately 1/8 inch wide and shall extend into the slab one-fourth the slab thickness, minimum, but not less than 1 inch.

3.1.1.1 Joint Strips

Strips shall be of the required dimensions and as long as practicable. After the first floating, the concrete shall be grooved with a tool at the joint locations. The strips shall be inserted in the groove and depressed until the top edge of the vertical surface is flush with the surface of the slab. The slab shall be floated and finished as specified. Working of the concrete adjacent to the joint shall be the minimum necessary to fill voids and consolidate the concrete. Where indicated, the top portion of the strip shall be sawed out after the curing period to form a recess for sealer. The removable section of PVC or HIPS strips shall be discarded and the insert left in place. True alignment of the strips shall be maintained during insertion.

3.1.1.2 Sawed Joints

Joint sawing shall be early enough to prevent uncontrolled cracking in the slab, but late enough that this can be accomplished without appreciable spalling. Concrete sawing machines shall be adequate in number and power, and with sufficient replacement blades to complete the sawing at the required rate. Joints shall be cut to true alignment and shall be cut in sequence of concrete placement. Sludge and cutting debris shall be removed.

3.1.2 Expansion Joints

Preformed expansion joint filler shall be used in expansion and isolation joints in slabs around columns and between slabs on grade and vertical surfaces where indicated. The filler shall extend the full slab depth, unless otherwise indicated. The edges of the joint shall be neatly finished with an edging tool of 1/8 inch radius, except where a resilient floor surface will be applied. Where the joint is to receive a sealant, the filler strips shall be installed at the proper level below the finished floor with a slightly tapered, dressed and oiled wood strip temporarily secured to the top to form a recess to the size shown on the drawings. The wood strip shall be removed after the concrete has set. Contractor may opt to use a removable expansion filler cap designed and fabricated for this purpose in lieu of the wood strip. The groove shall be thoroughly cleaned of laitance, curing compound, foreign materials, protrusions of hardened concrete, and any dust which shall be blown out of the groove with oil-free compressed air.

3.1.3 Joint Sealant

Sawed contraction joints and expansion joints in slabs shall be filled with joint sealant, unless otherwise shown. Joint surfaces shall be clean, dry, and free of oil or other foreign material which would adversely affect the bond between sealant and concrete. Joint sealant shall be applied as recommended by the manufacturer of the sealant.

3.1.3.1 Joints With Preformed Compression Seals

Compression seals shall be installed with the vacuum equipment capable of installing joint seals to the prescribed depth without cutting, nicking, twisting, or otherwise distorting or damaging the seal or concrete and with no more than 5 percent stretching of the seal. The sides of the joint and, if necessary, the sides of the compression seal shall be covered with a coating of lubricant. Butt joints shall be coated with liberal applications of lubricant.

All surfaces to receive the compression seal profile shall be dry, clean, sound concrete free of loose, cracked, delaminated and spalled sections. Repair any sections that do not meet this criteria. The surfaces to receive the seal shall be sandblasted to exposed aggregate. Sandblasting shall increase surface area to increase bond capacity of the adhesive, and remove all laitance and other bond-inhibiting contaminants.

3.1.3.2 Joints With Field-Molded Sealant

Joints shall not be sealed when the sealant material, ambient air, or concrete temperature is less than 40 degrees F. When the sealants are meant to reduce the sound transmission characteristics of interior walls, ceilings, and floors the guidance provided in ASTM C 919 shall be followed.

Joints requiring a bond breaker shall be coated with curing compound or with bituminous paint. Bond breaker and back-up material shall be installed where required. Joints shall be primed and filled flush with joint sealant in accordance with the manufacturer's recommendations.

3.2 WATERSTOPS, INSTALLATION AND SPLICES

Waterstops shall be installed at the locations shown to form a continuous water-tight diaphragm. Adequate provision shall be made to support and completely protect the waterstops during the progress of the work. Any waterstop punctured or damaged shall be repaired or replaced. Exposed waterstops shall be protected during application of form release agents to

avoid being coated. Suitable guards shall be provided to protect exposed projecting edges and ends of partially embedded waterstops from damage when concrete placement has been discontinued. Splices shall be made by certified trained personnel using approved equipment and procedures.

3.2.1 Rubber Waterstop

Splices shall be vulcanized or shall be made using cold bond adhesive as recommended by the manufacturer. Splices for TPE-R shall be as specified for PVC.

3.2.2 Quality Assurance

Edge welding will not be permitted. Centerbulbs shall be compressed or closed when welding to non-centerbulb type. Waterstop splicing defects which are unacceptable include, but are not limited to the following: 1) Tensile strength less than 80 percent of parent section. 2) Free lap joints. 3) Misalignment of centerbulb, ribs, and end bulbs greater than 1/16 inch. 4) Misalignment which reduces waterstop cross section more than 15 percent. 5) Bond failure at joint deeper than 1/16 inch or 15 percent of material thickness. 6) Misalignment of waterstop splice resulting in misalignment of waterstop in excess of 1/2 inch in 10 feet. 7) Visible porosity in the weld area, including pin holes. 8) Charred or burnt material. 9) Bubbles or inadequate bonding. 10) Visible signs of splice separation when cooled splice is bent by hand at a sharp angle.

3.2.3 Non-Metallic Hydrophilic Waterstop Installation

Ends to be joined shall be miter cut with sharp knife or shears. The ends shall be adhered with cyanacrylate (super glue) adhesive. When joining hydrophilic type waterstop to PVC waterstop, the hydrophilic waterstop shall be positioned as shown on the drawings. A liberal amount of a single component hydrophilic sealant shall be applied to the junction to complete the transition.

3.3 CONSTRUCTION JOINTS

Construction joints are specified in Section 03300 CAST-IN-PLACE STRUCTURAL CONCRETE except that construction joints coinciding with expansion and contraction joints shall be treated as expansion or contraction joints as applicable.

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SECTION 03200

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SECTION 03200
CONCRETE REINFORCEMENT

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 A 53	(1999b) Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A 82	(1997a) Steel Wire, Plain, for Concrete Reinforcement
ASTM A 184/A 184M	(1996) Fabricated Deformed Steel Bar Mats for Concrete Reinforcement
ASTM A 615/A 615M	(1996a _{el}) Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
ASTM A 675/A 675M	(1990a; R 1995 _{el}) Steel Bars, Carbon, Hot-Wrought, Special Quality, Mechanical Properties
ASTM A 706/A 706M	(1998) Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement
ASTM A 767/A 767M	(1997) Zinc-Coated (Galvanized) Steel Bars in Concrete Reinforcement
ASTM A 775/A 775M	(1997 _{el}) Epoxy-Coated Reinforcement Steel Bars

AMERICAN WELDING SOCIETY (AWS)

AWS D1.4	(1998) Structural Welding Code - Reinforcing Steel
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CONCRETE REINFORCING STEEL INSTITUTE (CRSI)

CRSI MSP-1	(1996) Manual of Standard Practice
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1.2 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-01 Data

Welding; FIO

A list of qualified welders names.

SD-04 Drawings

Reinforcement; GA

Detail drawings showing reinforcing steel placement, schedules, sizes, grades, and splicing and bending details. Drawings shall show support details including types, sizes and spacing.

SD-13 Certificates

Reinforcing Steel; FIO

Certified copies of mill reports attesting that the reinforcing steel furnished contains no less than 25 percent recycled scrap steel and meets the requirements specified herein, prior to the installation of reinforcing steel.

Splicing Lap Lengths; FIO

Certified copies of schedules for splice lengths for all reinforcing bars scheduled for different uses and locations including top bars.

1.3 WELDING

Welders shall be qualified in accordance with AWS D1.4. Qualification test shall be performed at the worksite and the Contractor shall notify the Contracting Officer 24 hours prior to conducting tests. Special welding procedures and welders qualified by others may be accepted as permitted by AWS D1.4.

1.4 DELIVERY AND STORAGE

Reinforcement and accessories shall be stored off the ground on platforms, skids, or other supports.

PART 2 PRODUCTS

2.1 DOWELS

Dowels shall conform to ASTM A 675/A 675M, Grade 60. Steel pipe conforming to ASTM A 53, Schedule 80, may be used as dowels provided the ends are closed with metal or plastic inserts or with mortar.

2.2 FABRICATED BAR MATS

Fabricated bar mats shall conform to ASTM A 184/A 184M.

2.3 REINFORCING STEEL

Reinforcing steel shall be deformed bars conforming to ASTM A 615/A 615M or ASTM A 706/A 706M, grades and sizes as indicated. Cold drawn wire used for

spiral reinforcement shall conform to ASTM A 82. In highly corrosive environments or when directed by the Contracting Officer, reinforcing steel shall conform to ASTM A 767/A 767M or ASTM A 775/A 775M as appropriate.

2.4 WIRE TIES

Wire ties shall be 16 gauge or heavier black annealed steel wire.

2.5 SUPPORTS

Bar supports for formed surfaces shall be designed and fabricated in accordance with CRSI MSP-1 and shall be steel or precast concrete blocks. Precast concrete blocks shall have wire ties and shall be not less than 4 inches square when supporting reinforcement on ground. Precast concrete block shall have compressive strength equal to that of the surrounding concrete. Where concrete formed surfaces will be exposed to weather or where surfaces are to be painted, steel supports within 1/2 inch of concrete surface shall be galvanized, plastic protected or of stainless steel. Concrete supports used in concrete exposed to view shall have the same color and texture as the finish surface. For slabs on grade, supports shall be precast concrete blocks, plastic coated steel fabricated with bearing plates, or specifically designed wire-fabric supports fabricated of plastic.

PART 3 EXECUTION

3.1 REINFORCEMENT

Reinforcement shall be fabricated to shapes and dimensions shown and shall conform to the requirements of ACI 318/318R. Reinforcement shall be cold bent unless otherwise authorized. Bending may be accomplished in the field or at the mill. Bars shall not be bent after embedment in concrete. Safety caps shall be placed on all exposed ends of vertical concrete reinforcement bars that pose a danger to life safety. Wire tie ends shall face away from the forms.

3.1.1 Placement

Reinforcement shall be free from loose rust and scale, dirt, oil, or other deleterious coating that could reduce bond with the concrete. Reinforcement shall be placed in accordance with ACI 318/318R at locations shown plus or minus one bar diameter. Reinforcement shall not be continuous through expansion joints and shall be as indicated through construction or contraction joints. Concrete coverage shall be as indicated or as required by ACI 318/318R. If bars are moved more than one bar diameter to avoid interference with other reinforcement, conduits or embedded items, the resulting arrangement of bars, including additional bars required to meet structural requirements, shall be approved before concrete is placed.

3.1.2 Splicing

Splices of reinforcement shall conform to ACI 318/318R and shall be made only as required or indicated. Splicing shall be by lapping, except that lap splices shall not be used for bars larger than No. 11 unless otherwise indicated. Lapped bars shall be placed in contact and securely tied or spaced transversely apart to permit the embedment of the entire surface of each bar in concrete. Lapped bars shall not be spaced farther apart than one-fifth the required length of lap or 6 inches.

3.2 DOWEL INSTALLATION

Dowels shall be installed in slabs on grade at locations indicated and at right angles to joint being doweled. Dowels shall be accurately positioned and aligned parallel to the finished concrete surface before concrete placement. Dowels shall be rigidly supported during concrete placement. One end of dowels shall be coated with a bond breaker.

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SECTION 03300

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SECTION 03300

CAST-IN-PLACE STRUCTURAL CONCRETE

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) Simplified Version of the Recommended Practice for Evaluation of Strength Test Results of Concrete |
| ACI 305R | (1991) 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 31/C 31M | (1998) Making and Curing Concrete Test Specimens in the Field |
| ASTM C 33 | (1999ael) Concrete Aggregates |
| ASTM C 39 | (1996) Compressive Strength of Cylindrical Concrete Specimens |
| ASTM C 42 | (1999) Obtaining and Testing Drilled Cores and Sawed Beams of Concrete |
| ASTM C 78 | (1994) Flexural Strength of Concrete (Using Simple Beam With Third-Point Loading) |
| ASTM C 94 | (1999) Ready-Mixed Concrete |

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ASTM C 136	(1996a) Sieve Analysis of Fine and Coarse Aggregates
ASTM C 143	(1998) 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	(1998) 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	(1998) Air-Entraining Admixtures for Concrete
ASTM C 309	(1998a) Liquid Membrane-Forming Compounds for Curing Concrete
ASTM C 494	(1999) Chemical Admixtures for Concrete
ASTM C 618	(1999) Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Concrete
ASTM C 881	(1999) Epoxy-Resin-Base Bonding Systems for Concrete
ASTM C 937	(1997) Grout Fluidifier for Preplaced-Aggregate Concrete
ASTM C 940	(1998a) Expansion and Bleeding of Freshly Mixed Grouts for Preplaced-Aggregate Concrete in the Laboratory
ASTM C 1017	(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 D 75	(1987; R 1997) Sampling Aggregates
ASTM D 1751	(1999) Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types)
ASTM D 1752	(1984; R 1996e1) Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction

CORPS OF ENGINEERS (COE)

COE CRD-C 94	(1995) Surface Retarders
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 540	(1971; R 1981) Standard Specification for Nonbituminous Inserts for Contraction Joints in Portland Cement Concrete Airfield Pavements, Sawable Type
COE CRD-C 572	(1974) Corps of Engineers Specifications for Polyvinylchloride Waterstop

NATIONAL READY-MIXED CONCRETE ASSOCIATION (NRMCA)

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

1.2 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-01 Data

Mixture Proportions; GA

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-09 Test Reports

Testing and Inspection for Contractor Quality Control; GA

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-13 Certificates

Qualifications; FIO

Written documentation for Contractor Quality Control personnel.

1.3 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.

1.4 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.

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1.4.1 Sample Wall Panels

One sample panel at least 4 feet by 5 feet and 12 inches thick shall be constructed to demonstrate Class A formed finish and a similar one for Class B formed finish. Panels shall be located as coordinated with the City of Grand Forks. Each panel shall include a full length and full width joint line and shall have at least two voids each 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. See Section 03360 SIMULATED STONE MASONRY for further sample wall panel requirements.

1.5 GENERAL REQUIREMENTS

1.5.1 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.

1.5.1.1 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
Very Flat	Same. Use only with F-system

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

1.5.1.2 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	All foundation slabs not exposed to view
Straightedged	All foundation slabs not exposed to view
Float Finish	Pumphouse foundation slabs
Trowel Finish	Pumphouse operation floor slab

1.5.2 Strength Requirements and w/c Ratio

1.5.2.1 Strength Requirements

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

COMPRESSIVE STRENGTH	STRUCTURE OR PORTION OF STRUCTURE
4000 psi at 28 days	All concrete 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. Flexural strength shall be determined in accordance with ASTM C 78.

- 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. 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. 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.

1.5.3 Air Entrainment

Except as otherwise specified for lightweight concrete, 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. Concrete with specified strength over 5000 psi may have 1.0 percent less air than specified above. 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.

1.5.4 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.

Structural Element	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 or when a Type F or G high range water reducing admixture conforming to ASTM C 494 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.

1.5.5 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.

1.5.6 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.

1.5.7 Special Properties and Products

Concrete may contain admixtures other than air entraining agents, such as water reducers, superplasticizers, or set retarding agents to provide special properties to the concrete, if specified or approved. Any of these materials to be used on the project shall be used in the mix design studies.

1.6 MIXTURE PROPORTIONS

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

1.6.1 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. 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, silica fume, and ground granulated blast furnace slag (GGBF slag) by the weight equivalency method as described in ACI 211.1. In the case where silica fume or GGBF slag is used, the weight of the silica fume and 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. 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.

1.6.2 Proportioning Studies for Flexural Strength Concrete

Trial design batches, mixture proportioning studies, and testing requirements shall conform to the requirements specified in paragraph Proportioning Studies for Normal Weight Concrete, except that proportions shall be based on flexural strength as determined by test specimens (beams) fabricated in accordance with ASTM C 192/C 192M and tested in accordance with ASTM C 78. Procedures given in ACI 211.1 shall be modified as necessary to accommodate flexural strength.

1.6.3 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.

1.6.3.1 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:

$$f'_{cr} = f'_c + 1.34S \text{ where units are in psi}$$

$$f'_{cr} = f'_c + 2.33S - 500 \text{ where units are in psi}$$

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

1.6.3.2 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

1.6.4 Average Flexural Strength Required for Mixtures

The mixture proportions selected during mixture design studies for flexural strength mixtures and the mixture used during concrete production shall be designed and adjusted during concrete production as approved, except that the overdesign for average flexural strength shall simply be 15 percent greater than the specified flexural strength at all times.

1.7 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.

1.8 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

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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.

1.8.1 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.

1.8.2 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.

1.8.3 Hardened Concrete

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

1.8.4 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, portland-pozzolan cement, or portland cement in combination with pozzolan or silica fume 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 with a maximum 15 percent amount of tricalcium aluminate, or Type II. White portland cement shall meet the above requirements except that it may be Type I or Type II.

2.1.2 High-Early-Strength Portland Cement

ASTM C 150, Type III with tricalcium aluminate limited to 8 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)

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ASTM C 618, Class C or F with the optional requirements for multiple factor, drying shrinkage, and uniformity from Table 2A of ASTM C 618. Requirement for maximum alkalis from Table 1A of ASTM C 618 shall apply. If pozzolan is used, it shall never be less than 15 percent nor more than 35 percent by weight of the total cementitious material.

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 designation 1-1/2 inches to No. 4.

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, 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, 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, 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.

2.3.7 Other Chemical Admixtures

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Chemical admixtures for use in producing flowing concrete shall comply with ASTM C 1017, Type I or II. These admixtures 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.

2.4 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, and shall be a commercial formulation suitable for the proposed application.

2.7 NONSLIP SURFACING MATERIAL

Nonslip surfacing material shall consist of 55 percent, minimum, aluminum oxide or silicon-dioxide abrasive ceramically bonded together to form a homogeneous material sufficiently porous to provide a good bond with portland cement paste; or factory-graded emery aggregate consisting of not less than 45 percent aluminum oxide and 25 percent ferric oxide. The aggregate shall be well graded from particles retained on the No. 30 sieve to particles passing the No. 8 sieve.

2.8 LATEX BONDING AGENT

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

2.9 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.

2.10 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.

2.11 JOINT MATERIALS

2.11.1 Joint Fillers, Sealers, and Waterstops

Expansion joint fillers shall be preformed materials conforming to ASTM D 1751 or ASTM D 1752. Materials for waterstops shall be in accordance with Section 03150 EXPANSION JOINTS, CONTRACTION JOINTS, AND WATERSTOPS. Materials for and sealing of joints shall conform to the requirements of Section 07900 JOINT SEALING.

2.11.2 Contraction Joints in Slabs

Sawable type contraction joint inserts shall conform to COE CRD-C 540. Nonsawable joint inserts shall have sufficient stiffness to permit placement in plastic concrete without undue deviation from a straight line and shall conform to the physical requirements of COE CRD-C 540, with the exception of Section 3.4 "Resistance to Sawing". Plastic inserts shall be polyvinyl chloride conforming to the materials requirements of COE CRD-C 572.

2.12 FLOWABLE CEMENTITIOUS FILL

Controlled low strength and density fill shall have air content up to 35 percent and 28-day compressive strength between 60 and 200 psi.

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.

3.1.2 Previously Placed Concrete

Concrete surfaces to which additional concrete is to be bonded shall be prepared for receiving the next horizontal lift by cleaning the construction joint surface with either air-water cutting, sandblasting, high-pressure water jet, or other approved method. Concrete at the side of vertical construction joints shall be prepared as approved by the Contracting Officer. Air-water cutting shall not be used on formed surfaces or surfaces congested with reinforcing steel. Regardless of the method used, the resulting surfaces shall be free from all laitance and inferior concrete so that clean surfaces of well bonded coarse aggregate are exposed and make up at least 10-percent of the surface area, distributed uniformly throughout the surface. The edges of the coarse aggregate shall not be undercut. The surface of horizontal construction joints shall be kept continuously wet for the first 12 hours during the 24-hour period prior to placing fresh concrete. The surface shall be washed completely clean as the last operation prior to placing the next lift. For heavy duty floors and two-course floors a thin coat of neat cement grout of about the consistency of thick cream shall be thoroughly scrubbed into the existing surface immediately ahead of the topping placing. The grout shall be a 1:1 mixture of portland cement and sand passing the No. 8 sieve. The topping concrete shall be deposited before the grout coat has had time to stiffen.

3.1.2.1 Air-Water Cutting

Air-water cutting of a fresh concrete surface shall be performed at the proper time and only on horizontal construction joints. The air pressure used in the jet shall be 100 psi plus or minus, 10 psi, and the water pressure shall be just sufficient to bring the water into effective influence of the air pressure. When approved by the Contracting Officer, a surface retarder complying with the requirements of COE CRD-C 94 may be applied to the surface of the lift in order to prolong the period of time during which air-water cutting is effective. After cutting, the surface shall be washed and rinsed as long as there is any trace of cloudiness of the wash water. Where necessary to remove accumulated laitance, coatings, stains, debris, and other foreign material, high-pressure waterjet or sandblasting shall be used as the last operation before placing the next lift.

3.1.2.2 High-Pressure Water Jet

A stream of water under a pressure of not less than 3,000 psi shall be used for cutting and cleaning. Its use shall be delayed until the concrete is sufficiently hard so that only the surface skin or mortar is removed and there is no undercutting of coarse-aggregate particles. If the waterjet is incapable of a satisfactory cleaning, the surface shall be cleaned by sandblasting.

3.1.2.3 Wet Sandblasting

Wet sandblasting shall be used after the concrete has reached sufficient strength to prevent undercutting of the coarse aggregate particles. After wet sandblasting, the surface of the concrete shall then be washed thoroughly to remove all loose materials.

3.1.2.4 Waste Disposal

The method used in disposing of waste water employed in cutting, washing, and rinsing of concrete surfaces shall be such that the waste water does not stain, discolor, or affect exposed surfaces of the structures, or damage the environment of the project area. The method of disposal shall be subject to approval.

3.1.3 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. Welding shall not be performed on embedded metals within 1 feet of the surface of the concrete. Tack welding shall not be performed on or to embedded items.

3.2 CONCRETE PRODUCTION

3.2.1 Batching, Mixing, and Transporting Concrete

Concrete shall either be batched and mixed onsite or shall be furnished from a ready-mixed concrete plant. Ready-mixed concrete shall be batched, mixed, and transported in accordance with ASTM C 94, 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. Site-mixed concrete shall conform to the following subparagraphs.

3.2.1.1 General

The batching plant shall be located off site 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.

3.3 TRANSPORTING CONCRETE TO PROJECT SITE

Concrete shall be transported to the placing site in truck mixers or by approved pumping equipment.

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. 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 segregation 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, 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.

3.6 JOINTS

Joints shall be located and constructed as indicated or approved. Joints not indicated on the drawings shall be located and constructed to minimize the impact on the strength of the structure. 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 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 50 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. 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.

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 or sawing 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 previously specified.

3.6.3 Expansion Joints

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

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 Section 03150 EXPANSION JOINTS, CONTRACTION JOINTS, AND WATERSTOPS.

3.6.5 Dowels and Tie Bars

Dowels and tie bars shall be installed at the locations shown on the drawings and to the details shown, using materials and procedures specified in 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. "Structural" type deformed bar dowels, or tie bars, shall be installed to meet the specified tolerances. Care shall be taken during placing adjacent to and around dowels and tie bars to ensure there is no displacement of the dowel or tie bar and that the concrete completely embeds the dowel or tie bar and is thoroughly consolidated.

3.7 FINISHING FORMED SURFACES

Forms, form materials, and form construction are specified in Section 03100 STRUCTURAL CONCRETE FORMWORK. Finishing of formed surfaces shall be as specified herein and in Section 03360 SIMULATED STONE MASONRY. 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 or B 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 and B Finishes, shall be inconspicuous. Repairs not meeting these requirements will be rejected and shall be replaced.

3.7.1 Class A Finish and Class B Finish

Class A finish is not required anywhere. Class B finish is required in the interior walls of the pumphouse superstructure and the access to the discharge chamber. 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 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 finish is required for the interior walls of the pumphouse substructure and discharge chamber. Class D finish is not required. 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 03360 SIMULATED STONE MASONRY. Special finishes shall conform to the requirements specified herein.

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 and B 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 inches shall 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. Unless specified otherwise, unformed surfaces shall receive only a rough slab finish. 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 Troweled Finish

The pumphouse superstructure floor including the garage area 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 3 4 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.

3.9.4 Non-Slip Finish

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

3.9.4.1 Broomed

Exposed floor areas around the trash rack access and the pumphouse foundation slab shall be given a broomed finish. After floating, the surface shall be lightly steel troweled, and then carefully scored by pulling a 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 CURING AND PROTECTION

3.10.1 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.

3.10.2 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.

3.10.3 Membrane Forming Curing Compounds

Membrane forming curing compounds shall not be used on surfaces in the pumphouse operating floor. Otherwise, concrete may be cured with a pigmented curing compound 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.

3.10.4 Impervious Sheeting

The following concrete surfaces may be cured using impervious sheets: all horizontal surfaces except the pumphouse operating floor. However, except for plastic coated burlap, impervious sheeting alone shall not be used for curing. Impervious-sheet curing shall only be used on horizontal or nearly horizontal surfaces. Surfaces shall be thoroughly wetted and be completely covered with the sheeting. Sheeting shall be at least 18 inches wider than the concrete surface to be covered. Covering shall be laid with light-colored side up. Covering shall be lapped not less than 12 inches and securely weighted down or shall be lapped not less than 4 inches and taped to form a continuous cover with completely closed joints. The sheet shall be weighted to prevent displacement so that it remains in contact with the concrete during the specified length of curing. Coverings shall be folded down over exposed edges of slabs and secured by approved means. Sheets shall be immediately repaired or replaced if tears or holes appear during the curing period.

3.10.5 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 Governmentthe 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.

3.11 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 damp-pack bedding mortar, except where nonshrink grout is indicated. The thickness of the mortar or 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. Nonshrink grout shall be used for pumps and generator equipment.

3.11.1 Damp-Pack Bedding Mortar

Damp-pack bedding mortar shall consist of 1 part cement and 2-1/2 parts

fine aggregate having water content such that a mass of mortar tightly squeezed in the hand will retain its shape but will crumble when disturbed.

The space between the top of the concrete and bottom of the bearing plate or base shall be packed with the bedding mortar by tamping or ramming with a bar or rod until it is completely filled.

3.11.2 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.

3.11.2.1 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 or machinery-bearing surface 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.

3.11.2.2 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.

3.12 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 as it deems necessary thereafter for conformance with ASTM C 1077.

3.12.1 Grading and Corrective Action

3.12.1.1 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.

3.12.1.2 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.

3.12.2 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.

3.12.3 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.

3.12.4 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.

3.12.5 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 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. A set of test specimens for concrete with a 90-day strength per the same paragraph shall consist of six specimens, two tested at 7 days, two at 28 days, and two at 90 days. Test specimens shall be molded and cured in accordance with ASTM C 31/C 31M and tested in accordance with ASTM C 39 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.

3.12.6 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.

3.12.7 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.

3.12.8 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.

3.12.9 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.

3.12.10 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.

3.12.11 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.
- 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. 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.

3.12.12 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.

3.13 FLOWABLE CEMENTITIOUS FILL

The Contractor shall prepare and install fill in strict accordance with manufacturer's instructions. Water content of mix should be adjusted to obtain maximum 3 inches initial slump prior to incorporating admixture. Contractor shall perform trial mixtures as recommended by manufacturer in order to obtain final mix meeting compressive strength and air content percent required. Place fill continuously until the designated work section is filled.

-- End of Section --

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SECTION 03360

SIMULATED STONE MASONRY

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 D 1308	(1987; R 1998) Effect of Household Chemicals on Clear and Pigmented Organic Finishes
ASTM D 3359	(1997) Measuring Adhesion by Tape Test
ASTM G 23	(1996) Operating Light-Exposure Apparatus (Carbon-Arc Type) With and Without Water for Exposure of Nonmetallic Material

1.2 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-04 Drawings

Simulated Stone Masonry; GA

Plan, elevation and details to show overall pattern, joint locations, form tie locations, and end, edge and other special conditions.

SD-14 Samples

Panel; FIO

Within 30 days of receiving the general contract General Contractor is required to submit a 24 inch x 24 inch sample of each the simulated stone masonry finishes. Sample is to demonstrate the finish described in paragraph DESIGN REQUIREMENTS. Approval of sample panel is required by Architect/Engineer and Owner.

Form Ties; FIO

Form ties, sample and description, showing method of separation when forms are removed.

1.3 DESIGN REQUIREMENTS

Design and pattern of the concrete surface shall follow the manufacturer's standard drawing. If an actual stone surface or stone wall to be matched is available, the completed colored and formed concrete surface shall match the natural material as closely as possible. See Section 04200 MASONRY for stone type. Patterning of simulated stone masonry shall appear natural and non-repeating. Seam lines or match lines caused from two of more molds coming together will not be apparent when viewing final wall. Final coloration of cast stone concrete surface shall accurately simulate the appearance of real stone including the multiple colors, shades, flecking, and veining that is apparent in real stone. It shall also demonstrate the colors that may be apparent from aging, such as staining from oxidation, rusting and/or organic staining from soil and/or vegetation. Note that in paragraph SUBMITTAL and Part 3, EXECUTION, a sample and mockup are required. Upon approval by Architect/Engineer and Owner, mockup shall serve as quality standard for the project.

1.4 QUALITY ASSURANCE

Manufacturer of simulated stone masonry molds and custom coloring system shall have 5 years experience making stone masonry molds and color stains to create formed concrete surfaces to match natural stone shapes, surface textures and colors.

Pre-installation meeting: Schedule conference with manufacturer representative to ensure understanding of simulated stone masonry molds use, color application, requirements for construction of mockup, and to coordinate the work.

1.5 PROJECT CONDITIONS

Environmental requirements: Apply color stain when ambient temperatures are between 50 and 100 degrees F. Consult manufacturer if conditions differ from this requirement.

1.6 SEQUENCING

Schedule color stain application with earthwork and backfilling of any wall areas making sure that all simulated stone texture is colored to the minimum distance below grade. Delay adjacent plantings until color application is completed. Coordinate work to permit coloring applications without interference from other trades.

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Simulated Stone Masonry Molds

Reusable, made of high-strength urethane, easily attachable to forms. Molds shall not compress more than 1/4 inch when concrete is poured at rate of 10 vertical feet per hour. Molds shall be removable without causing deterioration of surface or underlying concrete.

- a. Floodwall form liner: Custom Rock Form Liner #11016, Random Cut Stone, as manufactured by Custom Rock International, Scott System, Inc. or approved equal.

b. Obelisk form liner: Custom Rock Form Liner #11016, Random Cut Stone, as manufactured by Custom Rock International, Scott System, Inc. or approved equal.

c. C.I.P. concrete retaining wall form liner: Custom Rock Form Liner #11016, Random Cut Stone, as manufactured by Custom Rock International, Scott System, Inc. or approved equal.

d. C.I.P. concrete terrace form liner: Use Custom Rock Form Liner #1102, Rectangular Cut Stone, as manufactured by Custom Rock International, Scott System, Inc. or approved equal for all exposed vertical surfaces. Use Custom Rock Form Liner #1601, Granite texture mat, as manufactured by Custom Rock International, Scott System, Inc. or approved equal for all exposed horizontal surfaces.

2.1.2 Release Agent

Compatible with simulated stone masonry molds and with color stain system to be applied to surface. Consult manufacturer.

2.1.3 Form Ties

Form ties shall be made of either metal or fiberglass. Using metal ties which result in a portion of the tie permanently embedded in the concrete shall be designed to separate at least 1 inch back from finished surface, leaving only a neat hole that can be plugged with patching material. Contractor shall submit the type of form ties to the Engineer, project designer or Owner for approval prior to use in this work.

2.1.4 Mortar Joints

Joints shall be colored to simulate real mortar.

2.1.5 Color Stain

CRI pigmented stain is a special penetrating stain mix, as provided by manufacturer, and shall achieve color variations present in the natural stone being simulated for this project, as required by Architect/Engineer and Owner as referenced in paragraph DESIGN REQUIREMENTS. Stain shall create a surface finish that is breathable (allowing water vapor transmission), and that resists deterioration from water, acid, alkali, fungi, sunlight or weathering. Stain mix shall be a water borne, low V.O.C. material, less than 289 grams/liter, and shall meet requirements for weathering resistance of 2000 hours accelerated exposure measured by weather-o-meter in accordance with ASTM G 23. Scrub test 1000 revolutions. Abrasive resistance (Tabor-CF-10) 500 cycles. Adhesion ASTM D 3359 1.00MM cross cuts on glass pass 3 or higher on a scale of 1 to 5. Supply information pertaining to chemical resistance ASTM D 1308 to 87.

PART 3 EXECUTION

3.1 ACCEPTABLE INSTALLERS

3.1.1 Formed Concrete Construction

Five years experience pouring vertically formed architectural concrete. Installer shall be trained in manufacturer's special techniques in order to achieve realistic surfaces.

3.1.2 Color Stain System Application

Manufacturer or manufacturer's authorized representative.

3.2 CONSTRUCTION

Mockup: Build on site sixty days before work starts, using same materials, methods and work force that will be used for the project.

Architect/Engineer and Owner will determine specific requirements and location, and whether mockup shall be incorporated into the project.

1. Size: 50 square feet, or larger if needed to adequately illustrate the pattern and texture selected.

2. Include an area to demonstrate wall mold butt joint and if appropriate, continuation of pattern through expansion joint.

3. If design includes stone texture across top of wall, include in mockup.

4. After concrete work on mockup is completed and cured for a minimum of 28 days, and after surface is determined to be acceptable for coloring, apply color stain system.

5. After coloring is determined to be acceptable by the Architect/Engineer and Owner, construction of project may proceed, using mockup as quality standard.

3.3 SPECIAL TECHNIQUES

3.3.1 Forming Textured Concrete

For preparation, clean simulated stone masonry molds and make free of buildup prior to each pour. Inspect for blemishes or tears. Repair if needed following manufacturer's recommendations. Place stone molds with less than 1/4 inch separation between them. Attach molds to form securely following manufacturer's recommendations. Apply form release agent following manufacturers' recommendations. Form stripping and related construction shall avoid creating defects in finished surface. If the pattern selected has molds connecting through the middle of the stones, carefully remove the seam line created by abutting molds. Match the texture and shape of the surrounding stone, avoiding visible seams or mold marks. Place form ties at thinnest points of molds (high points of finished wall). Neatly patch the hole remaining after disengaging the protruding portion of the tie so that it will not be visible after coloring the concrete surface.

Where an expansion joint must occur at a point other than at mortar or rustication joints, such as at the face of concrete texture which is to have the appearance of stone, consult manufacturer for proper treatment of expansion material.

3.3.2 Applying Color Stain System

All simulated stone surfaces that are to be stained and any patching that has been done in these areas shall be at least 30 days old. Clean surface prior to application of stain materials to assure that surface is free of latency, dirt, dust, grease, efflorescence, paint, or other foreign material, following manufacturer's instructions for surface preparation. Do not sandblast. Preferred method to remove latency is pressure washing with

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water, minimum 3000 psi (a rate of 3 to 4 gallons per minute), using fan nozzle perpendicular to and at a distance of 1 or 2 feet from surface. Completed surface shall be free of blemishes, discoloration, surface voids and unnatural form marks.

3.4 PROTECTION

Where exposed soil or pavement is adjacent which may spatter dirt or soil from rainfall, or where surface may be subject to over spray from other processes, provide temporary cover of completed work.

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SECTION 04200

MASONRY

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 A 82	(1997a) Steel Wire, Plain, for Concrete Reinforcement
ASTM A 153/A 153M	(1998) Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A 615/A 615M	(1996ael) Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
ASTM C 67	(1998a) Sampling and Testing Brick and Structural Clay Tile
ASTM C 90	(1998) Loadbearing Concrete Masonry Units
ASTM C 91	(1998) Masonry Cement
ASTM C 216	(1998) Facing Brick (Solid Masonry Units Made from Clay or Shale)
ASTM C 270	(1997ael) Mortar for Unit Masonry
ASTM C 476	(1998) Grout for Masonry
ASTM C 494	(1999) Chemical Admixtures for Concrete
ASTM C 516	(1980) Vermiculite Loose Fill Thermal Insulation
ASTM C 578	(1995) Rigid, Cellular Polystyrene Thermal Insulation
ASTM C 641	(1982; R 1991) Staining Materials in Lightweight Concrete Aggregates
ASTM C 744	(1998) Prefaced Concrete and Calcium Silicate Masonry Units
ASTM C 780	(1996) Preconstruction and Construction Evaluation of Mortars for Plain and Reinforced Unit Masonry

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ASTM C 1072	(1998) Measurement of Masonry Flexural Bond Strength
ASTM C 1289	(1998) Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board
ASTM D 2000	(1999) Rubber Products in Automotive Applications
ASTM D 2240	(1997e1) Rubber Property - Durometer Hardness
ASTM D 2287	(1996) Nonrigid Vinyl Chloride Polymer and Copolymer Molding and Extrusion Compound

1.2 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-01 Data

Clay or Shale Brick; GA
Glass Block Units and Accessories; GA
Burnished Block Masonry Units; GA

Manufacturer's descriptive data.

SD-13 Certificates

Clay or Shale Brick; FIO
Concrete Masonry Units (CMU); FIO
Burnished Block Masonry Units; FIO
Glass Block Units and Accessories; FIO

Certificates of compliance stating that the materials meet the specified requirements.

SD-14 Samples

Stone Items; GA
Glass Block Units and Accessories; GA
Clay or Shale Brick; GA
Burnished Block Masonry Units; GA

Color samples of three stretcher units and one unit for each type of special shape. Units shall show the full range of color and texture.

1.3 DELIVERY, HANDLING, AND STORAGE

Materials shall be delivered, handled, stored, and protected to avoid chipping, breakage, and contact with soil or contaminating material.

1.3.1 Masonry Units

Concrete masonry units shall be covered or protected from inclement weather

and shall conform to the moisture content as specified in ASTM C 90 when delivered to the jobsite. In addition, glass block units and prefaced concrete units shall be stored with their finish surfaces covered. Prefabricated lintels shall be marked on top sides to show either the lintel schedule number or the number and size of top and bottom bars.

1.3.2 Reinforcement, Anchors, and Ties

Steel reinforcing bars, coated anchors, ties, and joint reinforcement shall be stored above the ground. Steel reinforcing bars and uncoated ties shall be free of loose mill scale and rust.

1.3.3 Cementitious Materials, Sand and Aggregates

Cementitious and other packaged materials shall be delivered in unopened containers, plainly marked and labeled with manufacturers' names and brands. Cementitious material shall be stored in dry, weathertight enclosures or be completely covered. Cement shall be handled in a manner that will prevent the inclusion of foreign materials and damage by water or dampness. Sand and aggregates shall be stored in a manner to prevent contamination or segregation.

PART 2 PRODUCTS

2.1 GENERAL REQUIREMENTS

The source of materials which will affect the appearance of the finished work shall not be changed after the work has started except with Contracting Officer's approval.

2.2 CLAY OR SHALE BRICK

Color range and texture of clay or shale brick shall be as indicated and shall conform to the approved sample. Grade SW shall be used for brick in contact with earth or grade and for all exterior work. Brick shall be tested for efflorescence. Clay or shale brick units shall be delivered factory-blended to provide a uniform appearance and color range in the completed wall.

2.2.1 Solid Clay or Shale Brick

Solid clay or shale brick shall conform to ASTM C 216, Type FBS. Brick size shall be utility and the nominal size of the brick used shall be 4 inches thick, 4 inches wide, and 12 inches long. Special 4 inch thick, 4 inches wide and 8 inches long with required as shown on drawings.

2.3 CONCRETE MASONRY UNITS (CMU)

Hollow and solid concrete masonry units shall conform to ASTM C 90, Type I. Cement shall have a low alkali content and be of one brand. The minimum compressive strength (f'm) of the solid and hollow units shall be no less than 1500 psi.

2.3.1 Aggregates

Lightweight aggregates and blends of lightweight and heavier aggregates in proportions used in producing the units, shall comply with the following requirements when tested for stain-producing iron compounds in accordance with ASTM C 641: by visual classification method, the iron stain deposited

on the filter paper shall not exceed the "light stain" classification.

2.3.2 Kinds and Shapes

Units shall be modular in size and shall include closer, jamb, header, lintel, and bond beam units and special shapes and sizes to complete the work as indicated. Units used in exposed masonry surfaces in any one building shall have a uniform fine to medium texture and a uniform color.

2.4 BURNISHED BLOCK MASONRY UNITS

Concrete blocks for grinding shall conform to ASTM C 90, Type 1. The ground surfaces shall have a factory-applied, heat-treated acrylic finish. Units shall conform to requirements of ASTM C 744 with respect to adhesion, abrasion, color change and resistance to crazing and ASTM C 67 with respect to freezing and thawing.

2.5 GLASS BLOCK UNITS AND ACCESSORIES

Glass block units shall be size, type, pattern, and style specified. Units shall be made of clear colorless glass. Pattern shall be clear with 75 percent light transmission allowance. Ventilators and accessories shall be the products manufactured by or as recommended by the glass block manufacturer.

2.5.1 Solid Glass Block Units

Units shall be 7-5/8 inches by 7-5/8 inches by 3 inches.

2.5.2 Horizontal Joint Reinforcement

Joint reinforcement shall be factory fabricated from steel wire, and shall conform to ASTM A 82. Wire shall be zinc coated after fabrication by the hot-dip process conforming to ASTM A 153/A 153M, Class B-2. Reinforcement shall consist of two or more parallel longitudinal wires not lighter than 9 gauge weld connected with cross wires not lighter than 14 gauge at not greater than 8 inches on center. At least one longitudinal wire for each face of glass block shall be provided. Out-to-out dimension of the longitudinal wires shall be 1-1/2 inches less than the actual width of the block. Joint reinforcement in flat sections not less than 8 feet long shall be provided, except that corner reinforcements and other special shapes may be shorter.

2.5.3 Strip Anchor

Perforated steel strip shall be not less than 20 gauge, minimum of 1-3/4 inches wide by 24 inches long and galvanized after fabrication.

2.5.4 Wire-Type Anchor

Steel wire shall be not less than 9 gauge of approved design suitable for use with the panel stiffener provided and galvanized after fabrication.

2.5.5 Expansion Strip

Dense fibrous glass batt or material shall be as recommended by the glass block manufacturer.

2.5.6 Packing (Backer Rods)

Polyethylene foam, neoprene, or filler shall be as recommended by the sealant manufacturer.

2.6 PRECAST CONCRETE ITEMS

Lintels and splashblocks shall be factory-made units from a plant regularly engaged in producing precast concrete units. Unless otherwise indicated, concrete shall be 4,000 psi minimum conforming to Section 03300 CAST-IN-PLACE STRUCTURAL CONCRETE using 1/2 inch to No. 4 nominal-size coarse aggregate, and minimum reinforcement shall be the reinforcement required for handling of the units. Clearance of 3/4 inch shall be maintained between reinforcement and faces of units. Unless precast-concrete items have been subjected during manufacture to saturated-steam pressure of at least 120 pounds per square inch for at least 5 hours, the items, after casting, shall be either damp-cured for 24 hours or steam-cured and shall then be aged under cover for 28 days or longer. Cast-concrete members weighing over 80 pounds shall have built-in loops of galvanized wire or other approved provisions for lifting and anchoring. Units shall have beds and joints at right angles to the face, with sharp true arises and shall be cast with drip grooves on the underside where units overhang walls. Exposed-to-view surfaces shall be free of surface voids, spalls, cracks, and chipped or broken edges. Precast units exposed-to-view shall be of uniform appearance and color. Unless otherwise specified, units shall have a smooth dense finish. Prior to use, each item shall be wetted and inspected for crazing. Items showing evidence of dusting, spalling, crazing, or having surfaces treated with a protective coating will be rejected.

2.6.1 Lintels

Precast lintels, unless otherwise shown, shall be of a thickness equal to the wall and reinforced with two No. 4 bars for the full length. Top of lintels shall be labeled "TOP" or otherwise identified and each lintel shall be clearly marked to show location in the structure.

2.6.2 Splash Blocks

Splash blocks shall be as detailed. Reinforcement shall be the manufacturer's standard.

2.7 STONE ITEMS

Cut stone shall be Minnesota Dolamitic Limestone and shall be cut to the design shown. Limestone shall be Northern Buff Minnesota Stone. Stone shall have a smooth machine finish free from tool marks.

Split faced stone shall be Minnesota Dolamitic Limestone with Northern Valley Stone pattern with straight coursed 7-1/2 inch height in buff blended colors.

2.8 MORTAR

Mortar shall be Type N in accordance with the proportion specification of ASTM C 270 except Type N cement-lime mortar proportions shall be 1 part cement, 1 part lime and 6 parts aggregate; when masonry cement ASTM C 91 is used the maximum air content shall be limited to 12 percent and performance equal to cement-lime mortar shall be verified. Verification of masonry cement performance shall be based on ASTM C 780 and ASTM C 1072. Cement

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shall have a low alkali content and be of one brand. Aggregates shall be from one source.

2.8.1 Mortar Admixtures

In cold weather, a non-chloride based accelerating admixture may be used subject to approval. Accelerating admixture shall be non-corrosive, shall contain less than 0.2 percent chlorides, and shall conform to ASTM C 494, Type C.

2.8.2 Coloring

Mortar coloring shall be added to the mortar used for exposed masonry surfaces to produce a uniform color. Mortar coloring shall not exceed 3 percent of the weight of cement for carbon black and ten percent of the weight of cement for all other pigments. Mortar coloring shall be chemically inert, of finely ground limeproof pigment, and furnished in accurately pre-measured and packaged units that can be added to a measured amount of cement.

2.9 GROUT

Grout shall conform to ASTM C 476. Cement used in grout shall have a low alkali content. Grout slump shall be between 8 and 10 inches. Grout shall be used subject to the limitations of Table III. Proportions shall not be changed and materials with different physical or chemical characteristics shall not be used in grout for the work unless additional evidence is furnished that the grout meets the specified requirements.

2.9.1 Grout Admixtures

In cold weather, a non-chloride based accelerating admixture may be used subject to approval. Accelerating admixture shall be non-corrosive, shall contain less than 0.2 percent chlorides, and shall conform to ASTM C 494, Type C.

2.9.2 Grout Barriers

Grout barriers for vertical cores shall consist of fine mesh wire, fiberglass, or expanded metal.

2.10 ANCHORS, TIES, AND BAR POSITIONERS

Anchors and ties shall be fabricated without drips or crimps and shall be zinc-coated in accordance with ASTM A 153/A 153M, Class B-2. Steel wire used for anchors and ties shall be fabricated from steel wire conforming to ASTM A 82. Anchors and ties shall be sized to provide a minimum of 5/8 inch mortar cover from either face.

2.10.1 Wall Ties

Wall ties shall be rectangular-shaped or Z-shaped fabricated of 3/16 inch diameter zinc-coated steel wire. Rectangular wall ties shall be no less than 4 inches wide. Wall ties may also be of a continuous type conforming to paragraph JOINT REINFORCEMENT. Adjustable type wall ties, if approved for use, shall consist of two essentially U-shaped elements fabricated of 3/16 inch diameter zinc-coated steel wire. Adjustable ties shall be of the double pintle to eye type and shall allow a maximum of 1/2 inch eccentricity between each element of the tie. Play between pintle and eye

opening shall be not more than 1/16 inch. The pintle and eye elements shall be formed so that both can be in the same plane.

2.10.2 Dovetail Anchors

Dovetail anchors shall be of the flexible wire type, 3/16 inch diameter zinc-coated steel wire, triangular shaped, and attached to a 12 gauge or heavier steel dovetail section. These anchors shall be used for anchorage of veneer wythes or composite-wall facings extending over the face of concrete columns, beams, or walls. Cells within vertical planes of these anchors shall be filled solid with grout for full height of walls or partitions, or solid units may be used. Dovetail slots are specified in Section 03300 CAST-IN-PLACE STRUCTURAL CONCRETE.

2.10.3 Bar Positioners

Bar positioners, used to prevent displacement of reinforcing bars during the course of construction, shall be factory fabricated from 9 gauge steel wire or equivalent, and coated with a hot-dip galvanized finish. Not more than one wire shall cross the cell.

2.11 JOINT REINFORCEMENT

Joint reinforcement shall be factory fabricated from steel wire conforming to ASTM A 82, welded construction. Tack welding will not be acceptable in reinforcement used for wall ties. Wire shall have zinc coating conforming to ASTM A 153/A 153M, Class B-2. All wires shall be a minimum of 9 gauge. Reinforcement shall be ladder type design, having one longitudinal wire in the mortar bed of each face shell for hollow units and one wire for solid units. Joint reinforcement shall be placed a minimum of 5/8 inch cover from either face. The distance between crosswires shall not exceed 16 inches. Joint reinforcement for straight runs shall be furnished in flat sections not less than 10 feet long. Joint reinforcement shall be provided with factory formed corners and intersections. If approved for use, joint reinforcement may be furnished with adjustable wall tie features.

2.12 REINFORCING STEEL BARS AND RODS

Reinforcing steel bars and rods shall conform to ASTM A 615/A 615M, Grade 60.

2.13 CONTROL JOINT KEYS

Control joint keys shall be a factory fabricated solid section of natural or synthetic rubber (or combination thereof) conforming to ASTM D 2000 or polyvinyl chloride conforming to ASTM D 2287. The material shall be resistant to oils and solvents. The control joint key shall be provided with a solid shear section not less than 5/8 inch thick and 3/8 inch thick flanges, with a tolerance of plus or minus 1/16 inch. The control joint key shall fit neatly, but without forcing, in masonry unit jamb sash grooves. The control joint key shall be flexible at a temperature of minus 30 degrees F after five hours exposure, and shall have a durometer hardness of not less than 70 when tested in accordance with ASTM D 2240.

2.14 EXPANSION-JOINT MATERIALS

Backer rod and sealant shall be adequate to accommodate joint compression equal to 50 percent of the width of the joint. The backer rod shall be compressible rod stock of polyethylene foam, polyurethane foam, butyl

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rubber foam, or other flexible, nonabsorptive material as recommended by the sealant manufacturer. Sealant shall conform to Section 07900JOINT SEALING.

2.15 INSULATION

2.15.1 Rigid Board-Type Insulation

Rigid board-type insulation shall be extruded polystyrene, polyurethane, or polyisocyanurate. Polystyrene shall conform to ASTM C 578. Polyurethane or polyisocyanurate shall conform to ASTM C 1289, Type I, Class 2, faced with aluminum foil on both sides of the foam. The insulation shall be a standard product and shall be marked with not less than the manufacturer's trademark or name, the specification number, the permeance and R-values.

2.15.1.1 Insulation Thickness and Air Space

The cavity space shall allow for a maximum insulation thickness of 1.5 inches, and a minimum air space of 1 inch.

2.15.1.2 Aged R-Value

The insulation shall provide a minimum aged R-value of 7.5 for the overall thickness. The aged R-value shall be determined at 75 degrees F in accordance with the appropriate referenced specification. The stated R-value of the insulation shall be certified by an independent testing laboratory or certified by an independent Registered Professional Engineer if tests are conducted in the manufacturer's laboratory.

2.15.1.3 Recovered Material

Insulation shall contain the highest practicable percentage of recovered material derived from solid waste (but material reused in the manufacturing process cannot be counted toward the percentage of recovered material). Where two materials have the same price and performance, the one containing the higher recovered material content shall be provided. The polyurethane or polyisocyanurate foam shall have a minimum recovered material content of 9 percent by weight of the core material.

2.15.2 Insulation Adhesive

Insulation adhesive shall be specifically prepared to adhere the insulation to the masonry and, where applicable, to the thru-wall flashing. The adhesive shall not deleteriously affect the insulation, and shall have a record of satisfactory and proven performance for the conditions under which to be used.

2.16 MASONRY CORE FILL INSULATION

Core fill insulation shall be a lightweight, free-flowing inorganic vermiculite, specially treated for water repellancy and a dry loose weight of 4.5-7.0 pcf and capable of supporting its own weight. Insulation shall meet requirements of ASTM C 516, Type II.

2.17 FLASHING

Flashing shall be as specified in Section 07600 SHEET METALWORK, GENERAL.

2.18 WEEP HOLE VENTILATORS

Weephole ventilators shall be prefabricated aluminum grill type vents designed to prevent insect entry with maximum air entry. Ventilators shall be sized to match modular construction with a standard 3/8 inch mortar joint.

PART 3 EXECUTION

3.1 ENVIRONMENTAL REQUIREMENTS

3.1.1 Hot Weather Installation

The following precautions shall be taken if masonry is erected when the ambient air temperature is more than 99 degrees F in the shade and the relative humidity is less than 50 percent. All masonry materials shall be shaded from direct sunlight; mortar beds shall be spread no more than 4 feet ahead of masonry; masonry units shall be set within one minute of spreading mortar; and after erection, masonry shall be protected from direct exposure to wind and sun for 48 hours.

3.1.2 Cold Weather Installation

Before erecting masonry when ambient temperature or mean daily air temperature falls below 40 degrees F, a written statement of proposed cold weather construction procedures shall be submitted for approval. The following precautions shall be taken during all cold weather erection.

3.1.2.1 Preparation

Ice or snow formed on the masonry bed shall be thawed by the application of heat. Heat shall be applied carefully until the top surface of the masonry is dry to the touch. Sections of masonry deemed frozen and damaged shall be removed before continuing construction of those sections.

- a. Air Temperature 40 to 32 Degrees F. Sand or mixing water shall be heated to produce mortar temperatures between 40 degrees F and 120 degrees F.
- b. Air Temperature 32 to 25 Degrees F. Sand and mixing water shall be heated to produce mortar temperatures between 40 degrees F and 120 degrees F. Temperature of mortar on boards shall be maintained above freezing.
- c. Air Temperature 25 to 20 Degrees F. Sand and mixing water shall be heated to provide mortar temperatures between 40 degrees F and 120 degrees F. Temperature of mortar on boards shall be maintained above freezing. Sources of heat shall be used on both sides of walls under construction. Windbreaks shall be employed when wind is in excess of 15 mph.
- d. Air Temperature 20 Degrees F and below. Sand and mixing water shall be heated to provide mortar temperatures between 40 degrees F and 120 degrees F. Enclosure and auxiliary heat shall be provided to maintain air temperature above 32 degrees F. Temperature of units when laid shall not be less than 20 degrees F.

3.1.2.2 Completed Masonry and Masonry Not Being Worked On

- a. Mean daily air temperature 40 degrees F to 32 degrees F. Masonry

shall be protected from rain or snow for 24 hours by covering with weather-resistive membrane.

- b. Mean daily air temperature 32 degrees F to 25 degrees F. Masonry shall be completely covered with weather-resistant membrane for 24 hours.
- c. Mean Daily Air Temperature 25 Degrees F to 20 Degrees F. Masonry shall be completely covered with insulating blankets or equally protected for 24 hours.
- d. Mean Daily Temperature 20 Degrees F and Below. Masonry temperature shall be maintained above 32 degrees F for 24 hours by enclosure and supplementary heat, by electric heating blankets, infrared heat lamps, or other approved methods.

3.1.2.3 Glass Block Requirements

Glass block shall not be laid when the air temperature is below 40 degrees F on a falling thermometer, or when it appears probable that temperatures below 40 degrees F will be encountered before the mortar has set, unless adequate means are provided for protecting the work from freezing. Protection shall consist of heating and maintaining the temperature of the glass block and mortar materials at not less than 40 degrees F and not more than 160 degrees F. After erection, an air temperature above 40 degrees F on both sides of the glass block shall be maintained for not less than 72 hours. Work will not be permitted with or on frozen materials. Glass block work may be started at 34 degrees F on a rising thermometer.

3.2 LAYING MASONRY UNITS

Masonry units shall be laid in running bond pattern. Facing courses shall be level with back-up courses, unless the use of adjustable ties has been approved in which case the tolerances shall be plus or minus 1/2 inch. Each unit shall be adjusted to its final position while mortar is still soft and plastic. Units that have been disturbed after the mortar has stiffened shall be removed, cleaned, and relaid with fresh mortar. Air spaces, cavities, chases, expansion joints, and spaces to be grouted shall be kept free from mortar and other debris. Units used in exposed masonry surfaces shall be selected from those having the least amount of chipped edges or other imperfections detracting from the appearance of the finished work. Vertical joints shall be kept plumb. Units being laid and surfaces to receive units shall be free of water film and frost. Solid units shall be laid in a nonfurrowed full bed of mortar. Mortar for veneer wythes shall be beveled and sloped toward the center of the wythe from the cavity side. Units shall be shoved into place so that the vertical joints are tight. Vertical joints of brick and the vertical face shells of concrete masonry units, except where indicated at control, expansion, and isolation joints, shall be completely filled with mortar. Mortar will be permitted to protrude up to 1/2 inch into the space or cells to be grouted. Means shall be provided to prevent mortar from dropping into the space below. In double wythe construction, the inner wythe may be brought up not more than 16 inches ahead of the outer wythe. Collar joints shall be filled with mortar or grout during the laying of the facing wythe, and filling shall not lag the laying of the facing wythe by more than 8 inches.

3.2.1 Surface Preparation

Surfaces upon which masonry is placed shall be cleaned of laitance, dust,

dirt, oil, organic matter, or other foreign materials and shall be slightly roughened to provide a surface texture with a depth of at least 1/8 inch. Sandblasting shall be used, if necessary, to remove laitance from pores and to expose the aggregate.

3.2.2 Forms and Shores

Forms and shores shall be sufficiently rigid to prevent deflections which may result in cracking or other damage to supported masonry and sufficiently tight to prevent leakage of mortar and grout. Supporting forms and shores shall not be removed in less than 10 days.

3.2.3 Concrete Masonry Units

Units in piers, pilasters, columns, starting courses on footings, solid foundation walls, lintels, and beams, and where cells are to be filled with grout shall be full bedded in mortar under both face shells and webs. Other units shall be full bedded under both face shells. Head joints shall be filled solidly with mortar for a distance in from the face of the unit not less than the thickness of the face shell. Foundation walls below grade shall be grouted solid. Jamb units shall be of the shapes and sizes to conform with wall units. Solid units may be incorporated in the masonry work where necessary to fill out at corners, gable slopes, and elsewhere as approved. Double walls shall be stiffened at wall-mounted plumbing fixtures by use of strap anchors, two above each fixture and two below each fixture, located to avoid pipe runs, and extending from center to center of the double wall. Walls and partitions shall be adequately reinforced for support of wall-hung plumbing fixtures when chair carriers are not specified.

3.2.4 Clay or Shale Brick Units

Brick facing shall be laid with the better face exposed. Brick shall be laid in running bond with each course bonded at corners, unless otherwise indicated. Molded brick shall be laid with the frog side down. Brick that is cored, recessed, or has other deformations may be used in sills, treads, soldier courses, except where deformations will be exposed to view.

3.2.4.1 Wetting of Units

Wetting of clay, shale brick, or hollow brick units having an initial rate of absorption of more than 1 gram per minute per square inch of bed surface shall be in conformance with ASTM C 67. The method of wetting shall ensure that each unit is nearly saturated but surface dry when laid.

3.2.4.2 Solid Units

Bed, head, and collar joints shall be completely filled with mortar.

3.2.4.3 Hollow Units

Hollow units shall be laid as specified for concrete masonry units.

3.2.5 Tolerances

Masonry shall be laid plumb, true to line, with courses level. Bond pattern shall be kept plumb throughout. Corners shall be square unless noted otherwise. Except for walls constructed of prefaced concrete masonry units, masonry shall be laid within the following tolerances (plus or minus

unless otherwise noted):

TABLE II
TOLERANCES

Variation from the plumb in the lines
and surfaces of columns, walls and arises

In adjacent masonry units	1/8 inch
In 10 feet	1/4 inch
In 20 feet	3/8 inch
In 40 feet or more	1/2 inch

Variations from the plumb for external corners,
expansion joints, and other conspicuous lines

In 20 feet	1/4 inch
In 40 feet or more	1/2 inch

Variations from the level for exposed lintels,
sills, parapets, horizontal grooves, and other
conspicuous lines

In 20 feet	1/4 inch
In 40 feet or more	1/2 inch

Variation from level for bed joints and top
surfaces of bearing walls

In 10 feet	1/4 inch
In 40 feet or more	1/2 inch

Variations from horizontal lines

In 10 feet	1/4 inch
In 20 feet	3/8 inch
In 40 feet or more	1/2 inch

Variations in cross sectional dimensions of
columns and in thickness of walls

Minus	1/4 inch
Plus	1/2 inch

3.2.6 Cutting and Fitting

Full units of the proper size shall be used wherever possible, in lieu of cut units. Cutting and fitting, including that required to accommodate the work of others, shall be done by masonry mechanics using power masonry saws. Concrete masonry units may be wet or dry cut. Wet cut units, before being placed in the work, shall be dried to the same surface-dry appearance as uncut units being laid in the wall. Cut edges shall be clean, true and

sharp. Openings in the masonry shall be made carefully so that wall plates, cover plates or escutcheons required by the installation will completely conceal the openings and will have bottoms parallel with the masonry bed joints. Reinforced masonry lintels shall be provided above openings over 12 inches wide for pipes, ducts, cable trays, and other wall penetrations, unless steel sleeves are used.

3.2.7 Jointing

Joints shall be tooled when the mortar is thumbprint hard. Horizontal joints shall be tooled last. Joints shall be brushed to remove all loose and excess mortar. Mortar joints shall be finished as follows:

3.2.7.1 Flush Joints

Joints in concealed masonry surfaces and joints at electrical outlet boxes in wet areas shall be flush cut. Flush cut joints shall be made by cutting off the mortar flush with the face of the wall.

3.2.7.2 Tooled Joints

Joints in exposed exterior and interior masonry surfaces shall be tooled slightly concave. Joints shall be tooled with a jointer slightly larger than the joint width so that complete contact is made along the edges of the unit. Tooling shall be performed so that the mortar is compressed and the joint surface is sealed. Jointer of sufficient length shall be used to obtain a straight and true mortar joint.

3.2.7.3 Door and Window Frame Joints

On the exposed interior side of exterior frames, joints between frames and abutting masonry walls shall be raked to a depth of 3/8 inch. On the exterior side of exterior frames, joints between frames and abutting masonry walls shall be raked to a depth of 3/8 inch.

3.2.8 Joint Widths

Joint widths shall be as follows:

3.2.8.1 Concrete Masonry Units

Concrete masonry units shall have 3/8 inch joints.

3.2.8.2 Brick

Brick joint widths shall be the difference between the actual and nominal dimensions of the brick in either height or length. Brick expansion joint widths shall be as shown.

3.2.9 Embedded Items

Spaces around built-in items shall be filled with mortar. Openings around flush-mount electrical outlet boxes in wet locations shall be pointed with mortar. Anchors, ties, wall plugs, accessories, flashing, pipe sleeves and other items required to be built-in shall be embedded as the masonry work progresses. Anchors, ties and joint reinforcement shall be fully embedded in the mortar. Cells receiving anchor bolts and cells of the first course below bearing plates shall be filled with grout.

3.2.10 Unfinished Work

Unfinished work shall be stepped back for joining with new work. Tothing may be resorted to only when specifically approved. Loose mortar shall be removed and the exposed joints shall be thoroughly cleaned before laying new work.

3.2.11 Masonry Wall Intersections

Each course shall be masonry bonded at corners and elsewhere as shown. Masonry walls shall be anchored or tied together at corners and intersections with bond beam reinforcement and prefabricated corner or tee pieces of joint reinforcement as shown.

3.3 ANCHORED VENEER CONSTRUCTION

The inner and outer wythes shall be completely separated by a continuous airspace as shown on the drawings. Both the inner and the outer wythes shall be laid up together except when adjustable joint reinforcement assemblies are approved for use. When both wythes are not brought up together, through-wall flashings shall be protected from damage until they are fully enclosed in the wall. The airspace between the wythes shall be kept clear and free of mortar droppings by temporary wood strips laid on the wall ties and carefully lifted out before placing the next row of ties.

A coarse gravel or drainage material shall be placed behind the weep holes in the cavity to a minimum depth of 4 inches of coarse aggregate or 10 inches of drainage material to keep mortar droppings from plugging the weep holes.

3.4 WEEP HOLES

Weep holes shall be provided not more than 24 inches on centers in mortar joints of the exterior wythe above wall flashing, over foundations, bond beams, and any other horizontal interruptions of the cavity. Weep holes shall be constructed using weep hole ventilators. Other approved methods may be used for providing weep holes. Weep holes shall be kept free of mortar and other obstructions.

3.5 COMPOSITE WALLS

Masonry wythes shall be tied together with joint reinforcement or with unit wall ties. Facing shall be anchored to concrete backing with wire dovetail anchors set in slots built in the face of the concrete as specified in Section 03300 CAST-IN-PLACE STRUCTURAL CONCRETE. The facing wythe shall be anchored or tied to the backup at a maximum spacing of 16 inches on center vertically and 24 inches on center horizontally. Unit ties shall be spaced not over 24 inches on centers horizontally, in courses not over 16 inches apart vertically, staggered in alternate courses. Ties shall be laid not closer than 5/8 inch to either masonry face. Ties shall not extend through control joints. Collar joints between masonry facing and masonry backup shall be filled solidly with grout.

3.6 MORTAR

Mortar shall be mixed in a mechanically operated mortar mixer for at least 3 minutes, but not more than 5 minutes. Measurement of ingredients for mortar shall be by volume. Ingredients not in containers, such as sand, shall be accurately measured by the use of measuring boxes. Water shall be mixed with the dry ingredients in sufficient amount to provide a workable

mixture which will adhere to the vertical surfaces of masonry units. Mortar that has stiffened because of loss of water through evaporation shall be retempered by adding water to restore the proper consistency and workability. Mortar that has reached its initial set or that has not been used within 2-1/2 hours after mixing shall be discarded.

3.7 REINFORCING STEEL

Reinforcement shall be cleaned of loose, flaky rust, scale, grease, mortar, grout, or other coating which might destroy or reduce its bond prior to placing grout. Bars with kinks or bends not shown on the drawings shall not be used. Reinforcement shall be placed prior to grouting. Unless otherwise indicated, vertical wall reinforcement shall extend to within 2 inches of tops of walls.

3.7.1 Positioning Bars

Vertical bars shall be accurately placed within the cells at the positions indicated on the drawings. A minimum clearance of 1/2 inch shall be maintained between the bars and masonry units. Minimum clearance between parallel bars shall be one diameter of the reinforcement. Vertical reinforcing may be held in place using bar positioners located near the ends of each bar and at intermediate intervals of not more than 192 diameters of the reinforcement. Column and pilaster ties shall be wired in position around the vertical steel. Ties shall be in contact with the vertical reinforcement and shall not be placed in horizontal bed joints.

3.7.2 Splices

Bars shall be lapped a minimum of 48 diameters of the reinforcement. Welded or mechanical connections shall develop at least 125 percent of the specified yield strength of the reinforcement.

3.8 JOINT REINFORCEMENT

Joint reinforcement shall be installed at 16 inches on center or as indicated. Reinforcement shall be lapped not less than 6 inches. Prefabricated sections shall be installed at corners and wall intersections. The longitudinal wires of joint reinforcement shall be placed to provide not less than 5/8 inch cover to either face of the unit.

3.9 PLACING GROUT

Cells containing reinforcing bars shall be filled with grout. Hollow masonry units in walls or partitions supporting plumbing, heating, or other mechanical fixtures, voids at door and window jambs, and other indicated spaces shall be filled solid with grout. Cells under lintel bearings on each side of openings shall be filled solid with grout for full height of openings. Walls below grade, lintels, and bond beams shall be filled solid with grout. Units other than open end units may require grouting each course to preclude voids in the units. Grout not in place within 1-1/2 hours after water is first added to the batch shall be discarded. Sufficient time shall be allowed between grout lifts to preclude displacement or cracking of face shells of masonry units. If blowouts, flowouts, misalignment, or cracking of face shells should occur during construction, the wall shall be torn down and rebuilt.

3.9.1 Horizontal Grout Barriers

Grout barriers shall be embedded in mortar below cells of hollow units receiving grout.

3.9.2 Cleanouts

3.9.2.1 Cleanouts for Hollow Unit Masonry Construction

Cleanout holes shall be provided at the bottom of every pour in cores containing vertical reinforcement when the height of the grout pour exceeds 5 feet. Where all cells are to be grouted, cleanout courses shall be constructed using bond beam units in an inverted position to permit cleaning of all cells. Cleanout holes shall be provided at a maximum spacing of 32 inches where all cells are to be filled with grout. A new series of cleanouts shall be established if grouting operations are stopped for more than 4 hours. Cleanouts shall not be less than 3 by 4 inch openings cut from one face shell. Manufacturer's standard cutout units may be used at the Contractor's option. Cleanout holes shall not be closed until masonry work, reinforcement, and final cleaning of the grout spaces have been completed and inspected. For walls which will be exposed to view, cleanout holes shall be closed in an approved manner to match surrounding masonry.

3.9.3 Grouting Equipment

3.9.3.1 Grout Pumps

Pumping through aluminum tubes will not be permitted. Pumps shall be operated to produce a continuous stream of grout without air pockets, segregation, or contamination. Upon completion of each day's pumping, waste materials and debris shall be removed from the equipment, and disposed of outside the masonry.

3.9.3.2 Vibrators

Internal vibrators shall maintain a speed of not less than 5,000 impulses per minute when submerged in the grout. At least one spare vibrator shall be maintained at the site at all times. Vibrators shall be applied at uniformly spaced points not further apart than the visible effectiveness of the machine. Duration of vibration shall be limited to time necessary to produce satisfactory consolidation without causing segregation.

3.9.4 Grout Placement

Masonry shall be laid to the top of a pour before placing grout. Grout shall not be placed in two-wythe solid unit masonry cavity until mortar joints have set for at least 3 days during hot weather and 5 days during cold damp weather. Grout shall not be placed in hollow unit masonry until mortar joints have set for at least 24 hours. Grout shall be placed using a hand bucket, concrete hopper, or grout pump to completely fill the grout spaces without segregation of the aggregates. Vibrators shall not be inserted into lower pours that are in a semi-solidified state. The height of grout pours and type of grout used shall be limited by the dimensions of grout spaces as indicated in Table III. Low-lift grout methods may be used on pours up to and including 5 feet in height. High-lift grout methods shall be used on pours exceeding 5 feet in height.

3.9.4.1 Low-Lift Method

Grout shall be placed at a rate that will not cause displacement of the

masonry due to hydrostatic pressure of the grout. Mortar protruding more than 1/2 inch into the grout space shall be removed before beginning the grouting operation. Grout pours 12 inches or less in height shall be consolidated by mechanical vibration or by puddling. Grout pours over 12 inches in height shall be consolidated by mechanical vibration and reconsolidated by mechanical vibration after initial water loss and settlement has occurred. Vibrators shall not be inserted into lower pours that are in a semi-solidified state. Low-lift grout shall be used subject to the limitations of Table III.

3.9.4.2 High-Lift Method

Mortar droppings shall be cleaned from the bottom of the grout space and from reinforcing steel. Mortar protruding more than 1/4 inch into the grout space shall be removed by dislodging the projections with a rod or stick as the work progresses. Reinforcing, bolts, and embedded connections shall be rigidly held in position before grouting is started. CMU units shall not be pre-wetted. Grout, from the mixer to the point of deposit in the grout space shall be placed as rapidly as practical by pumping and placing methods which will prevent segregation of the mix and cause a minimum of grout splatter on reinforcing and masonry surfaces not being immediately encased in the grout lift. The individual lifts of grout shall be limited to 4 feet in height. The first lift of grout shall be placed to a uniform height within the pour section and vibrated thoroughly to fill all voids. This first vibration shall follow immediately behind the pouring of the grout using an approved mechanical vibrator. After a waiting period sufficient to permit the grout to become plastic, but before it has taken any set, the succeeding lift shall be poured and vibrated 12 to 18 inches into the preceding lift. If the placing of the succeeding lift is going to be delayed beyond the period of workability of the preceding, each lift shall be reconsolidated by reworking with a second vibrator as soon as the grout has taken its settlement shrinkage. The waiting, pouring, and reconsolidation steps shall be repeated until the top of the pour is reached. The top lift shall be reconsolidated after the required waiting period. The high-lift grouting of any section of wall between vertical grout barriers shall be completed to the top of a pour in one working day unless a new series of cleanout holes is established and the resulting horizontal construction joint cleaned. High-lift grout shall be used subject to the limitations in Table III.

TABLE III

POUR HEIGHT AND TYPE OF GROUT FOR VARIOUS GROUT SPACE DIMENSIONS

Maximum Grout Pour Height (feet) (4)	Grout Type	Grouting Procedure	Minimum Dimensions of the Total Clear Areas Within Grout Spaces and Cells (in.) (1,2)	
			Multiwythe Masonry (3)	Hollow-unit Masonry
1	Fine	Low Lift	3/4	1-1/2 x 2
5	Fine	Low Lift	2	2 x 3
8	Fine	High Lift	2	2 x 3
12	Fine	High Lift	2-1/2	2-1/2 x 3
24	Fine	High Lift	3	3 x 3
1	Coarse	Low Lift	1-1/2	1-1/2 x 3
5	Coarse	Low Lift	2	2-1/2 x 3

TABLE III

POUR HEIGHT AND TYPE OF GROUT FOR VARIOUS GROUT SPACE DIMENSIONS

Maximum Grout Pour Height (feet) (4)	Grout Type	Grouting Procedure	Minimum Dimensions of the Total Clear Areas Within Grout Spaces and Cells (in.) (1,2)	
			Multiwythe Masonry (3)	Hollow-unit Masonry
8	Coarse	High Lift	2	3 x 3
12	Coarse	High Lift	2-1/2	3 x 3
24	Coarse	High Lift	3	3 x 4

Notes:

- (1) The actual grout space or cell dimension must be larger than the sum of the following items:
 - a) The required minimum dimensions of total clear areas given in the table above;
 - b) The width of any mortar projections within the space;
 - c) The horizontal projections of the diameters of the horizontal reinforcing bars within a cross section of the grout space or cell.
- (2) The minimum dimensions of the total clear areas shall be made up of one or more open areas, with at least one area being 3/4 inch or greater in width.
- (3) For grouting spaces between masonry wythes.
- (4) Where only cells of hollow masonry units containing reinforcement are grouted, the maximum height of the pour shall not exceed the distance between horizontal bond beams.

3.10 BOND BEAMS

Bond beams shall be filled with grout and reinforced as indicated on the drawings. Grout barriers shall be installed under bond beam units to retain the grout as required. Reinforcement shall be continuous, including around corners, except through control joints or expansion joints, unless otherwise indicated on the drawings. Where splices are required for continuity, reinforcement shall be lapped 48 bar diameters. A minimum clearance of 1/2 inch shall be maintained between reinforcement and interior faces of units.

3.11 CONTROL JOINTS

Control joints shall be provided as indicated and shall be constructed by using sash jamb units with control joint key in accordance with the details shown on the drawings. Sash jamb units shall have a 3/4 by 3/4 inch groove near the center at end of each unit. The vertical mortar joint at control joint locations shall be continuous, including through all bond beams. This shall be accomplished by utilizing half blocks in alternating courses on each side of the joint. The control joint key shall be interrupted in courses containing continuous bond beam steel. In single wythe exterior masonry walls, the exterior control joints shall be raked to a depth of 3/4 inch; backer rod and sealant shall be installed in accordance with Section 07900 JOINT SEALING. Exposed interior control joints shall be raked to a

depth of 1/4 inch. Concealed control joints shall be flush cut.

3.12 BRICK EXPANSION JOINTS AND CONCRETE MASONRY VENEER JOINTS

Brick expansion joints and concrete masonry veneer joints shall be provided and constructed as shown on the drawings. Joints shall be kept free of mortar and other debris.

3.13 LINTELS

3.13.1 Masonry Lintels

Masonry lintels shall be constructed with lintel units filled solid with grout in all courses and reinforced with a minimum of two No. 4 bars in the bottom course unless otherwise indicated on the drawings. Lintel reinforcement shall extend beyond each side of masonry opening 40 bar diameters or 24 inches, whichever is greater. Reinforcing bars shall be supported in place prior to grouting and shall be located 1/2 inch above the bottom inside surface of the lintel unit.

3.13.2 Precast Concrete and Steel Lintels

Precast concrete and steel lintels shall be as shown on the drawings. Lintels shall be set in a full bed of mortar with faces plumb and true. Steel and precast lintels shall have a minimum bearing length of 8 inches unless otherwise indicated on the drawings.

3.14 SILLS AND COPINGS

Sills and copings shall be set in a full bed of mortar with faces plumb and true.

3.15 ANCHORAGE TO CONCRETE

Anchorage of masonry to the face of concrete columns, beams, or walls shall be with dovetail anchors spaced not over 16 inches on centers vertically and 24 inches on center horizontally.

3.16 INSULATION

Anchored veneer walls shall be insulated, where shown, by installing board-type insulation on the cavity side of the inner wythe. Board type insulation shall be applied directly to the masonry or thru-wall flashing with adhesive. Insulation shall be neatly fitted between obstructions without impaling of insulation on ties or anchors. The insulation shall be applied in parallel courses with vertical joints breaking midway over the course below and shall be applied in moderate contact with adjoining units without forcing, and shall be cut to fit neatly against adjoining surfaces.

3.17 MASONRY CORE FILL INSULATION

Insulation shall be poured from the bag or hopper directly into the concrete block core or wall cavity. Pours can be made at any interval, but not to exceed 20 feet in height, without requiring bridging. Rodding and tamping are not required.

3.18 SPLASH BLOCKS

Splash blocks shall be located as shown.

3.19 POINTING AND CLEANING

After mortar joints have attained their initial set, but prior to hardening, mortar and grout daubs or splashings shall be completely removed from masonry-unit surfaces that will be exposed or painted. Before completion of the work, defects in joints of masonry to be exposed or painted shall be raked out as necessary, filled with mortar, and tooled to match existing joints. Immediately after grout work is completed, scum and stains which have percolated through the masonry work shall be removed using a high pressure stream of water and a stiff bristled brush. Masonry surfaces shall not be cleaned, other than removing excess surface mortar, until mortar in joints has hardened. Masonry surfaces shall be left clean, free of mortar daubs, dirt, stain, and discoloration, including scum from cleaning operations, and with tight mortar joints throughout. Metal tools and metal brushes shall not be used for cleaning.

3.19.1 Concrete Masonry Unit and Concrete Brick Surfaces

Exposed concrete masonry unit and concrete brick surfaces shall be dry-brushed at the end of each day's work and after any required pointing, using stiff-fiber bristled brushes.

3.19.2 Clay or Shale Brick Surfaces

Exposed clay or shale brick masonry surfaces shall be cleaned as necessary to obtain surfaces free of stain, dirt, mortar and grout daubs, efflorescence, and discoloration or scum from cleaning operations. After cleaning, the sample panel of similar material shall be examined for discoloration or stain as a result of cleaning. If the sample panel is discolored or stained, the method of cleaning shall be changed to assure that the masonry surfaces in the structure will not be adversely affected. The exposed masonry surfaces shall be water-soaked and then cleaned with a solution proportioned 1/2 cup trisodium phosphate and 1/2 cup laundry detergent to one gallon of water or cleaned with a proprietary masonry cleaning agent specifically recommended for the color and texture by the clay products manufacturer. The solution shall be applied with stiff fiber brushes, followed immediately by thorough rinsing with clean water. Proprietary cleaning agents shall be used in conformance with the cleaning product manufacturer's printed recommendations. Efflorescence shall be removed in conformance with the brick manufacturer's recommendations.

3.20 BEARING PLATES

Bearing plates for beams, joists, joist girders and similar structural members shall be set to the proper line and elevation with damp-pack bedding mortar, except where non-shrink grout is indicated. Bedding mortar and non-shrink grout shall be as specified in Section 03300 CAST-IN-PLACE STRUCTURAL CONCRETE.

3.21 PROTECTION

Facing materials shall be protected against staining. Top of walls shall be covered with nonstaining waterproof covering or membrane when work is not in progress. Covering of the top of the unfinished walls shall continue until the wall is waterproofed with a complete roof or parapet system. Covering shall extend a minimum of 2 feet down on each side of the wall and shall be held securely in place. Before starting or resuming, top

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surface of masonry in place shall be cleaned of loose mortar and foreign material.

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METALWORK FABRICATION, MACHINE WORK, MISCELLANEOUS PROVISIONS

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.

ALUMINUM ASSOCIATION (AA)

AA SAS-30 (1986) Aluminum Structures Construction Manual Series - Section 1 Specifications for Aluminum Structures

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 36/A 36M (1997a) Carbon Structural Steel

ASTM A 123 (1989a) Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products

ASTM A 325 (1994) Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength

ASTM A 490M (1993) High-Strength Steel Bolts, Classes 10.9 and 10.9.3, for Structural Steel Joints (Metric)

ASTM A 514/A 514M (1994a) High-Yield-Strength, Quenched and Tempered Alloy Steel Plate, Suitable for Welding

ASTM A 780 (1993a) Repair of Damaged and Uncoated Areas of Hot-Dipped Galvanized Coatings

ASTM D 962 (1981; R 1994) Aluminum Powder and Paste Pigments for Paints

ASTM E 165 (1995) Liquid Penetrant Examination Inspection Method

ASTM E 709 (1995) Magnetic Particle Examination

ASME INTERNATIONAL (ASME)

ASME B4.1 (1967; R 1994) Preferred Limits and Fits for Cylindrical Parts

ASME B46.1 (1995) Surface Texture (Surface Roughness, Waviness, and Lay)

Grand Forks Phase 1 Levees

ASME BPV IX	(1998) Boiler and Pressure Vessel Code; Section IX, Welding and Brazing Qualifications
AMERICAN WELDING SOCIETY (AWS)	
AWS D1.1	(2000) Structural Welding Code - Steel
AWS D1.2	(1997) Structural Welding Code - Aluminum
SOCIETY OF AUTOMOTIVE ENGINEERS (SAE)	
SAE AMS 3110	(1992; Rev G) Primer Zinc Chromate
SAE AMS 3132	(1994; Rev F) Varnish, Phenolic Resin Corrosion-Preventive

1.2 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-01 Data

Welding of Structural Steel; FIO

Schedules of welding procedures for steel structures shall be submitted and approved prior to commencing fabrication.

Welding of Aluminum; FIO

Schedules of welding processes for aluminum fabrications shall be submitted and approved prior to commencing fabrication.

Structural Steel Welding Repairs; GA

Welding repair plans for steel shall be submitted and approved prior to making repairs.

Materials Orders; FIO

Copies of purchase orders, mill orders, shop orders and work orders for materials shall be submitted prior to the use of the materials in the work.

Materials List; FIO

Materials list for fabricated items shall be submitted at the time of submittal of detail drawings.

Shipping Bill; FIO

Shipping bill shall be submitted with the delivery of finished pieces to the site.

SD-04 Drawings

Detail Drawings; GA

Detail drawings for metalwork and machine work shall be submitted and approved prior to fabrication.

SD-09 Reports

Tests, Inspections, and Verifications; FIO

Certified test reports for materials shall be submitted with all materials delivered to the site.

SD-13 Certificates

Qualification of Welders and Welding Operators; FIO

Certifications for welders and welding operators shall be submitted prior to commencing fabrication.

Application Qualification for Steel Studs; FIO

Certified reports for the application qualification for steel studs shall be submitted and approved prior to commencing fabrication.

Welding of Aluminum; FIO

Certified report for aluminum welding qualification tests shall be submitted and approved prior to commencing welding.

1.3 DETAIL DRAWINGS

Detail drawings for metalwork and machine work shall include catalog cuts, templates, fabrication and assembly details and type, grade and class of material as appropriate. Elements of fabricated items inadvertently omitted on contract drawings shall be detailed by the fabricator and indicated on the detail drawings.

1.4 QUALIFICATION OF WELDERS AND WELDING OPERATORS

The Contractor shall certify that the qualification of welders and welding operators and tack welders who will perform structural steel welding have been qualified for the particular type of work to be done in accordance with the requirements of [AWS D1.1, Section 5,] prior to commencing fabrication. The certificate shall list the qualified welders by name and shall specify the code and procedures under which qualified and the date of qualification. Prior qualification will be accepted if welders have performed satisfactory work under the code for which qualified within the preceding three months. The Contractor shall require welders to repeat the qualifying tests when their work indicates a reasonable doubt as to proficiency. Those passing the requalification tests will be recertified. Those not passing will be disqualified until passing. All expenses in connection with qualification and requalification shall be borne by the Contractor.

PART 2 PRODUCTS

2.1 MATERIALS

Grand Forks Phase 1 Levees

2.1.1 Materials Orders

The Contractor shall furnish 3 copies of purchase orders, mill orders, shop orders and work orders for all materials orders and items used in the work.

Where mill tests are required purchase orders shall contain the test site address and the name of the testing agency.

2.1.2 Materials List

The Contractor shall furnish a materials list of the materials to be used in the fabrication of each item.

2.1.3 Shipping Bill

The Contractor shall furnish a shipping bill or memorandum of each shipment of finished pieces or members to the project site giving the designation mark and weight of each item, the number of items, the total weight, and the car initial and number if shipped by rail in carload lots.

2.2 FABRICATION

2.2.1 Structural Fabrication

Structural steel shapes and plates shall be ASTM A 36/A 36M, unless otherwise noted on the drawings. All structural steel shapes and plates shall be galvanized, unless otherwise noted on drawings. Material must be straight before being laid off or worked. If straightening is necessary it shall be done by methods that will not impair the metal. Sharp kinks or bends shall be cause for rejection of the material. Material with welds will not be accepted except where welding is definitely specified, indicated or otherwise approved. Bends shall be made by approved dies, press brakes or bending rolls. Where heating is required, precautions shall be taken to avoid overheating the metal and it shall be allowed to cool in a manner that will not impair the original properties of the metal.

Proposed flame cutting of material other than structural steel shall be subject to approval and shall be indicated on detail drawings. Shearing shall be accurate and all portions of the work shall be neatly finished. Corners shall be square and true unless otherwise shown. Re-entrant cuts shall be filleted to a minimum radius of 3/4 inch unless otherwise approved. Finished members shall be free of twists, bends and open joints. Bolts, nuts and screws shall be tight.

2.2.1.1 Dimensional Tolerances for Structural Work

Dimensions shall be measured by an approved calibrated steel tape of approximately the same temperature as the material being measured. The overall dimensions of an assembled structural unit shall be within the tolerances indicated on the drawings or as specified in the particular section of these specifications for the item of work. Where tolerances are not specified in other sections of these specifications or shown, an allowable variation of 1/32 inch is permissible in the overall length of component members with both ends milled and component members without milled ends shall not deviate from the dimensions shown by not more than 1/16 inch for members 30 feet or less in length and by more than 1/8 inch for members over 30 feet in length.

2.2.1.2 Structural Steel Fabrication

Structural steel may be cut by mechanically guided or hand-guided torches,

provided an accurate profile with a surface that is smooth and free from cracks and notches is obtained. Surfaces and edges to be welded shall be prepared in accordance with AWS D1.1, Subsection 3.2. Where structural steel is not to be welded, chipping or grinding will not be required except as necessary to remove slag and sharp edges of mechanically guided or hand-guided cuts not exposed to view. Hand-guided cuts which are to be exposed or visible shall be chipped, ground or machined to sound metal. Minimize the amount of field welding. Shop assemble components into largest size possible commensurate with transportation and handling limitations. Shop connections shall be bolted with high strength belts or welded. Provide a minimum of two 3/4 inch diameter ASTM A 325 high strength bolts for all connections. Provide friction-type connections for all bolted connections. One-sided or other types of eccentric connects not indicated will not be permitted without prior approval.

2.2.1.3 Structural Aluminum Fabrication

Laying out and cutting of aluminum shall be in accordance with the AA SAS-30, Section 6.

2.2.2 Welding

2.2.2.1 Welding of Structural Steel

a. Welding Procedures for Structural Steel - Welding procedures for structural steel shall be prequalified as described in AWS D1.1, Subsection 5.1 or shall be qualified by tests as prescribed in AWS D1.1, Section 5. Properly documented evidence of compliance with all requirements of these specifications for previous qualification tests shall establish a welding procedure as prequalified. For welding procedures qualified by tests, the test welding and specimen testing must be witnessed and the test report document signed by the Contracting Officer. Approval of any welding procedure will not relieve the Contractor of the responsibility for producing a finished structure meeting all requirements of these specifications. The Contractor will be directed or authorized to make any changes in previously approved welding procedures that are deemed necessary or desirable by the Contractor Officer. The Contractor shall submit a complete schedule of welding procedures for each steel structure to be welded. The schedule shall conform to the requirements specified in the provisions AWS D1.1, Sections 2, 3, 4, 7 and 9 and applicable provisions of Section 10. The schedule shall provide detailed procedure specifications and tables or diagrams showing the procedures to be used for each required joint. Welding procedures must include filler metal, preheat, interpass temperature and stress-relief heat treatment requirements. Each welding procedure shall be clearly identified as being prequalified or required to be qualified by tests. Welding procedures must show types and locations of welds designated or in the specifications to receive nondestructive examination.

b. Welding Process - Welding of structural steel shall be by an electric arc welding process using a method which excludes the atmosphere from the molten metal and shall conform to the applicable provisions of AWS D1.1, Sections 1 thru 7, 9, 10 and 11. Welding shall be such as to minimize residual stresses, distortion and shrinkage.

c. Welding Technique

(1) Filler Metal - The electrode, electrode-flux combination and

grade of weld metal shall conform to the appropriate AWS specification for the base metal and welding process being used or shall be as shown where a specific choice of AWS specification allowables is required. The AWS designation of the electrodes to be used shall be included in the schedule of welding procedures. Only low hydrogen electrodes shall be used for manual shielded metal-arc welding regardless of the thickness of the steel. A controlled temperature storage oven shall be used at the job site as prescribed by AWS D1.1, Subsection 4.5 to maintain low moisture of low hydrogen electrodes.

(2) Preheat and Interpass Temperature - Preheating shall be performed as required by AWS D1.1, Subsection 4.2 and 4.3 or as otherwise specified except that the temperature of the base metal shall be at least 70 degrees F. The weldments to be preheated shall be slowly and uniformly heated by approved means to the prescribed temperature, held at that temperature until the welding is completed and then permitted to cool slowly in still air.

(3) Stress-Relief Heat Treatment - Where stress relief heat treatment is specified or shown, it shall be in accordance with the requirements of AWS D1.1, Subsection 4.4 unless otherwise authorized or directed.

d. Workmanship - Workmanship for welding shall be in accordance with AWS D1.1, Section 3 and other applicable requirements of these specifications.

(1) Preparation of Base Metal - Prior to welding the Contractor shall inspect surfaces to be welded to assure compliance with AWS D1.1, Subsection 3.2.

(2) Temporary Welds - Temporary welds required for fabrication and erection shall be made under the controlled conditions prescribed for permanent work. Temporary welds shall be made using low-hydrogen welding electrodes and by welders qualified for permanent work as specified in these specifications. Preheating for temporary welds shall be as required by AWS D1.1 for permanent welds except that the minimum temperature shall be 120 degrees F in any case. In making temporary welds arcs shall not be struck in other than weld locations. Each temporary weld shall be removed and ground flush with adjacent surfaces after serving its purpose.

(3) Tack Welds - Tacks welds that are to be incorporated into the permanent work shall be subject to the same quality requirements as the permanent welds and shall be cleaned and thoroughly fused with permanent welds. Preheating shall be performed as specified above for temporary welds. Multiple-pass tack welds shall have cascaded ends. Defective tack welds shall be removed before permanent welding.

2.2.2.2 Welding of Steel Castings

Unsound material shall be removed from the surfaces of steel castings to be incorporated into welded connections by chipping, machining, air-arc gouging or grinding. Major connections designed for transfer of stresses shall not be welded if the temperature of the casting is lower than 100 degrees F. Castings containing over 0.35 percent carbon or over 0.75

percent manganese shall be preheated to a temperature not to exceed 450 degrees F and welding shall be accomplished while the castings are maintained at a temperature above 350 degrees F. Welding will not be permitted on castings containing carbon in excess of 0.45 percent except on written authorization. Castings requiring welding repairs after the first annealing and castings involving welding fabrication shall be stress-relieved annealed prior to receiving final machining unless otherwise permitted.

2.2.2.3 Welding of Aluminum

Welding of aluminum shall conform to AA SAS-30 or AWS D1.2, Sections 1 through 7, 9 and 10. The welding process and welding operators shall be prequalified as required by AWS D1.2, Section 5 or AA SAS-30, Subsection 7.2.4 in accordance with the methods described in ASME BPV IX, Section IX. A certified report giving the results of the qualifying tests shall be furnished for approval. A complete schedule of the welding process for each aluminum fabrication to be welded shall be furnished for approval.

2.2.2.4 Welding of Steel Studs

The procedures for welding steel studs to structural steel, including mechanical, workmanship, technique, stud application qualification, production quality control and fabrication and verification inspection procedures shall conform to the requirements of AWS D1.1, Section 7, except as otherwise specified.

a. Application Qualification for Steel Studs - As a condition of approval of the stud application process, the Contractor shall furnish certified test reports and certification that the studs conform to the requirements of AWS D1.1, Subsections 7.2 and 7.3, certified results of the stud manufacturer's stud base qualification test, and certified results of the stud application qualification test as required by AWS D1.1, Subsection 7.6, except as otherwise specified.

b. Production Quality Control - Quality control for production welding of studs shall conform to the requirements of AWS D1.1, Subsection 7.7, except as otherwise specified. Studs on which pre-production testing is to be performed shall be welded in the same general position as required on production studs (flat, vertical, overhead or sloping). If the reduction of the length of studs becomes less than normal as they are welded, welding shall be stopped immediately and not resumed until the cause has been corrected.

2.2.3 Bolted Connections

2.2.3.1 Bolted Structural Steel Connections

Bolts, nuts and washers shall be of the type specified or indicated. All nuts shall be equipped with washers except for high strength bolts. Beveled washers shall be used where bearing faces have a slope of more than 1:20 with respect to a plane normal to the bolt axis. Where the use of high strength bolts is specified or indicated the materials, workmanship and installation shall conform to the applicable provisions of ASTM A 325 or ASTM A 490M.

a. Bolt Holes - Bolt holes shall be accurately located, smooth, perpendicular to the member and cylindrical.

(1) Holes for regular bolts shall be drilled or subdrilled and reamed in the shop and shall not be more than 1/16 inch larger than the diameter of the bolt.

(2) Holes for fitted bolts shall be match-reamed or drilled in the shop. Burrs resulting from reaming shall be removed. The threads of bolts shall be entirely outside of the holes. The body diameter of bolts shall have tolerances as recommended by ASME B4.1 for the class of fit specified. Fitted bolts shall be fitted in reamed holes by selective assembly to provide an LN-2 fit.

(3) Holes for high strength bolts shall have diameters of not more than 1/16 inch larger than bolt diameters. If the thickness of the material is not greater than the diameter of the bolts the holes may be punched. If the thickness of the material is greater than the diameter of the bolts the holes may be drilled full size or subpunched or subdrilled at least 1/8 inch smaller than the diameter of the bolts and then reamed to full size. Poor matching of holes will be cause for rejection. Drifting occurring during assembly shall not distort the metal or enlarge the holes. Reaming to a larger diameter of the next standard size bolt will be allowed for slight mismatching.

2.2.3.2 Bolted Aluminum Connections

Punching, drilling, reaming and bolting for bolted aluminum connections shall conform to the requirements of AA SAS-30, Section 6.

2.2.4 Riveted Connections

2.2.4.1 Riveted Structural Steel Connections

a. Rivet Holes - Rivet holes shall be accurately spaced, cylindrical and perpendicular to the member. Countersinking shall be true and square with the hole. Rivet holes shall be 1/16 inch larger than the diameter of the rivet. If the thickness of the material is not greater than the diameter of the rivet the holes may be punched full size. If the thickness of the material is greater than the diameter of the rivet the holes shall be drilled full size or subpunched or subdrilled at least 1/8 inch smaller than the diameter of the rivet and then reamed to full size in accordance with the following provisions unless otherwise specified or authorized. For shop connections rivet holes may be drilled full size if the component parts to be riveted are welded, bolted or clamped together before drilling of rivet holes. For field connections the holes required to be subpunched or subdrilled shall be reamed in the shop if the work is assembled and matchmarked in the shop. For field connections not assembled in the shop the holes required to be subpunched or subdrilled shall be reamed in the field after the work has been assembled and bolted together.

(1) Punched Holes - Punching shall be accurate. The diameter of the punch shall be not more than 1/16 inch greater than the diameter of the rivet. The diameter of the die opening shall not be more than 1/16 inch greater than the diameter of the punch. Holes shall be clean cut without torn or ragged edges.

(2) Reamed and Drilled Holes - Reaming and final drilling shall be done with the component parts of the member assembled and firmly fastened together. Drilling shall be done with twist

drills. Reaming shall be done with short taper reamers having not less than four flutes. Reamed holes shall be made smooth by the reamer touching the entire circumference of the hole. Outside burrs on reamed holes shall be removed to the extent of making a 1/16 inch chamfer.

(3) Accuracy of Punched and Drilled Holes - The accuracy of holes punched or drilled full size shall be such that for assembled components with a group of contiguous holes in the same plane 75 percent of the holes shall admit a rod equal to the diameter of the cold rivet at right angles to the plane of the connection. The accuracy of holes required to be reamed or drilled after assembly shall be such that any group of contiguous holes in the same plane shall show no offset greater than 1/32 inch between adjacent thicknesses of metal. Drifting to enlarge holes will not be allowed. Poor matching of holes will be cause for rejection. Reaming to a larger diameter for the next standard size rivet will be allowed for slight mismatching.

b. Driving Rivets - Components to be riveted shall have all parts well pinned and firmly drawn together with bolts before riveting is commenced. Rivets shall be heated uniformly to a light cherry red color at a temperature not over 1950 degrees F in a gas, oil or electric furnace constructed so that it can be adjusted to the proper temperature except that an approved coal or coke furnace may be used for heating field rivets. Rivets shall not be driven after their temperature falls below 1000 degrees F. When heated and ready for driving rivets shall be free from slag, scale and adhesive materials. Rivets shall be hot driven with pressure tools. Driven rivets shall completely fill the holes. Rivet heads shall be neatly formed with dies of approved shape and shall be full size, concentric with the rivet hole and in full contact with the member. Loose, burned, badly formed or otherwise defective rivets shall be removed and replaced with care to avoid damage to adjacent metal. Recupping or caulking will not be permitted. Countersunk rivet heads shall be chipped or ground flush with the surface of the plate unless otherwise specified or authorized. Field rivets shall not be painted until they have been inspected and accepted.

2.2.4.2 Riveted Aluminum Connections

Punching, drilling, reaming and riveting for riveted aluminum connections shall conform to the requirements of AA SAS-30, Section 6.

2.2.5 Machine Work

Tolerances, allowances and gauges for metal fits between plain, non-threaded, cylindrical parts shall conform to ASME B4.1 for the class of fit shown or required unless otherwise shown on approved detail drawings. Where fits are not shown they shall be suitable as approved. Tolerances for machine-finished surfaces designated by non-decimal dimensions shall be within 1/64 inch. Sufficient machining stock shall be allowed on placing pads to ensure true surfaces of solid material. Finished contact or bearing surfaces shall be true and exact to secure full contact. Journal surfaces shall be polished and all surfaces shall be finished with sufficient smoothness and accuracy to ensure proper operation when assembled. Parts entering any machine shall be accurately machined and all like parts shall be interchangeable except that parts assembled together for drilling or reaming of holes or machining will not be required to be

interchangeable with like parts. All drilled holes bolts shall be accurately located.

2.2.5.1 Finished Surfaces

Surface finishes indicated or specified shall be in accordance with ASME B46.1. Values of required roughness heights are arithmetical average deviations expressed in microinches. These values are maximum. Lesser degrees will be satisfactory unless otherwise indicated. Compliance with surface requirements shall be determined by sense of feel and visual inspection of the work compared to Roughness Comparison Specimens in accordance with the provisions of ASME B46.1. Values of roughness width and waviness height shall be consistent with the general type of finish specified by roughness height. Where the finish is not indicated or specified it shall be that which is most suitable for the particular surface, provide the class of fit required and be indicated on the detail drawings by a symbol which conforms to ASME B46.1 when machine finishing is provided. Flaws such as scratches, ridges, holes, peaks, cracks or checks which will make the part unsuitable for the intended use will be cause for rejection.

2.2.5.2 Unfinished Surfaces

All work shall be laid out to secure proper matching of adjoining unfinished surfaces unless otherwise directed. Where there is a large discrepancy between adjoining unfinished surfaces they shall be chipped and ground smooth or machined to secure proper alignment. Unfinished surfaces shall be true to the lines and dimensions shown and shall be chipped or ground free of all projections and rough spots. Depressions or holes not affecting the strength or usefulness of the parts shall be filled in an approved manner.

2.2.6 Miscellaneous Provisions

2.2.6.1 Metallic Coatings

a. Zinc Coatings - Zinc coatings shall be applied in a manner and of a thickness and quality conforming to ASTM A 123. Where zinc coatings are destroyed by cutting, welding or other causes the affected areas shall be regalvanized. Coatings 2 ounces or heavier shall be regalvanized with a suitable low-melting zinc base alloy similar to the recommendations of the American Hot-Dip Galvanizers Association to the thickness and quality specified for the original zinc coating. Coatings less than 2 ounces shall be repaired in accordance with ASTM A 780.

2.2.7 Shop Assembly

Each machinery and structural unit furnished] shall be assembled in the shop to determine the correctness of the fabrication and matching of the component parts unless otherwise specified. Tolerances shall not exceed those shown. Each unit assembled shall be closely checked to ensure that all necessary clearances have been provided and that binding does not occur in any moving part. Assembly in the shop shall be in the same position as final installation in the field unless otherwise specified. Assembly and disassembly work shall be performed in the presence of the Contracting Officer unless waived in writing. Errors or defects disclosed shall be immediately remedied by the Contractor without cost to the Government. Before disassembly for shipment each piece of a machinery or structural

unit shall be match-marked to facilitate erection in the field. The location of match-marks shall be indicated by circling with a ring of white paint after the shop coat of paint has been applied or as otherwise directed.

2.3 TESTS, INSPECTIONS, AND VERIFICATIONS

The Contractor shall have required material tests and analyses performed and certified by an approved laboratory to demonstrate that materials are in conformity with the specifications. These tests and analyses shall be performed and certified at the Contractor's expense. Tests, inspections, and verifications shall conform to the requirements of the particular sections of these specifications for the respective items of work unless otherwise specified or authorized. Tests shall be conducted in the presence of the Contracting Officer if so required. The Contractor shall furnish specimens and samples for additional independent tests and analyses upon request by the Contracting Officer. Specimens and samples shall be properly labeled and prepared for shipment.

2.3.1 Nondestructive Testing

When doubt exists as to the soundness of any material part such part may be subjected to any form of nondestructive testing determined by the Contracting Officer. This may include ultrasonic, magnaflux, dye penetrant, x-ray, gamma ray or any other test that will thoroughly investigate the part in question. The cost of such investigation will be borne by the Government. Any defects will be cause for rejection and rejected parts shall be replaced and retested at the Contractor's expense.

2.3.2 Tests of Machinery and Structural Units

The details for tests of machinery and structural units shall conform to the requirements of the particular sections of these specifications covering these items. Each complete machinery and structural unit shall be assembled and tested in the shop in the presence of the Contracting Officer unless otherwise directed. Waiving of tests will not relieve the Contractor of responsibility for any fault in operation, workmanship or material that occurs before the completion of the contract or guarantee. After being installed at the site each complete machinery or structural unit shall be operated through a sufficient number of complete cycles to demonstrate to the satisfaction of the Contracting Officer that it meets the specified operational requirements in all respects.

2.3.3 Inspection of Structural Steel Welding

The Contractor shall maintain an approved inspection system and perform required inspections in accordance with Contract Clause CONTRACTOR INSPECTION SYSTEM. Welding shall be subject to inspection to determine conformance with the requirements of AWS D1.1, the approved welding procedures and provisions stated in other sections of these specifications.

Nondestructive examination of designated welds will be required. Supplemental examination of any joint or coupon cut from any location in any joint may be required.

2.3.3.1 Visual Examination

All visual examination of completed welds shall be cleaned and carefully examined for insufficient throat or leg sizes, cracks, undercutting, overlap, excessive convexity or reinforcement and other surface defects to

ensure compliance with the requirements of AWS D1.1, Section 3 and Section 9, Part D.

2.3.3.2 Nondestructive Examination

The nondestructive examination of shop and field welds shall be performed as designated or described in the sections of these specifications covering the particular items of work.

a. Testing Agency - The nondestructive examination of welds and the evaluation of examination tests as to the acceptability of the welds shall be performed by a testing agency adequately equipped and competent to perform such services or by the Contractor using suitable equipment and qualified personnel. In either case written approval of the examination procedures is required and the examination tests shall be made in the presence of the Contracting Officer. The evaluation of examination tests shall be subject to the approval and all records shall become the property of the Government.

b. Examination Procedures - Examination procedures shall conform to the following requirements.

(1) Ultrasonic Testing - Making, evaluating and reporting ultrasonic testing of welds shall conform to the requirements of AWS D1.1, Section 6, Part C. The ultrasonic equipment shall be capable of making a permanent record of the test indications. A record shall be made of each weld tested.

(2) Radiographic Testing - Making, evaluating and reporting radiographic testing of welds shall conform to the requirements of AWS D1.1, Section 6, Part B.

(3) Magnetic Particle Inspection - Magnetic particle inspection of welds shall conform to the applicable provisions of ASTM E 709.

(4) Dye Penetrant Inspection - Dye penetrant inspection of welds shall conform to the applicable provisions of ASTM E 165.

c. Acceptability of Welds - Welds shall be unacceptable if shown to have defects prohibited by AWS D1.1, Subsection 9.25 or possess any degree of incomplete fusion, inadequate penetration or undercutting.

2.3.3.3 Test Coupons

The Government reserves the right to require the Contractor to remove coupons from completed work when doubt as to soundness cannot be resolved by nondestructive examination. Should tests of any two coupons cut from the work of any welder show strengths less than that specified for the base metal it will be considered evidence of negligence or incompetence and such welder shall be removed from the work. When coupons are removed from any part of a structure the members cut shall be repaired in a neat manner with joints of the proper type to develop the full strength of the members. Repaired joints shall be peened as approved or directed to relieve residual stress. The expense for removing and testing coupons, repairing cut members and the nondestructive examination of repairs shall be borne by the Government or the Contractor in accordance with the Contract Clauses INSPECTION AND ACCEPTANCE.

2.3.3.4 Supplemental Examination

When the soundness of any weld is suspected of being deficient due to faulty welding or stresses that might occur during shipment or erection the Government reserves the right to perform nondestructive supplemental examinations before final acceptance. The cost of such inspection will be borne by the Government.

2.3.4 Structural Steel Welding Repairs

Defective welds in the structural steel welding repairs shall be repaired in accordance with AWS D1.1, Subsection 3.7. Defective weld metal shall be removed to sound metal by use of air carbon-arc or oxygen gouging. Oxygen gouging shall not be used on ASTM A 514/A 514M steel. The surfaces shall be thoroughly cleaned before welding. Welds that have been repaired shall be retested by the same methods used in the original inspection. Except for the repair of members cut to remove test coupons and found to have acceptable welds costs of repairs and retesting shall be borne by the Contractor.

PART 3 EXECUTION

3.1 INSTALLATION

All parts to be installed shall be thoroughly cleaned. Packing compounds, rust, dirt, grit and other foreign matter shall be removed. Holes and grooves for lubrication shall be cleaned. Enclosed chambers or passages shall be examined to make sure that they are free from damaging materials. Where units or items are shipped as assemblies they will be inspected prior to installation. Disassembly, cleaning and lubrication will not be required except where necessary to place the assembly in a clean and properly lubricated condition. Pipe wrenches, cold chisels or other tools likely to cause damage to the surfaces of rods, nuts or other parts shall not be used for assembling and tightening parts. Bolts and screws shall be tightened firmly and uniformly but care shall be taken not to overstress the threads. When a half nut is used for locking a full nut the half nut shall be placed first and followed by the full nut. Threads of all bolts except high strength bolts, nuts and screws shall be lubricated with an approved lubricant before assembly. Threads of corrosion-resisting steel bolts and nuts shall be coated with an approved antigalling compound. Driving and drifting bolts or keys will not be permitted.

3.1.1 Alignment and Setting

Each machinery or structural unit shall be accurately aligned by the use of steel shims or other approved methods so that no binding in any moving parts or distortion of any member occurs before it is fastened in place. The alignment of all parts with respect to each other shall be true within the respective tolerances required. Machines shall be set true to the elevations shown.

3.1.2 Blocking and Wedges

All blocking and wedges used during installation for the support of parts to be grouted in foundations shall be removed before final grouting unless otherwise directed. Blocking and wedges left in the foundations with approval shall be of steel or iron.

3.2 PROTECTION OF FINISHED WORK

3.2.1 Machined Surfaces

Machined surfaces shall be thoroughly cleaned of foreign matter. All finished surfaces shall be protected by suitable means. Unassembled pins and bolts shall be oiled and wrapped with moisture resistant paper or protected by other approved means. Finished surfaces of ferrous metals to be in bolted contact shall be washed with an approved rust inhibitor and coated with an approved rust resisting compound for temporary protection during fabrication, shipping and storage periods. Finished surfaces of metals which shall be exposed after installation except corrosion resisting steel or nonferrous metals shall be painted.

3.2.2 Aluminum

Aluminum that shall be in contact with grout or concrete shall be protected from galvanic or corrosive action by being given a coat of zinc-chromate primer and a coat of aluminum paint. Aluminum in contact with structural steel shall be protected against galvanic or corrosive action by being given a coat of zinc-chromate primer and a coat of aluminum paint. The zinc-chromate primer shall conform to SAE AMS 3110. The aluminum paint shall consist of a aluminum paste conforming to ASTM D 962, spar varnish conforming to SAE AMS 3132 and thinner compatible with the varnish. The aluminum paint shall be field mixed in proportion of 2 pounds of paste, not more than one gallon of spar varnish and not more than one pint of thinner.

3.3 TESTS

3.3.1 Workmanship

Workmanship shall be of the highest grade and in accordance with the best modern practices to conform with the specifications for the item of work being furnished.

3.3.2 Production Welding

Production welding shall conform to the requirements of AWS D1.1 or AWS D1.2 as applicable. Studs on which pre-production testing is to be performed shall be welded in the same general position as required on production items (flat, vertical, overhead or sloping). Test and production stud welding will be subjected to visual examination or inspection. If the reduction of the length of studs becomes less than normal as they are welded, welding shall be stopped immediately and not resumed until the cause has been corrected.

-- End of Section --

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SECTION 05120

STRUCTURAL STEEL

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 FCD	(1995a) Quality Certification Program Description
AISC ASD Manual	(1989) Manual of Steel Construction Allowable Stress Design
AISC ASD/LRFD Vol II	(1992) Manual of Steel Construction Vol II: Connections
AISC Design Guide No. 10	(1989) Erection Bracing of Low-Rise Structural Steel Frames
AISC LRFD Vol II	(1995) Manual of Steel Construction Load & Resistance Factor Design, Vol II: Structural Members, Specifications & Codes
AISC Pub No. S303	(1992) Code of Standard Practice for Steel Buildings and Bridges

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 6/A 6M	(2000) General Requirements for Rolled Structural Steel Bars, Plates, Shapes, and Sheet Piling
ASTM A 36/A 36M	(1997a) Carbon Structural Steel
ASTM A 53	(1999b) Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A 307	(1997) Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength
ASTM A 325M	(1997) High-Strength Bolts for Structural Steel Joints (Metric)
ASTM A 490M	(1993) High-Strength Steel Bolts, Classes 10.9 and 10.9.3, for Structural Steel Joints (Metric)

Grand Forks Phase 1 Levees

ASTM A 563M	(1997) Carbon and Alloy Steel Nuts (Metric)
ASTM A 992/A 992M	(1998e1) Steel for Structural Shapes For Use in Building Framing
ASTM F 593	(1998) Stainless Steel Bolts, Hex Cap Screws, and Studs
ASTM F 844	(1998) Washers, Steel, Plain (Flat), Unhardened for General Use
ASME INTERNATIONAL (ASME)	
ASME B46.1	(1995) Surface Texture (Surface Roughness, Waviness, and Lay)
AMERICAN WELDING SOCIETY (AWS)	
AWS A2.4	(1998) Standard Symbols for Welding, Brazing and Nondestructive Examination
AWS D1.1	(2000) Structural Welding Code - Steel
THE SOCIETY FOR PROTECTIVE COATINGS (SSPC)	
SSPC Paint 25	(1991) Red Iron Oxide, Zinc Oxide, Raw Linseed Oil and Alkyd Primer (Without Lead and Chromate Pigments)

1.2 GENERAL REQUIREMENTS

Structural steel fabrication and erection shall be performed by an organization experienced in structural steel work of equivalent magnitude. The Contractor shall be responsible for correctness of detailing, fabrication, and for the correct fitting of structural members. Connections, for any part of the structure not shown on the contract drawings, shall be considered simple shear connections and shall be designed and detailed in accordance with pertinent provisions of AISC ASD Manual and AISC LRFD Vol II. Substitution of sections or modification of connection details will not be accepted unless approved by the Contracting Officer. AISC ASD Manual and AISC ASD/LRFD Vol II shall govern the work. Welding shall be in accordance with AWS D1.1; except that welding for critical applications shall be in accordance with Section 05055 METALWORK FABRICATION, MACHINE WORK, MISCELLANEOUS PROVISIONS. High-strength bolting shall be in accordance with AISC ASD Manual.

1.3 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-01 Data

Erection; GA

Prior to erection, erection plan of the structural steel framing describing all necessary temporary supports, including the sequence of installation and removal.

Welding; GA

WPS not prequalified.

Welding; GA

WPS prequalified.

SD-04 Drawings

Structural Steel System; GA

Structural Connections; GA

Shop and erection details including members with their connections not shown on the contract drawings. Welds shall be indicated by standard welding symbols in accordance with AWS A2.4.

SD-13 Certificates

Mill Test Reports; GA

Certified copies of mill test reports for structural steel, structural bolts, nuts, washers and other related structural steel items, including attesting that the structural steel furnished contains no less than 25 percent recycled scrap steel and meets the requirements specified, prior to the installation.

Welder Qualifications; GA

Certified copies of welder qualifications test records showing qualification in accordance with AWS D1.1.

Welding Inspector; GA

Welding Inspector qualifications.

Fabrication; GA

A copy of the AISC certificate indicating that the fabrication plant meets the specified structural steelwork category.

SD-14 Samples

High Strength Bolts and Nuts; GA

Carbon Steel Bolts and Nuts; GA

Nuts Dimensional Style; GA

Washers; GA

Expansion Bolts and Adhesive Bolts; GA

Random samples of bolts, nuts, washers, and anchor bolts as delivered to the job site if requested, taken in the presence of the Contracting Officer and provided to the Contracting Officer for testing to establish compliance with specified requirements.

1.4 STORAGE

Material shall be stored out of contact with the ground in such manner and location as will minimize deterioration.

1.5 WELDING INSPECTOR

Welding Inspector qualifications shall be in accordance with AWS D1.1

PART 2 PRODUCTS

2.1 STRUCTURAL STEEL

2.1.1 Carbon Grade Steel

Carbon grade steel shall conform to ASTM A 36/A 36M, unless otherwise noted on drawings. All carbon grade steel shall be galvanized unless noted on drawings.

2.1.2 Structural Shapes for Use in Building Framing

Wide flange shapes in accordance with ASTM A 992/A 992M shall be used where indicated on the drawings.

2.2 STEEL PIPE

Steel pipe shall conform to ASTM A 53, Grade B.

2.3 HIGH STRENGTH BOLTS AND NUTS

High strength bolts shall conform to ASTM A 325M, Type 1 with carbon steel nuts conforming to ASTM A 563M, Grade C or ASTM A 325M, Type 3 with carbon steel nuts conforming to ASTM A 563M, Grade C3.

2.4 CARBON STEEL BOLTS AND NUTS

Carbon steel bolts shall conform to ASTM A 307, Grade A with carbon steel nuts conforming to ASTM A 563M, Grade A.

2.5 NUTS DIMENSIONAL STYLE

Carbon steel nuts shall be Heavy Hex style when used with ASTM A 307 bolts or Heavy Hex style when used with ASTM A 325M or ASTM A 490M bolts.

2.6 WASHERS

Plain washers shall conform to ASTM F 844.

2.7 EXPANSION BOLTS AND ADHESIVE BOLTS

Material: ASTM F 593 stainless steel, Type 304 or 316. Provide Type 316 unless noted otherwise. Provide minimum edge distance cover and spacing as recommended by manufacturer, or as indicated on drawings whichever is larger. Depth of embedment: minimum embedment as recommended by manufacturer or 9 diameters of bolt, whichever is larger. Notify Contracting Officer if required depth of embedment cannot be achieved at a particular bolt location. Follow manufacturer's recommendations for installation and torque.

Submit manufacturer's load test data to verify at least the bolt capacities at the following embedment depths: (Data must be based on actual tests performed in unreinforced mass concrete of not more than 4000 psi compressive strength. Capacity must be at a concrete temperature of at

least 130 degrees F.)

BOLT DIAMETER (IN)	MINIMUM EMBEDMENT (IN)	MINIMUM ULTIMATE TENSION CAPACITY (KIP)
1/2	4-1/2	8.1
5/8	5-5/8	11.4
3/4	6-3/4	15.4
7/8	7-7/8	20.1
1	9	24.7
1-1/4	11-1/4	34.3

2.8 PAINT

Paint shall conform to SSPC Paint 25.

PART 3 EXECUTION

3.1 FABRICATION

Fabrication shall be in accordance with the applicable provisions of AISC ASD Manual. Fabrication and assembly shall be done in the shop to the greatest extent possible. The fabricating plant shall be certified under the AISC. Compression joints depending on contact bearing shall have a surface roughness not in excess of 500 micro inches as determined by ASME B46.1, and ends shall be square within the tolerances for milled ends specified in ASTM A 6/A 6M. Structural steelwork, except surfaces of steel to be encased in concrete, surfaces to be field welded, surfaces to be fireproofed, and contact surfaces of friction-type high-strength bolted connections shall be prepared for painting in accordance with endorsement "P" of AISC FCD and primed with the specified paint.

3.2 ERECTION

- a: Erection of structural steel, except as indicated in item b. below, shall be in accordance with the applicable provisions of AISC ASD Manual. Erection plan shall be reviewed, stamped and sealed by a structural engineer licensed by the state in which the project is located.
- b. For low-rise structural steel buildings (60 feet tall or less and a maximum of 2 stories), the erection plan shall conform to AISC Pub No. S303 and the structure shall be erected in accordance with AISC Design Guide No. 10.

3.2.1 Structural Connections

bolts and other connections between the structural steel and foundations shall be provided and shall be properly located and built into connecting work. Field welded structural connections shall be completed before load is applied.

3.2.2 Base Plates and Bearing Plates

Column base plates for columns and bearing plates for beams, girders, and similar members shall be provided. Base plates and bearing plates shall be provided with full bearing after the supported members have been plumbed and properly positioned, but prior to placing superimposed loads. Separate setting plates under column base plates will not be permitted. The area under the plate shall be damp-packed solidly with bedding mortar, except

where nonshrink grout is indicated on the drawings. Bedding mortar and grout shall be as specified in Section 03300 CAST-IN-PLACE STRUCTURAL CONCRETE.

3.2.3 Field Priming

After erection, the field bolt heads and nuts, field welds, and any abrasions in the shop coat shall be cleaned and primed with paint of the same quality as that used for the shop coat.

3.2.4 Expansion Bolts and Adhesive Bolts

Install in strict accordance with manufacturer's instructions for hole size, hole cleaning, installation, torque requirements substrate temperature and curing. Use only carbide-tipped drilling equipment.

3.3 WELDING

The Contractor shall develop and submit the Welding Procedure Specifications (WPS) for all welding, including welding done using prequalified procedures. Prequalified procedures may be submitted for information only; however, procedures that are not prequalified shall be submitted for approval.

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SECTION 05300

STEEL DECKING

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 ASD Spec (1989) Specification for Structural Steel Buildings - Allowable Stress Design and Plastic Design

AMERICAN IRON AND STEEL INSTITUTE (AISI)

AISI Cold-Formed Mnl (1996) Cold-Formed Steel Design Manual

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 108 (1999) Steel Bars, Carbon, Cold Finished, Standard Quality

ASTM A 611 (1997) Structural Steel (SS), Sheet, Carbon, Cold-Rolled

ASTM A 653/A 653M (1999a) Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process

AMERICAN WELDING SOCIETY (AWS)

AWS D1.1 (2000) Structural Welding Code - Steel

AWS D1.3 (1998) Structural Welding Code - Sheet Steel

STEEL DECK INSTITUTE (SDI)

SDI Diaphragm Mnl (1987; Amended 1991) Diaphragm Design Manual

SDI Pub No 29 (1995) Design Manual for Composite Decks, Form Decks, Roof Decks, and Cellular Metal Floor Deck with Electrical Distributio

1.2 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The

following shall be in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-01 Data

Deck Units; GA

Design computations for the structural properties of the deck units or SDI certification that the units are designed in accordance with SDI specifications.

Attachments; GA

Prior to welding operations, copies of qualified procedures and lists of names and identification symbols of qualified welders and welding operators.

SD-04 Drawings

Deck Units; GA

Accessories; GA

Attachments; GA

Holes and Openings; GA

Drawings shall include type, configuration, structural properties, location, and necessary details of deck units, accessories, and supporting members; size and location of holes to be cut and reinforcement to be provided; location and sequence of welded or fastener connections; and the manufacturer's erection instructions.

SD-13 Certificates

Deck Units; GA

Attachments; GA

Manufacturer's certificates attesting that the decking material meets the specified requirements. Manufacturer's certificate attesting that the operators are authorized to use the low-velocity piston tool.

SD-14 Samples

Deck Units; GA

Accessories; GA

A 2 sq. ft. sample of the decking material to be used, along with a sample of each of the accessories used. A sample of acoustical material to be used shall be included.

1.3 DELIVERY, STORAGE, AND HANDLING

Deck units shall be delivered to the site in a dry and undamaged condition, stored off the ground with one end elevated, and stored under a weathertight covering permitting good air circulation. Finish of deck units shall be maintained at all times by using touch-up paint whenever necessary to prevent the formation of rust.

PART 2 PRODUCTS

2.1 DECK UNITS

Deck units shall conform to SDI Pub No 29. Panels of maximum possible lengths shall be used to minimize end laps. Deck units shall be fabricated in lengths to span 3 or more supports with flush, telescoped, or nested 2 inchlaps at ends, and interlocking, or nested side laps, unless otherwise indicated. Deck with cross-sectional configuration differing from the units indicated may be used, provided that the properties of the proposed units, determined in accordance with AISI Cold-Formed Mnl, are equal to or greater than the properties of the units indicated and that the material will fit the space provided without requiring revisions to adjacent materials or systems.

2.1.1 Roof Deck

Deck to receive concrete as a filler shall conform to ASTM A 653/A 653M or ASTM A 611. Deck shall be fabricated of 0.034 inch design thickness or thicker steel and shall be galvanized.

2.1.2 Shear Connectors

Shear connectors shall be headed stud type, ASTM A 108, Grade 1015 or 1020, cold finished carbon steel with dimensions complying with AISC ASD Spec.

2.2 TOUCH-UP PAINT

Touch-up paint for galvanized units shall be an approved galvanizing repair paint. Finish of deck units and accessories shall be maintained by using touch-up paint whenever necessary to prevent the formation of rust.

2.3 ADJUSTING PLATES

Adjusting plates or segments of deck units shall be provided in locations too narrow to accommodate full-size units. As far as practical, the plates shall be the same thickness and configuration as the deck units.

2.4 CLOSURE PLATES

2.4.1 Closure Plates for Roof Deck

The concrete shall be supported and retained at each level. Provide edge closures at all edges of the slab of sufficient strength and stiffness to support the wet concrete. Metal closures shall be provided for all openings in steel deck 1/4 inch and over.

2.4.1.1 Sheet Metal

Where deck is cut for passage of pipes, ducts, columns, etc., and deck is to remain exposed, provide a neatly cut sheet metal collar to cover edges of deck. Do not cut deck until after installation of supplemental supports.

2.5 ACCESSORIES

The manufacturer's standard accessories shall be furnished as necessary to complete the deck installation. Metal accessories shall be of the same material as the deck and have minimum design thickness as follows: saddles, 0.0474 inch; cant strip, 0.0295 inch; other metal accessories, 0.0358 inch; unless otherwise indicated. Accessories shall include but not be limited to saddles, cant strips, butt cover plates, underlapping sleeves, and ridge

and valley plates.

PART 3 EXECUTION

3.1 ERECTION

Erection of deck and accessories shall be in accordance with SDI Pub No 29 or SDI Diaphragm Mnl and the approved detail drawings. Damaged deck and accessories including material which is permanently stained or contaminated, with burned holes or deformed shall not be installed. The deck units shall be placed on secure supports, properly adjusted, and aligned at right angles to supports before being permanently secured in place. The deck shall not be filled with concrete, used for storage or as a working platform until the units have been secured in position. Loads shall be distributed by appropriate means to prevent damage during construction and to the completed assembly. The maximum uniform distributed storage load shall not exceed the design live load. There shall be no loads suspended directly from the steel deck. Acoustical material shall be neatly fitted into the rib voids.

3.2 ATTACHMENTS

All fasteners shall be installed in accordance with the manufacturer's recommended procedure, except as otherwise specified. The deck units shall be welded with nominal 5/8 inch diameter puddle welds or fastened with screws, powder-actuated fasteners or pneumatically driven fasteners to supports as indicated on the design drawings and in accordance with requirements of SDI Pub No 29. All welding of steel deck shall be in accordance with AWS D1.3 using methods and electrodes as recommended by the manufacturer of the steel deck being used. Welds shall be made only by operators previously qualified by tests prescribed in AWS D1.3 to perform the type of work required. Welding washers shall not be used at the connections of the deck to supports. Welding washers shall not be used at sidelaps. Holes and similar defects will not be acceptable. Deck ends shall be lapped 2 inches. All partial or segments of deck units shall be attached to structural supports in accordance with Section 2.5 of SDI Diaphragm Mnl. Powder-actuated fasteners shall be driven with a low-velocity piston tool by an operator authorized by the manufacturer of the piston tool. Pneumatically driven fasteners shall be driven with a low-velocity fastening tool and shall comply with the manufacturer's recommendations. Shear connectors shall be attached as shown and shall be welded as per AWS D1.1 through the steel deck to the steel member.

3.3 HOLES AND OPENINGS

All holes and openings required shall be coordinated with the drawings, specifications, and other trades. Holes and openings shall be drilled or cut, reinforced and framed as indicated on the drawings or described in the specifications and as required for rigidity and load capacity. Holes and openings less than 6 inches across require no reinforcement. Holes and openings 6 to 12 inches across shall be reinforced by 0.0474 inch thick steel sheet at least 12 inches wider and longer than the opening and be fastened to the steel deck at each corner of the sheet and at a maximum of 6 inches on center. Holes and openings larger than 12 inches shall be reinforced by steel angles installed perpendicular to the steel joists and supported by the adjacent steel joists. Steel angles shall be installed perpendicular to the deck ribs and shall be fastened to the angles perpendicular to the steel joists.

3.4 PREPARATION OF FIRE-PROOFED SURFACES

Deck surfaces, both composite and noncomposite, which are to receive sprayed-on fireproofing, shall be galvanized and shall be free of all grease, mill oil, paraffin, dirt, salt, and other contaminants which impair adhesion of the fireproofing. Any required cleaning shall be done prior to steel deck installation using a cleaning method that is compatible with the sprayed-on fireproofing.

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SECTION 05500

MISCELLANEOUS METAL

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.

ALUMINUM ASSOCIATION (AA)

AA DAF-45 (1997) Designation System for Aluminum Finishes

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI MBG 531 (1993) Metal Bar Grating Manual

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 36/A 36M (1997ael) Carbon Structural Steel

ASTM A 48 (2000) Gray Iron Castings

ASTM A 53 (1999b) Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless

ASTM A 123/A 123M (1997ael) Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products

ASTM A 325 (1994) Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength

ASTM A 536 (1999el) Ductile Iron Castings

ASTM A 653/A 653M (1999a) Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process

ASTM A 786 (2000) Rolled Steel Floor Plates

ASTM A 924/A 924M (1999) General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process

AMERICAN WELDING SOCIETY (AWS)

AWS D1.1 (2000) Structural Welding Code - Steel

COMMERCIAL ITEM DESCRIPTIONS (CID)

CID A-A-344 (Rev B) Lacquer, Clear Gloss, Exterior,
Interior

NATIONAL ASSOCIATION OF ARCHITECTURAL METAL MANUFACTURERS (NAAMM)

NAAMM MBG 531 (1994) Metal Bar Grating Manual

NAAMM MBG 532 (1994) Heavy Duty Metal Bar Grating Manual

US DEPARTMENT OF LABOR, OCCUPATIONAL SAFETY AND HEALTH
ADMINISTRATION (OSHA)

OSHA 20 CFR1910 OSHA Safety and Health Standard for
General Industry

1.2 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-04 Drawings

Miscellaneous Metal Items; GA

Detail drawings indicating material thickness, type, grade, and class; dimensions; and construction details. Drawings shall include catalog cuts, erection details, manufacturer's descriptive data and installation instructions, and templates.

SD-14 Samples

Miscellaneous Metal Items; FIO.

Samples shall be full size, taken from manufacturer's stock, and shall be complete as required for installation in the structure. Samples may be installed in the work, provided each sample is clearly identified and its location recorded.

1.3 GENERAL REQUIREMENTS

The Contractor shall verify all measurements and shall take all field measurements necessary before fabrication. Welding to or on structural steel shall be in accordance with AWS D1.1. Items specified to be galvanized, when practicable and not indicated otherwise, shall be hot-dip galvanized after fabrication. Galvanizing shall be in accordance with ASTM A 123/A 123M, ASTM A 653/A 653M, or ASTM A 924/A 924M, as applicable. Exposed fastenings shall be compatible materials, shall generally match in color and finish, and shall harmonize with the material to which fastenings are applied. Materials and parts necessary to complete each item, even though such work is not definitely shown or specified, shall be included. Poor matching of holes for fasteners shall be cause for rejection. Fastenings shall be concealed where practicable. Thickness of metal and details of assembly and supports shall provide strength and stiffness. Joints exposed to the weather shall be formed to exclude water.

1.4 DISSIMILAR MATERIALS

Where dissimilar metals are in contact, or where aluminum is in contact with concrete, mortar, masonry, wet or pressure-treated wood, or absorptive materials subject to wetting, the surfaces shall be protected with a coat of bituminous paint or asphalt varnish.

1.5 WORKMANSHIP

Miscellaneous metalwork shall be well formed to shape and size, with sharp lines and angles and true curves. Drilling and punching shall produce clean true lines and surfaces. Welding shall be continuous along the entire area of contact except where tack welding is permitted. Exposed connections of work in place shall not be tack welded. Exposed welds shall be ground smooth. Exposed surfaces of work in place shall have a smooth finish, and unless otherwise approved, exposed riveting shall be flush. Where tight fits are required, joints shall be milled. Corner joints shall be coped or mitered, well formed, and in true alignment. Work shall be accurately set to established lines and elevations and securely fastened in place. Installation shall be in accordance with manufacturer's installation instructions and approved drawings, cuts, and details.

1.6 ANCHORAGE

Anchorage shall be provided where necessary for fastening miscellaneous metal items securely in place. Anchorage not otherwise specified or indicated shall include slotted inserts made to engage with the anchors, expansion shields, and power-driven fasteners when approved for concrete; toggle bolts and through bolts for masonry; machine and carriage bolts for steel; and lag bolts and screws for wood.

1.7 ALUMINUM FINISHES

Unless otherwise specified, aluminum items shall have standard mill finish. The thickness of the coating shall be not less than that specified for protective and decorative type finishes for items used in interior locations or architectural Class I type finish for items used in exterior locations in AA DAF-45. Items to be anodized shall receive a polished satin finish. Aluminum surfaces to be in contact with plaster or concrete during construction shall be protected with a field coat conforming to CID A-A-344.

1.8 SHOP PAINTING

Surfaces of ferrous metal except galvanized surfaces, shall be cleaned and shop coated with the manufacturer's standard protective coating unless otherwise specified. Surfaces of items to be embedded in concrete shall not be painted. Items to be finish painted shall be prepared according to manufacturer's recommendations or as specified.

PART 2 PRODUCTS

2.1 PIPE GUARDS

Pipe guards shall be heavy duty steel pipe conforming to ASTM A 53, Type E or S, weight STD, black finish.

2.2 FLOOR GRATINGS AND FRAMES

Carbon steel grating shall be designed in accordance with NAAMM MBG 531 or NAAMM MBG 532 to meet the indicated load requirements. Edges shall be

banded with bars 1/4 inch less in height than bearing bars for grating sizes above 3/4 inch. Banding bars shall be flush with the top of bearing grating. Frames shall be of welded steel construction finished to match the grating. Floor gratings and frames shall be galvanized after fabrication.

2.3 STEEL GRATING

ANSI MBG 531. Minimum depth: 1-1/4 inch. Minimum rectangular bearing bar thickness: 3/16 inch. Maximum 1-3/16 inch on center spacing. Design live load shall not be less than 100 psf plus a concentrated load of 300 pounds with a maximum deflection of 1/300 of span under a superimposed live load of 100 psf or HS-20 loading where shown on the drawings. Cross bars shall be welded, swagged or pressure locked to bearing beam, maximum spacing 4 inch/oc. Top edges of bars shall be serrated or grooved. Individual grating sections shall not be wider than 3 feet and not more than 100 pounds. Finish: Galvanized. Clips and bolts shall be stainless steel or galvanized. Seat angles shall be galvanized steel. Ends and perimeter edges shall be banded. Openings through grating shall be reinforced to provide required load carrying capacity and banded with 4 inch high toe plate.

Minimize the amount of field welding. Shop-assemble components into largest size possible commensurate with transportation and handling limitations. Shop connections shall be bolted with high-strength bolts or welded. Provide as a minimum, two 3/4 inch diameter, ASTM A 325 high-strength bolts for all bolted connections. Provide friction-type connections for all bolted connections. One-sided or other types of eccentric connections not indicated will not be permitted without prior approval.

2.4 HANDRAILS

Handrails shall be designed to resist a concentrated load of 200 pounds in any direction at any point of the top of the rail or 50 pounds per foot applied horizontally at right angles to top of the rail, whichever is more severe.

2.4.1 Steel Handrails, Including Carbon Steel Inserts

Steel handrails, including inserts in concrete, shall be steel pipe conforming to ASTM A 53. Steel railings shall be 2 inch nominal size. Railings shall be hot-dip galvanized. Pipe collars shall be galvanized steel.

- a. Joint posts, rail, and corners shall be fabricated by one of the following methods:

- (1) Flush type rail fittings of commercial standard, welded and ground smooth with railing splice locks secured with 3/8 inch hexagonal recessed-head setscrews.

- (2) Mitered and welded joints by fitting post to top rail and intermediate rail to post, mitering corners, groove welding joints, and grinding smooth. Railing splices shall be butted and reinforced by a tight fitting interior sleeve not less than 6 inches long.

- (3) Railings may be bent at corners in lieu of jointing, provided

bends are made in suitable jigs and the pipe is not crushed.

- b. Removable sections, toe-boards, and brackets shall be provided as indicated.

2.5 MANHOLE STEPS AND COVERS

Manhole steps shall conform to ASTM A 536 and be made of cast iron. Manhole covers shall conform to ASTM A 48, Class 35. The type used shall be grey cast iron, slab type, with single lid, double-hinges and lifting handle. The installed cover shall be capable of withstanding 1 ton concentrated load. The cover shall come complete with frame, lid, required accessories, have manufacturer's shop finish and have shop-coated assembly.

2.6 STEEL CHECKERED PLATE

The material used for steel checkered plate shall conform to ASTM A 786 with a minimum thickness of 1/4 inch. Stiffener angles at checkered plate joints welded to 1 plate and fastened to the other. Provide stiffener angles, bars or other supports to limit deflection to 1/300 of span using a live load of 50 psf as a basis for calculating deflection. The floor sections shall be removable with the weight of each being not be more than 150 pounds. Provide 2 holes, slotted round ends 3/4 inch x 1-1/2 inch for lifting each section of floor plate, ream holes to remove burrs.

2.7 MISCELLANEOUS

Miscellaneous plates and shapes for items that do not form a part of the structural steel framework, such as lintels, sill angles, miscellaneous mountings, and frames, shall be provided to complete the work.

2.8 FALL RESTRAINT SYSTEM

The fall restraint system shall contain 1 construction vest-style full body harness with tongue buckle leg straps. The system shall contain 1 Ultra-Lok self-retracting life line. The restraint system shall be provided with 1 self-locking snap hook for connection of self-retracting life line to a tie off adapter. Connectors (hooks, carabiners, D rings, etc) must support a minimum load of 5,000 pounds. Ensure connecting hooks and anchorage are compatible. Anchorages selected for personal restraint system shall be capable of sustaining static loads applied in the directions permitted by personal fall restraint system of at least 5,000 pounds. When more than 1 personal fall restraint system is attached to an anchorage, the anchorage strengths set forth must be multiplied by the number of personal fall restraint systems attached to the anchorage. The fall restraint system shall conform with OSHA 20 CFR1910 and all applicable OSHA requirements.

2.9 STEEL LADDER

Steel ladder shall be complete with structural or formed channel stringers, steel plate treads and risers, landings, columns, handrails, and necessary bolts and other fastenings as indicated. Structural steel shall conform to ASTM A 36/A 36M. Stairs and accessories shall be galvanized. Risers on stairs with metal pan treads shall be deformed to form a sanitary cove to retain the tread concrete. Integral nosings shall have braces extended into the concrete fill. Gratings for treads and landings shall conform to NAAMM MBG 531. Grating treads shall have slip-resistant nosings.

2.10 TRENCH COVERS, FRAMES, AND LINERS

Trench covers shall be designed to meet the indicated load requirements. Trench frames and anchors shall be all welded steel construction designed to match cover. Covers shall have flush drop handles formed of 1/4 inch round stock, and shall be cast-iron grating. Grating opening widths shall not exceed 1 inch. Trench liners shall be cast iron with integral frame for cover.

2.11 ALUMINUM HATCH

Aluminum hatch doors shall have 1/4 inch diamond plate, reinforced with aluminum stiffeners as needed. The hatch door shall open to 90 degrees and lock automatically in position. The hatch shall withstand 150 psf and be equipped with lock and removable handles. The frame shall be made of 1/4 inch extruded aluminum with built-in neoprene cushion and strap anchors. The finish shall be a mill finish, with bituminous coating applied to portions of exterior of frame in contact with concrete.

PART 3 EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

All items shall be installed at the locations shown and according to the manufacturer's recommendations. Items listed below require additional procedures as specified.

3.2 INSTALLATION OF STEEL GRATING

Attach grating to end and intermediate supports with grating saddle clips and bolts. Maximum spacing shall be at 2 feet on center with a minimum of 2 per side. Attach individual units of grating together with clips at 2 feet on center maximum with a minimum of 2 clips per side.

3.3 INSTALLATION OF PIPE GUARDS

Pipe guards shall be set vertically in concrete piers. Piers shall be constructed of, and the hollow cores of the pipe filled with, concrete specified in SECTION 03300 CAST-IN-PLACE STRUCTURAL CONCRETE.

3.4 ATTACHMENT OF HANDRAILS

Toeboards and brackets shall be installed where indicated. Splices, where required, shall be made at expansion joints. Removable sections shall be installed as indicated.

3.4.1 Installation of Steel Handrails

Installation shall be by means of pipe sleeves secured to base plates bolted to stringers or structural steel framework. Rail ends shall be secured by steel pipe flanges anchored by expansion shields and bolts.

3.5 INSTALLATION OF MANHOLE STEPS AND COVERS

Install manhole steps and cover in strict accordance to manufacturer's specifications. The unit shall be operable upon completion of installation. Locate manhole steps and covers as shown on drawings.

3.6 TRENCH FRAMES AND COVERS

Trench frames and covers shall finish flush with the floor.

3.7 INSTALLATION OF FALL RESTRAINT SYSTEM

Installation shall be in accordance with manufacturer's recommendations. Where applicable, install in a workmanship manner, plumb and level as required. Install supports and fastening mechanism as needed to provide secure and sturdy system. All welds and bolted connections shall be clear and all sharp and rough areas removed. Field welding of galvanized materials shall be recoated with approved galvanized materials.

3.8 INSTALLATION OF ALUMINUM HATCH

Fasten hatch securely in place. Completely assemble hatch with inside-outside operable handles, lifting and hold-open mechanism, hinges, and necessary hardware for complete operation. The unit shall be operable upon completion of installation. Locate hatch where shown on drawings.

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SECTION 05510

PIPE AND TUBE RAILINGS

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 A 36/A 36M	(1997a) Carbon Structural Steel
ASTM A 53	(1999b) Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A 123	(1989a) Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A 307	(1997) Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength
ASTM A 325	(1994) 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 569	(1998) Commercial Steel (CS) Sheet and Strip, Carbon (0.15 Maximum Percent), Hot-Rolled
ASTM A 570/A 570M	(1998) Steel, Sheet and Strip, Carbon, Hot-Rolled, Structural Quality
ASTM A 611	(1997) Structural Steel (SS), Sheet, Carbon, Cold-Rolled
ASTM A 653/A 653M	(1999a) Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM A 780	(1993a) Repair of Damaged and Uncoated Areas of Hot-Dipped Galvanized Coatings
ASTM C 936	(1996) Solid Concrete Interlocking Paving Units

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ASTM C 1107 (1999) Packaged Dry, Hydraulic-Cement Grout (Nonshrink)

AMERICAN WELDING SOCIETY (AWS)

AWS D1.1 (2000) Structural Welding Code - Steel

AWS D1.3 (1998) Structural Welding Code - Sheet Steel

FEDERAL SPECIFICATIONS (FS)

FS-A-A-1922 (1995) Shield, Expansion (Caulking Anchors, Single Lead)

FS-FF-W-84 (1967) Washers, Lock (Spring)

FS-FF-W-92 (1974) Washer, Flat (Plain)

MILITARY SPECIFICATIONS (MS)

MS MIL P-21035 (Rev B, CN 1) Paint High Zinc Dust Content, Galvanizing Repair (Metric)

THE SOCIETY FOR PROTECTIVE COATINGS (SSPC)

SSPC Paint 20 (1991) Zinc-Rich Primers (Type I - "Inorganic" and Type II - "Organic")

SSPC PA 1 (1991) Shop, Field, and Maintenance Painting

SSPC SP 1 (1982) Solvent Cleaning

SSPC SP 3 (1995) Power Tool Cleaning

SSPC SP 7 (1994) Brush-Off Blast Cleaning

SSPC SP 8 (1982) Picklin

1.2 PERFORMANCE REQUIREMENTS

Member sizes indicated are minimum; provide sizes required.

Structural performance of handrails and railings:

a. Top Rail of Guards and Handrails: Concentrated load of 200 lbf applied at any point and in any direction. Uniform load of 50 lbf/ft. applied horizontally and concurrently with uniform load of 100 lbf/ft. applied vertically downward. Concentrated and uniform loads above need not be assumed to act concurrently.

b. Infill area of guards: Capable of withstanding a horizontal concentrated load of 200 lbf applied to 1 square foot at any point in system, including panels, intermediate rails, balusters, or other elements composing infill area.

1.3 SUBMITTALS

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Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-01 Data

Manufacturer's specifications and installation instructions; FIO.

All manufactured products used in fabrications.

Structural design calculations; FIO

Structural design calculations prepared, signed and sealed by an engineer licensed in the State of North Dakota. Include vibration analysis.

SD-04 Drawings

Materials; GA

For each fabricated item, show the following:

- a. Plans and elevations.
- b. Jointing and connections. Indicate welded connections using standard AWS symbols; indicate net weld length.
- c. Profiles of sections and reinforcing.
- d. Fasteners and anchors.
- e. Accessories.
- f. Location of each finish.

SD-14 Samples

Materials; GA

Samples of products and materials when requested.

1.4 QUALITY ASSURANCE

Provide design sealed by a professional engineer registered in the State of North Dakota.

1.5 PROJECT CONDITIONS

Coordination with masonry and concrete work: Where fabricated items or their anchors are to be embedded into concrete and masonry work, deliver such items to those performing the installation, together with coordination drawings and installation instructions.

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Steel Shapes

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Plates, bars, angles, channels and H-sections shall conform to ASTM A 36/A 36M. Grating bars shall conform to ASTM A 36/A 36M or ASTM A 569. Galvanizing shall be hot-dip galvanized after fabrication in accordance with ASTM A 123. Pipe shall conform to ASTM A 53, Grade B. Tube shall be cold-formed in conformance with ASTM A 500, hot-dip galvanized after fabrication in accordance with ASTM A 123.

2.1.2 Steel Sheet

For structural uses: Hot-rolled, ASTM A 570/A 570M; cold rolled, ASTM A 611.

2.1.3 Galvanized Steel Sheet

For structural uses: ASTM A 653/A 653M. Galvanizing: In accordance with ASTM A 653/A 653M, G90, unless otherwise indicated.

2.2 MATERIALS - MISCELLANEOUS

2.2.1 Grout

Nonmettalic, noncorrodible, nonshrink, factory blended and packaged; complying with ASTM C 1107; recommended by manufacturer for exterior use.

2.2.2 Concrete

As specified in Division 3.

2.2.3 Fasteners

Use fasteners suitable for the material being fastened and for the type of connection required. For exterior use: Nonferrous stainless steel, zinc coated or cadmium plated. Use fasteners of same material as items being fastened unless otherwise indicated. Bolts and studs: ASTM A 307 except where ASTM A 325 indicated on drawings. Nuts: ASTM A 563. Plain Washers: FS-FF-W-92. Lock Washers: FS-FF-W-84. Expansion Shields: FS-A-A-1922.

2.2.4 Galvanizing Repair Paint

Zinc dust paint complying with SSPC Paint 20 or MS MIL P-21035B, Type I or II.

2.2.5 Concrete Pavers

Solid, interlocking paving units, ASTM C 936, made from normal-weight agTT-P-664, or equivalent.

2.3 FABRICATION - GENERAL

Fabricate and shop-assemble in largest practical sections for delivery to site. Prepare and reinforce fabrications as required to receive applied items. Smooth off exposed edges and projections that are within reach and would otherwise be uncom-fortable to touch.

2.3.1 Joints and Connections

Make exposed joints and connections tight, flush, and neat. All joints and connections shall be welded, except where otherwise indicated. Exposed fasteners may be used only for joints and connections specifically

indicated as requiring exposed fasteners.

2.3.2 Welding

Provide continuous welds at corners and seams. Structural shapes shall comply with AWS D1.1 recommendations. Sheet metal shall comply with AWS D1.3 recommendations. Grind flush and smooth welds exposed to view.

2.3.3 Joints Exposed to Weather

Fabricate to keep water out, or provide adequate drainage of water that penetrates.

2.3.4 Sheet Metal

Bend corners to smallest possible radius.

2.3.5 Anchors

Fabricate to suit anchors indicated; use anchors of same material and finish as item except where specifically indicated otherwise.

2.4 FABRICATION - RAILINGS

Construct as indicated. Round pipe/tube shall be nominal pipe sizes (NPS) shown on drawings. Connections shall be welded and ground. Welding: Fill joints completely and grind off flush. Close exposed ends of hollow members with prefabricated fittings or with 3/16-inch-thick plate fully welded. Bending of members: Use jigs to make each similar configuration the same; make neat bends without other deformation. Close exposed open ends of members using same material as used in member.

2.5 FINISHING

2.5.1 Galvanizing

Hot-dip galvanize after fabrication in accordance with ASTM A 653/A 653M.

2.5.2 Preparation of Steel for Finishing

Prepare by removing loose mill scale, loose corrosion products, dirt, oil and grease. Use pickling, blast cleaning, or power tool cleaning, as required. Perform pickling in accordance with SSPC SP 8. Perform blast cleaning in accordance with SSPC SP 7, minimum. Perform power tool cleaning in accordance with SSPC SP 3. Grind off projections on exposed surfaces and fill holes and depressions. Solvent cleaning in accordance with SSPC SP 1.

2.5.3 Priming

Apply primer in shop immediately after preparation; comply with SSPC PA 1. Apply extra coat to corners, welds, edges, and fasteners. Shop prime all steel members of fabrications indicated to be factory-primed for painting. Exceptions are the following:

- a. Surfaces to be fieldwelded.
- b. Surfaces in direct contact bond with concrete.

- c. Exterior railing (hot-dip galvanized).

2.5.4 Protection

Protect finishes on exposed surfaces from damage by using temporary protective coverings. Where corrosion occurs prior to application of finish coating, clean corroded areas and re-apply shop coatings. Touch-up damaged factory finishes as recommended by fabricator.

PART 3 EXECUTION

3.1 INSTALLATION

Install items in correct location, plumb and level, without rack or warp. Provide temporary supports and bracing as required. Anchor to substrates and bracing as required. Perform all field fabrication required for installation. Fit joints tightly. Weld joints as indicated. Weld in accordance with AWS code. Grind exposed welds flush and smooth. Do not cut or weld items galvanized after fabrication. Fill steel pans with concrete, as indicated; make surface level.

3.2 CLEANING AND TOUCH-UP

Touch up damage to galvanized surfaces using methods and materials as follows:

- a. Items to Receive Paint Finish: ASTM A 780, any method.
- b. Items Left Exposed (Mill Galvanized Finish): ASTM A 780, Annex A1 ("hot stick" method).

Touch up shop painting immediately after erection. Clean field welds, bolted joints and areas where primer is damaged. Paint with material used for shop painting, minimum 2 mils dry film thickness.

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SECTION 05615

STOPLOGS

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 A 36	(1997e1) Carbon Structural Steel
ASTM A 276	(1998b) Stainless Steel Bars and Shapes
ASTM A 325	(1994) Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength
ASTM A 449	(1993) Quenched and Tempered Steel Bolts and Studs
ASTM A 563	(1997) Carbon and Alloy Steel Nuts
ASTM A 572	(1992b) High-Strength Low-Alloy Columbian-Vanadium Steel of Structural Quality
ASTM B 221	(1996) Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes
ASTM B 308	(1995a) Aluminum-Alloy 6061-T6 Standard Structural Shapes
ASTM D 395	(1989; R 1994) Rubber Property - Compression Set
ASTM D 412	(1998a) Vulcanized Rubber and Thermoplastic Rubbers and Thermoplastic Elastomers - Tension
ASTM D 471	(1995) Rubber Property - Effect of Liquids
ASTM D 572	(1988; R 1994) Rubber - Deterioration by Heat and Oxygen
ASTM D 2240	(1997e1) Rubber Property - Durometer Hardness

1.2 SUBMITTALS

Government approval is required for submittals with a "GA" designation;

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submittals having an "FIO" designation are for information only. The following shall be in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-04 Drawings

Detail Drawings; GA

Detail drawings shall be submitted as specified in Section 05055 METALWORK FABRICATION, MACHINE WORK, MISCELLANEOUS PROVISIONS.

SD-07 Schedules

Materials; FIO

Materials orders, materials lists and materials shipping bills shall be submitted as specified in Section 05055 METALWORK FABRICATION, MACHINE WORK, MISCELLANEOUS PROVISIONS.

SD-09 Reports

Tests, Inspections, and Verifications; FIO

Certified test reports for material tests shall be submitted with all materials delivered to the site.

SD-13 Certificates

Welding; FIO

Schedules of welding procedures for structural steel [and welding processes for aluminum shall be submitted as specified in Section 05055 METALWORK FABRICATION, MACHINE WORK, MISCELLANEOUS PROVISIONS.

SD-18 Records

Materials Disposition Records; FIO

A system of identification which shows the disposition of specific lots of approved materials and fabricated items in the work shall be established and submitted before completion of the contract.

SD-19 Operation and Maintenance Manuals

Operation and Maintenance Manuals; FIO

Submit O&M Manuals for stoplogs before completion of the contract.

1.3 QUALIFICATION OF WELDERS AND WELDING OPERATORS

Qualification of welders and welding operators shall conform to the requirements of Section 05055 METALWORK FABRICATION, MACHINE WORK, MISCELLANEOUS PROVISIONS.

1.4 DELIVERY, STORAGE AND HANDLING

Delivery, handling and storage of materials and fabricated items shall conform to the requirements specified in Section 05055 METALWORK FABRICATION, MACHINE WORK, MISCELLANEOUS PROVISIONS.

1.4.1 Rubber Seals

Rubber seals shall be stored in a place which permits free circulation of air, maintains a temperature of 70 degrees F or less, and prevents the rubber from being exposed to the direct rays of the sun. Rubber seals shall be kept free of oils, grease, and other materials which would deteriorate the rubber. Rubber seals shall not be distorted during handling.

PART 2 PRODUCTS

2.1 DISCHARGE CHAMBER STOPLOGS

2.1.1 Stoplog Panels

Two stoplog panels shall be provided for the entire project. Each stoplog shall be single-panel construction. Each stoplog shall be sized for use over a 60 inch diameter opening in a concrete wall. Each stoplog shall be fitted with J-type rubber seals permanently attached to the perimeter wet side of the panel to seat against the concrete wall. Each stoplog and components shall be designed for 30 feet of water head pressure.

Stoplog panels shall be fabricated from ASTM A 36 steel or aluminum. Panel must weigh less than 2,000 pounds to allow installation using a readily available crane. A guide system shall be fabricated and installed in the discharge chamber to permit installation of stoplog panel by lowering the panel from top of discharge chamber. The guide system may be mounted to chamber wall and shall guide the stoplog panel to its "closure" position. The guide system must also securely hold the stoplog panel in its "closure" position under the design water head pressure.

2.1.2 MATERIALS

Materials orders, materials lists and materials shipping bills shall conform to the requirements of Section 05055 METALWORK FABRICATION, MACHINE WORK, MISCELLANEOUS PROVISIONS.

2.1.2.1 Metals

Structural steel, structural aluminum, and other metal materials sections and standard articles shall be as shown and as specified herein and in Section 05055 METALWORK FABRICATION, MACHINE WORK, MISCELLANEOUS PROVISIONS.

- a. Structural aluminum shall conform to ASTM B 221 and ASTM B 308 ,Alloy 6061, Temper T6.

2.1.2.2 Rubber Seals

Rubber seals shall be fluorocarbon (Teflon) clad rubber seals of the mold type only, shall be compounded of natural rubber, synthetic polyisoprene, or a blend of both, and shall contain reinforcing carbon black, zinc oxide, accelerators, antioxidants, vulcanizing agents, and plasticizers. Physical characteristics of the seals shall meet the following requirements:

PHYSICAL TEST	TEST VALUE	TEST METHOD SPECIFICATION
Tensile Strength	2,500 psi (min.)	ASTM D 412

PHYSICAL TEST	TEST VALUE	TEST METHOD SPECIFICATION
Elongation at Break	450% (min.)	ASTM D 412
300% Modulus	900 psi (min.)	ASTM D 412
Durometer Hardness (Shore Type A)	60 to 70	ASTM D 2240
*Water Absorption	5% by weight (max.)	ASTM D 471
Compression Set	30% (max.)	ASTM D 395
Tensile Strength (after aging 48 hrs)	803500f tensile strength (min.)	ASTM D 572

* The "Water Absorption" test shall be performed with distilled water. The washed specimen shall be blotted dry with filter paper or other absorbent material and suspended by means of small glass rods in the oven at a temperature of 70 degrees plus/minus 2 degrees C for 22 plus/minus 1/4 hour. The specimen shall be removed, allowed to cool to room temperature in air, and weighed. The weight shall be recorded to the nearest 1 mg as W1 (W1 is defined in ASTM D 471). The immersion temperature shall be 70 degrees plus/minus 1 degree C and the duration of immersion shall be 166 hours.

a. Fabrication: Rubber seals shall have a fluorocarbon film vulcanized and bonded to the sealing surface of the bulb. The film shall be 0.060 inch thick Huntington Abrasion Resistant Fluorocarbon Film No. 4508, or equal, and shall have the following physical properties:

- Tensile strength 2,000 psi (min.)
- Elongation 250 percent (min.)

The outside surface of the bonded film shall be flush with the surface of the rubber seal and shall be free of adhering or bonded rubber. Strips and corner seals shall be molded in lengths suitable for obtaining the finish lengths shown and with sufficient excess length to provide test specimens for testing the adequacy of the adhesion bond between the film and bulb of the seal. At one end of each strip or corner seal to be tested, the fluorocarbon film shall be masked during bonding to prevent a bond for a length sufficient to hold the film securely during testing.

2.1.3 Manufactured Units

Bolts, nuts, and washers shall conform to the requirements specified.

Manufactured units shall conform to the requirements specified and in Section 05055 METALWORK FABRICATION, MACHINE WORK, MISCELLANEOUS PROVISIONS.

2.2 CLOSURE STRUCTURE STOPLOGS

2.2.1 Stoplogs

Stoplogs shall be fabricated from aluminum tubes to the dimensions

indicated on the drawings. Seal pads shall be bonded to the stoplogs as indicated on the drawings with an adhesive recommended by the manufacturer of the seal pad material and as approved and suited to the intended use. The pads shall also be attached with screws to the stoplogs as indicated on the drawings.

2.2.2 Stoplog Grooves and Sill

Extra care shall be taken in the fabrication and installation of the stoplog grooves and sills to ensure that leakage is kept to a minimum. If leakage is kept to a minimum. If leakage is excessive and misalignment of the grooves and/or sills, or their componet parts, is a contributing factor to the leakage, the Contractor shall propose corrective measures and shall implement corrective measures at no additional cost to the Government. Stoplog Groove and end sill surfaces in contact with concrete shall be coated with a bonding agent equal to Sika Armatec 110.

2.2.3 Materials

Materials orders, materials lists and materials shipping bills shall conform to the requirements of Section 05055 METALWORK FABRICATION, MACHINE WORK, MISCELLANEOUS PROVISIONS.

2.2.3.1 Seal Pads

Seal pad material shall be fabricated from material having the same characteristics and material properties as one of the following products. The adhesive used to bond the material to the stoplog shall be recommended by the manufacturer and as submitted and approved. The following manufacturers are acceptable:

- a. Custom Urethane Elasmers, Inc.: Compound PO-655.
- b. Seals Unlimited, Inc.: Product 75A.
- c. Wendt Productions, Inc.: Keelshield (smooth surface).

2.2.3.2 Structural Steel

All structural steel shall conform to ASTM A 572, Grade 50. All structural steel shall be galvanized after fabrication except stainless steel.

2.2.3.3 Structural Aluminum

Structural aluminum shall conform to ASTM B 221 and ASTM B 308, Alloy 6061, Temper T6.

2.2.3.4 Steel Threaded Rod

All steel threaded rod shall conform to ASTM A 449 and galvanized after fabrication.

2.2.3.5 Stainless Steel Threaded Rod

All stainless steel threaded rod shall conform to ASTM A 276. The threaded rod shall be strain hardened Type 316 with a minimum yield strength equal to 75 ksi and a minimum ultimate strength equal to 95 ksi.

2.2.3.6 Stop Tie-down Straps

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Stop tie-down straps shall be 2-piece, 2 inch wide polyester webbed, with straps with flat hook on each end. A ratchet buckle shall be used for tightening. The minimum working load shall be 1000 pounds. The minimum length shall be 20 feet.

2.2.3.7 Welded Shear Studs

Welded shear studs shall be Type A103. Studs shall have a minimum yield strength equal to 50 ksi and a minimum ultimate strength equal to 55 ksi.

2.2.3.8 Bolts

All bolts shall conform to ASTM A 325.

2.2.3.9 Nuts

All nuts shall conform to ASTM A 563.

2.2.3.10 Welds

All welds shall have E70 electrodes. Refer to Section 05055 METALWORK FABRICATION, MACHINE WORK, MISCELLANEOUS PROVISIONS for additional information.

2.3 FABRICATION

2.3.1 Detail Drawings

Detail drawings of stoplogs and appurtenant shop fabricated items, including fabrication drawings, shop assembly drawings, delivery drawings, and field installation drawings, shall conform to the requirements specified and in Section 05055 METALWORK FABRICATION, MACHINE WORK, MISCELLANEOUS PROVISIONS.

2.3.1.1 Fabrication Drawings

Fabrication drawings shall show complete details of materials, tolerances, connections, and proposed welding sequences which clearly differentiate shop welds and field welds.

2.3.1.2 Shop Assembly Drawings

Shop assembly drawings shall provide details for connecting the adjoining fabricated components in the shop to assure satisfactory field installation.

2.3.1.3 Delivery Drawings

Delivery drawings shall provide descriptions of methods of delivering components to the site, including details for supporting fabricated components during shipping to prevent distortion or other damages.

2.3.1.4 Field Installation Drawings

Field installation drawings shall provide a detailed description of the field installation procedures. The description shall include the location and method of support of installation and handling equipment; provisions to be taken to protect concrete and other work during installation; method of maintaining components in correct alignment; and methods for installing

appurtenant items.

2.3.2 Structural Fabrication

Structural fabrication shall conform to the requirements specified and in Section 05055 METALWORK FABRICATION, MACHINE WORK, MISCELLANEOUS PROVISIONS.

2.3.3 Welding

Welding shall conform to the requirements specified in Section 05055 METALWORK FABRICATION, MACHINE WORK, MISCELLANEOUS PROVISIONS.

2.3.4 Bolted Connections

Bolted connections shall conform to the requirements specified in Section 05055 METALWORK FABRICATION, MACHINE WORK, MISCELLANEOUS PROVISIONS.

2.3.5 Machine Work

Machine work shall conform to the requirements specified in Section 05055 METALWORK FABRICATION, MACHINE WORK, MISCELLANEOUS PROVISIONS.

2.3.6 Miscellaneous Provisions

Miscellaneous provisions for fabrication shall conform to the requirements specified and in Section 05055 METALWORK FABRICATION, MACHINE WORK, MISCELLANEOUS PROVISIONS.

2.3.7 Fabrications

2.3.7.1 Stoplogs

Stoplogs shall be fabricated of aluminum 37,000 psi tensile yield strength minimum Alloy 6061, Temper T6.

2.3.7.2 Stoplog Guides, Grooves, and Sills

Stoplog guides, grooves, and sills shall be fabricated of structural steel conforming to ASTM A 36, hot-dip galvanized as specified in Section 05055 METALWORK FABRICATION, MACHINE WORK, MISCELLANEOUS PROVISIONS.

2.3.7.3 Miscellaneous Embedded Metals

Corner protection angles, frames, base plates, and other embedded metal items required for complete installation shall conform to the details shown.

2.3.8 Seal Assemblies

Seal assemblies shall consist of rubber seals, spacer bars, and fasteners. Rubber seals shall be continuous over the full length. Seals shall be accurately fitted and drilled for proper installation. Bolt holes shall be drilled in the rubber seals by using prepared templates or the retainer bars as templates. Splices in seals shall be fully molded, develop a minimum tensile strength of 50 percent of the unspliced seal, and occur only at locations shown on fabrication drawings. All vulcanizing of splices shall be done in the shop. The vulcanized splices between molded corners and straight lengths shall be located as close to the corners as practicable. Splices shall be on a 45 degree bevel related to the "thickness" of the seal. The surfaces of finished splices shall be smooth

and free of irregularities. Stainless steel retainer bars shall be field-spliced only where shown and machine-finished after splicing.

2.4 TESTS, INSPECTIONS, AND VERIFICATIONS

Tests, inspections, and verifications for materials shall conform to the requirements specified in Section 05055 METALWORK FABRICATION, MACHINE WORK, MISCELLANEOUS PROVISIONS.

2.4.1 Testing of Rubber Seals

The fluorocarbon film of rubber seals shall be tested for adhesion bond in accordance with ASTM D 413 using either the machine method or the deadweight method. A 1 inch long piece of seal shall be cut from the end of the seal which has been masked and subjected to tension at an angle approximately 90 degrees to the rubber surface. There shall be no separation between the fluorocarbon film and the rubber when subjected to a load of 30 pounds per inch width.

Failure of any specimen to meet the requirements of the test used will be cause for rejection of the piece from which the test specimen was taken.

PART 3 EXECUTION

3.1 INSTALLATION

Installation shall conform to the requirements specified and in SECTION 05055: METALWORK FABRICATION, MACHINE WORK, MISCELLANEOUS PROVISIONS.

3.1.1 Embedded Metals

Corner protection angles, frames, base plates, and other embedded metal items required for complete installation shall be accurately installed to the alignment and grade required to ensure accurate fitting and matching of components. Anchors for embedded metals shall be installed as shown. Items requiring two concrete pours for installation shall be attached to the embedded anchors after the initial pour, adjusted to the proper alignment, and concreted in place with the second pour.

3.2 PROTECTION OF FINISHED WORK

Protection of finished work shall conform to the requirements specified in Section 05055 METALWORK FABRICATION, MACHINE WORK, MISCELLANEOUS PROVISIONS.

3.3 ACCEPTANCE TRIAL OPERATION

After completion of installation, the Contracting Officer will examine the stoplog installation for final acceptance. The individual components of the stoplog installation will be examined first to determine whether or not the workmanship conforms to the specification requirements. The Contractor will be required to place the stoplogs in the guides a sufficient number of times to demonstrate that the stoplogs fit properly and seat uniformly. Required repairs or replacements to correct defects, shall be made at no cost to the Government. The trial operation shall be repeated after defects are corrected.

-- End of Section --

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SECTION 06100

ROUGH CARPENTRY

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 FOREST & PAPER ASSOCIATION (AF&PA)

AF&PA T01 (1991; Supple 1993; Addenda Apr 1997; Supple T02) National Design Specification for Wood Construction

AF&PA T11 (1988) Manual for Wood Frame Construction

AMERICAN INSTITUTE OF TIMBER CONSTRUCTION (AITC)

AITC TC Manual (1994) Timber Construction Manual

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 307 (1997) Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength

ASTM C 518 (1998) Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus

ASTM C 665 (1998) Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing

ASTM E 96 (1995) Water Vapor Transmission of Materials

ASTM E 154 (1988; R 1999) Water Vapor Retarders Used in Contact with Earth Under Concrete Slabs, on Walls, or as Ground Cover

ASTM F 547 (1977; R 1995) Definitions of Terms Relating to Nails for Use with Wood and Wood-Base Materials

AMERICAN WOOD-PRESERVERS' ASSOCIATION (AWPA)

AWPA C2 (1995) Lumber, Timber, Bridge Ties and Mine Ties - Preservative Treatment by Pressure Processes

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AWPA C9 (1997) Plywood - Preservative Treatment by Pressure Processes

AWPA M4 (1996) Standard for the Care of Preservative-Treated Wood Products

AWPA P5 (1997) Standards for Waterborne Preservatives

APA - THE ENGINEERED WOOD ASSOCIATION (APA)

APA PRP-108 (1980; Rev Jan 1996) Performance Standards and Policies for Structural-Use Panels

CALIFORNIA REDWOOD ASSOCIATION (CRA)

CRA RIS-01-SS (1997) Standard Specifications for Grades of California Redwood Lumber

DEPARTMENT OF COMMERCE (DOC)

DOC PS 1 (1996) Voluntary Product Standard - Construction and Industrial Plywood

DOC PS 2 (1992) Performance Standards for Wood-Based Structural-Use Panels

FACTORY MUTUAL ENGINEERING AND RESEARCH (FM)

FM LPD 1-49 (1995) Loss Prevention Data Sheet - Perimeter Flashing

NATIONAL HARDWOOD LUMBER ASSOCIATION (NHLA)

NHLA Rules (1994) Rules for the Measurement & Inspection of Hardwood & Cypress

NORTHEASTERN LUMBER MANUFACTURERS ASSOCIATION (NELMA)

NELMA Grading Rules (1997) Standard Grading Rules for Northeastern Lumber

SOUTHERN CYPRESS MANUFACTURERS ASSOCIATION (SCMA)

SCMA Specs (1986; Supple No. 1, Aug 1993) Standard Specifications for Grades of Southern Cypress

SOUTHERN PINE INSPECTION BUREAU (SPIB)

SPIB Rules (1994; Supple 8 thru 11) Standard Grading Rules for Southern Pine Lumber

TRUSS PLATE INSTITUTE (TPI)

TPI 1 (1995; Errata) National Design Standard for Metal Plate-Connected Wood Truss Construction and Commentary; and Apendix 1

Grand Forks Phase 1 Levees

TPI Bklet HIB (1991) Handling, Installing & Bracing
Metal Plate Connected Wood Trusses

WEST COAST LUMBER INSPECTION BUREAU (WCLIB)

WCLIB Std 17 (1996; Supples VII(A-E), VIII(A-C))
Grading Rules for West Coast Lumber

WESTERN WOOD PRODUCTS ASSOCIATION (WWPA)

WWPA Grading Rules (1999) Western Lumber Grading Rules 95

1.2 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-01 Data

Structural Wood Members; GA

Design analysis and calculations of fabricated wood trusses and other fabricated structural members showing design criteria used to accomplish the applicable analysis.

SD-04 Drawings

Structural/Engineered Wood Members; GA

Drawings of fabricated wood trusses and other fabricated structural members indicating materials, shop fabrication, and field erection details; including methods of fastening.

1.3 DELIVERY AND STORAGE

Materials shall be delivered to the site in undamaged condition, stored off ground in fully covered, well ventilated areas, and protected from extreme changes in temperature and humidity.

PART 2 PRODUCTS

2.1 LUMBER AND SHEATHING

2.1.1 Grading and Marking

2.1.1.1 Lumber Products

Solid sawn and finger-jointed lumber shall bear an authorized gradestamp or grademark recognized by ALSC, or an ALSC recognized certification stamp, mark, or hammerbrand. Surfaces that are to be exposed to view shall not bear grademarks, stamps, or any type of identifying mark. Hammer marking will be permitted on timbers when all surfaces will be exposed to view.

2.1.1.2 Fabricated Structural Members

Wood trusses shall be fabricated in accordance with TPI 1.

2.1.1.3 Plywood and Other Sheathing Products

Grand Forks Phase 1 Levees

Materials shall bear the grademark or other identifying marks indicating grades of material and rules or standards under which produced, including requirements for qualifications and authority of the inspection organization. Except for plywood and wood structural panels, bundle marking will be permitted in lieu of marking each individual piece. Surfaces that are to be exposed to view shall not bear grademarks or other types of identifying marks.

2.1.2 Sizes

Lumber and material sizes shall conform to requirements of the rules or standards under which produced. Unless otherwise specified, lumber shall be surfaced on four sides. Unless otherwise specified, sizes indicated are nominal sizes, and actual sizes shall be within manufacturing tolerances allowed by the standard under which the product is produced.

2.1.3 Treatment

Exposed areas of treated wood that are cut or drilled after treatment shall receive a field treatment in accordance with AWPA M4. Items of all-heart material of cedar, cypress, or redwood will not require preservative treatment, except when in direct contact with soil. Except as specified for all-heart material of the previously mentioned species, the following items shall be treated:

- a. Wood members in contact with or within 18 inches of soil.
- b. Wood members in contact with water.
- c. Wood members exposed to the weather including those used in builtup roofing systems or as nailing strips or nailers over fiberboard or gypsum-board wall sheathing as a base for wood siding.
- d. Wood members set into concrete regardless of location, including flush-with-deck wood nailers for roofs.
- e. Wood members in contact with concrete that is in contact with soil or water or that is exposed to weather.

2.1.3.1 Lumber and Timbers

Lumber and timbers shall be treated in accordance with AWPA C2 with waterborne preservatives listed in AWPA P5 to a retention level as follows:

- a. 0.25 pcf intended for above ground use.
- b. 0.40 pcf intended for ground contact and fresh water use.

2.1.3.2 Plywood

Plywood shall be treated in accordance with AWPA C9 with waterborne preservatives listed in AWPA P5 to a retention level as follows:

- a. 0.25 pcf intended for above ground use.
- b. 0.40 pcf intended for ground contact and fresh water use.

2.1.4 Moisture Content

At the time lumber and other materials are delivered and when installed in the work their moisture content shall be as follows:

a. Treated and Untreated Lumber Except Roof Planking: 4 inches or less, nominal thickness, 19 percent maximum. 5 inches or more, nominal thickness, 23 percent maximum in a 3 inch perimeter of the timber cross-section.

b. Roof Planking: 15 percent maximum.

c. Materials Other Than Lumber: In accordance with standard under which product is produced.

2.1.5 Structural/Engineered Wood Members

2.1.5.1 Design Criteria

Design trusses under direct supervision of a professional engineer experience in structural framing design of trusses. Structural design of trusses shall include wind load and gravity load causing critical design stresses. The design shall consider combined effects of bending and axial loads where appropriate. For combinations that include gravity and wind, allowable stresses may be increased by 1/3. The spacing for the trusses will be set at 24 inches, unless otherwise shown on the drawings.

The minimum design loads are as follows:

- a. The total superimposed downward load is 80 psf. The superimposed downward load on the truss top cord is 60 psf (includes 50 psf live load). The superimposed downward load on the truss bottom cord is 10 psf. The wind design shall be designed to accommodate a minimum wind speed of 80 mph, standard occupancy with an Exposure C classification.

The manufacturer shall provide miscellaneous parts, including temporary bridging and permanent bracing and related items of hardware, metal hangers, anchors, and special metal shapes necessary for proper prefabrication, erection, assembly, supporting and anchoring of wood trusses.

2.1.5.2 Allowable Design Values

Species and grades shall be as listed in AF&PA T01. Structural lumber used in fabrication of bolted trusses and other fabricated structural members for engineered uses, except laminated members, shall have allowable design values of 1050 psi in bending; 700 psi in tension parallel to the grain; 300 psi in compression perpendicular to the grain; 300 psi in compression parallel to the grain; 60 psi in horizontal shear; and a modulus of elasticity of 1,200,000 psi. Joists, rafters including trussed type, decking, and headers shall have design values of 1,200 psi in bending for repetitive member uses. Design of members and fastenings shall conform to AITC TC Manual. Other stress graded or dimensioned items such as blocking, carriages, and studs shall be standard or No. 2 grade except that studs may be Stud grade. The maximum moisture content of the wood shall be 19 percent.

2.1.5.3 Trussed Rafters

As an option to standard rafters, trussed rafters may be provided. The design shall be as indicated. Connections shall be made with light-metal plate-connectors. Light-metal-plate-connected wood trusses shall be designed and fabricated in conformance with TPI 1. When new plate configuration is proposed, load testing of trusses is required and shall conform to Appendix D of TPI 1.

2.1.6 Sheathing

Sheathing shall be plywood, wood structural panels, or wood for roof sheathing.

2.1.6.1 Plywood

Plywood shall conform to DOC PS 1, APA PRP-108 or DOC PS 2, Grade C-D or sheathing grade with exterior glue. Sheathing for roof and walls without corner bracing of framing shall have a span rating of 16/0 or greater for supports 16 inches on center and a span rating of 24/0 or greater for supports 24 inches on center.

2.1.6.2 Wood Structural Panels

Panels shall meet the qualification requirements of APA PRP-108 or DOC PS 2 for rated sheathing, Exposure 1 or Structural I rated sheathing, Exposure 1. Sheathing for roofs or walls without corner bracing of framing shall have a span rating of 16/0 or greater for supports 16 inches on center and shall have a span rating of 24/0 or greater for supports 24 inches on center.

2.1.6.3 Wood

Species and grade shall be in accordance with TABLE I at the end of this section. Wall sheathing shall be 1 inch thick for supports 16 or 24 inches on center without corner bracing of framing provided sheathing is applied diagonally. Roof sheathing shall be 1 inch thick for supports 16 or 24 inches on center.

2.1.7 Miscellaneous Wood Members

2.1.7.1 Nonstress Graded Members

Members shall include bridging, corner bracing, furring, grounds, and nailing strips. Members shall be in accordance with TABLE I for the species used. Sizes shall be as follows unless otherwise shown:

<u>Member</u>	<u>Size (inch)</u>
Bridging	1 x 3 or 1 x 4 for use between members 2 x 12 and smaller; 2 x 4 for use between members larger than 2 x 12.
Nailing strips	1 x 3 or 1 x 4 when used as shingle base or interior finish, otherwise 2 inch stock.

2.1.7.2 Blocking

Blocking shall be standard or number 2 grade.

2.2 ACCESSORIES AND NAILS

Markings shall identify both the strength grade and the manufacturer. Accessories and nails shall conform to the following:

2.2.1 Anchor Bolts

ASTM A 307, size as indicated, complete with nuts and washers.

2.2.2 Bolts: Lag, Toggle, and Miscellaneous Bolts and Screws

Type, size, and finish best suited for intended use. Finish options include zinc compounds, cadmium, and aluminum paint impregnated finishes.

2.2.3 Clip Angles

Steel, 3/16 inch thick, size best suited for intended use; or zinc-coated steel or iron commercial clips designed for connecting wood members.

2.2.4 Expansion Shields

Type and size best suited for intended use.

2.2.5 Joist Hangers

Steel or iron, zinc-coated, size to fit members where used, sufficient strength to develop the full strength of supported member, complete with any special nails required.

2.2.6 Metal Bridging

Optional to wood bridging; zinc-coated steel, size and design to provide rigidity equivalent to specified wood bridging.

2.2.7 Nails and Staples

ASTM F 547, size and type best suited for purpose; staples shall be as recommended by the manufacturer of the materials to be joined. For sheathing and subflooring, length of nails shall be sufficient to extend 1 inch into supports. In general, 8-penny or larger nails shall be used for nailing through 1 inch thick lumber and for toe nailing 2 inch thick lumber; 16-penny or larger nails shall be used for nailing through 2 inch thick lumber. Nails used with treated lumber and sheathing shall be galvanized. Nailing shall be in accordance with the recommended nailing schedule contained in AF&PA T11. Where detailed nailing requirements are not specified, nail size and spacing shall be sufficient to develop an adequate strength for the connection. The connection's strength shall be verified against the nail capacity tables in AF&PA T01. Reasonable judgement backed by experience shall ensure that the designed connection will not cause the wood to split. If a load situation exceeds a reasonable limit for nails, a specialized connector shall be used.

2.3 INSULATION

Thermal resistance of insulation shall be not less than the R-values shown. R-values shall be determined at 75 degrees F in accordance with ASTM C 518.

Insulation shall contain the highest practicable percentage of recovered material which has been recovered or diverted from solid waste, but not

including material reused in a manufacturing process. Where two materials have the same price and performance, the one containing the higher recovered material content shall be provided. Insulation shall be the standard product of a manufacturer and factory marked or identified with manufacturer's name or trademark and R-value. Identification shall be on individual pieces or individual packages.

2.3.1 Batt or Blanket

2.3.1.1 Glass Fiber Batts and Rolls

Glass fiber batts and rolls shall conform to ASTM C 665, Type I unfaced insulation. Insulation shall have a 10 mil thick, white, puncture resistant woven-glass cloth with vinyl facing on one side. Width and length shall suit construction conditions.

2.4 VAPOR RETARDER

Vapor retarder shall be polyethylene sheeting conforming to ASTM E 154 or other equivalent material. Vapor retarder shall have a maximum vapor permeance rating of 0.5 perms as determined in accordance with ASTM E 96, unless otherwise specified.

PART 3 EXECUTION

3.1 INSTALLATION OF FRAMING

3.1.1 General

General framing shall be in accordance with AF&PA T11. Members shall be closely fitted, accurately set to required lines and levels, and rigidly secured in place. Members shall be framed for passage of ducts. Members shall be cut, notched, or bored in accordance with applicable requirements of AF&PA T01 for the passage of pipes, wires, or conduits. Rafters, purlins, and joists shall be set with crown edge up. When joists, beams, and girders are placed on masonry or concrete, a wood base plate shall be positioned and leveled with grout. The joist, beam, or girder shall then be placed on the plate. When joists, beams, and girders are set into masonry or concrete, a pocket shall be formed into the wall. The joist, beam, or girder shall then be placed into the pocket and leveled with a steel shim.

3.1.2 Structural Members

Members shall be adequately braced before erection. Members shall be aligned and all connections completed before removal of bracing. Individually wrapped members shall be unwrapped only after adequate protection by a roof or other cover has been provided. Scratches and abrasions of factory-applied sealer shall be treated with two brush coats of the same sealer used at the factory.

3.1.2.1 Structural/Engineered Wood Members

Set and secure wood trusses level, plumb, and place in correct locations. Temporary bracing and anchorage shall be provided to hold trusses in place until permanently secured. Ensure trusses have sufficient bearing area and install permanent bracing and bridging prior to application of design loads. Members may not be cut or altered. Regarding wood preservatives, brush apply 2 coats on members in contact with sheet metal, members in

contact with cementitious materials, and ensure saw cut ends are protected. Steel connects shall be compatible with the selected wood treatment. Connector plates shall be G90 galvanized sheet steel, die stamped with integral teeth, minimum 20-gauge thickness.

3.1.3 Roof Framing or Rafters

Tops of supports or rafters shall form a true plane. Valley, ridge, and hip members shall be of depth equal to cut on rafters where practicable, but in no case less than depth of rafters. Valleys, hips, and ridges shall be straight and true intersections of roof planes. Necessary crickets and watersheds shall be formed. Rafters, except hip and valley rafters, shall be spiked to wall plate and to ceiling joists with no less than three 8-penny nails. Rafters shall be toe-nailed to ridge, valley, or hip members with at least three 8-penny nails. Rafters shall be braced to prevent movement until permanent bracing, decking or sheathing is installed. Hip and valley rafters shall be secured to wall plates by clip angles. Openings in roof shall be framed with headers and trimmers. Unless otherwise indicated, headers carrying more than two rafters and trimmers supporting headers carrying more than one rafter shall be double. Hip rafters longer than the available lumber shall be butt jointed and scabbed. Valley rafters longer than the available lumber shall be double, with pieces lapped not less than 4 feet and well spiked together. Trussed rafters shall be installed in accordance with TPI Bklet HIB. Engineered wood joists shall be installed in accordance with distributor's instructions.

3.2 INSTALLATION OF SHEATHING

3.2.1 Plywood and Wood Structural Panels

Sheathing shall be applied with edges 1/8 inch apart at side and end joints, and nailed at supported edges at 6 inches on center and at intermediate supports 12 inches on center unless otherwise shown. Nailing of edges shall be 3/8 inch from the edges. Roof sheathing shall be applied with long dimension at right angles to supports, end joints made over supports, and end joints staggered.

3.2.2 Wood

Sheathing end joints shall be made over framing members and so alternated that there will be at least two boards between joints on the same support. Each board shall bear on at least three supports. Boards shall be nailed at each support using two nails for boards 6 inches and less in width and three nails for boards more than 6 inches in width. Roof sheathing shall not be installed where roof decking is installed.

3.3 INSTALLATION OF MISCELLANEOUS WOOD MEMBERS

3.3.1 Bridging

Wood bridging shall have ends accurately bevel-cut to afford firm contact and shall be nailed at each end with two nails. Metal bridging shall be installed as recommended by the manufacturer. The lower ends of bridging shall be driven up tight and secured after subflooring or roof sheathing has been laid and partition framing installed.

3.3.2 Blocking

Blocking shall be provided as necessary for application of siding, sheathing, and other materials or building items, and to provide firestopping. Blocking for firestopping shall ensure a maximum dimension of 8 feet for any concealed space. Blocking shall be cut to fit between framing members and rigidly nailed thereto.

3.3.3 Nailers and Nailing Strips

Nailers and nailing strips shall be provided as necessary for the attachment of finish materials. Nailers used in conjunction with roof deck installation shall be installed flush with the roof deck system. Stacked nailers shall be assembled with spikes or nails spaced not more than 18 inches on center and staggered. Beginning and ending nails shall not be more than 6 inches for nailer end. Ends of stacked nailers shall be offset approximately 12 inches in long runs and alternated at corners. Anchors shall extend through the entire thickness of the nailer. Strips shall be run in lengths as long as practicable, butt jointed, cut into wood framing members when necessary, and rigidly secured in place. Nailers and nailer installation for Factory Mutual wind uplift rated roof systems specified in other Sections of these specifications shall conform to the recommendations contained in FM LPD 1-49.

3.4 INSTALLATION OF INSULATION

Insulation shall be installed after construction has advanced to a point that the installed insulation will not be damaged by remaining work. For thermal insulation the actual installed thickness shall provide the R-values shown. Insulation shall be installed on the weather side of such items as electrical boxes and water lines. Unless otherwise specified, installation shall be in accordance with the manufacturer's recommendation.

3.5 INSTALLATION OF VAPOR RETARDER

Joints in the vapor retarder shall be lapped and sealed according to the manufacturer's recommendations.

3.6 TABLES

TABLE I. SPECIES AND GRADE

Subflooring, Roof Sheathing, Wall Sheathing, Furring

Grading Rules	Species	Const Standard	No. 2 Comm	No. 2 Board Comm	No. 3 Comm
NHLA Rules					
	Cypress			X	
NELMA Grading Rules					
	Northern White Cedar				X
	Eastern White Pine	X			
	Northern Pine	X			
	Balsam Fir				X
	Eastern Hemlock-Tamarack				X
CRA RIS-01-SS					
	Redwood		X		
SCMA Specs					
	Cypress			X	
SPIB Rules					
	Southern Pine		X		
WCLIB Std 17					
	Douglas Fir-Larch	X			
	Hem-Fir	X			
	Sitka Spruce	X			
	Mountain Hemlock	X			
	Western Cedar	X			
WWPA Grading Rules					
	Douglas Fir-Larch	X			
	Hem-Fir	X			
	Idaho White Pine	X			
	Lodgepole Pine			X	
	Ponderosa Pine			X	
	Sugar Pine			X	
	Englemann Spruce			X	
	Douglas Fir South			X	
	Mountain Hemlock			X	
	Subalpine Fir			X	
	Western Cedar			X	

TABLE II. SPECIES AND GRADE

Wood Bumpers

Grading Rules	Species	No. 1	No. 2
NHLA Rules			

TABLE II. SPECIES AND GRADE

Wood Bumpers

Grading Rules	Species	No. 1	No. 2
	Red Oak	X	
NELMA Grading Rules	Northern Pine		X
	Eastern Hemlock- Tamarack		X
SPIB Rules	Southern Pine	X	
WCLIB Std 17	Douglas Fir-Larch		X
	Hem-Fir		X
WWPA Grading Rules	Douglas Fir-Larch		X
	Hem-Fir		X
	Douglas Fir-South		X

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SECTION 06200

FINISH CARPENTRY

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.

NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY (NIST)

NIST PS 20 (1994; Addenda Jan. 1997) American Softwood Lumber Standard

1.2 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-04 Drawings

Kiosk; GA

SD-14 Samples

Kiosk; GA

Submit samples of finish for vanity plastic laminate for selection of color and pattern.

1.3 QUALITY ASSURANCE

Factory-mark each piece of lumber and plywood with type, grade, mill and grading agency identification; except omit marking from surfaces to receive transparent finish, and submit mill certificate that material has been inspected and graded in accordance with requirements if it cannot be marked on a concealed surface.

1.4 DELIVERY, STORAGE AND HANDLING

Do not deliver lumber or trim until suitable storage is available on site; take care to avoid moisture buildup. Store in accordance with good practice to avoid warp, damage, soiling and deterioration.

PART 2 PRODUCTS

2.1 LUMBER

Nominal sizes are indicated, except as shown by detailed dimensions.

Grand Forks Phase 1 Levees

Provide dressed or worked and dressed lumber, as applicable, manufactured to actual sizes as required by NIST PS 20 or to actual sizes and patterns as shown, unless otherwise indicated. Provide seasoned (KD) lumber having a moisture content from time of manufacture until time of installation not greater than values required by applicable grading rules of respective grading and inspecting agency for species and product indicated. Provide kiln-dried (KD) hardwood lumber having a moisture content from time of manufacture until time of installation within ranges required in referenced woodworking standard.

2.1.1 Lumber For Transparent Finish (Stained or Clear)

Use pieces made of solid lumber stock.

2.1.2 Lumber For Painted Finish

At Contractor's option, use pieces which are either glued-up lumber or made of solid lumber stock.

2.2 EXTERIOR TRIM

2.2.1 Trim

Western red cedar, B Clear, rough sawn.

2.3 EXTERIOR WOOD SCREEN

Lumber: Western red cedar, B Clear, rough sawn. Concrete: See Section 03300 CAST-IN-PLACE STRUCTURAL CONCRETE.

2.4 MISCELLANEOUS HARDWARE

Furnish miscellaneous hardware including but not limited to nails, screws, bolts, toggle bolts, staples, masonry anchors, and appurtenances.

PART 3 EXECUTION

3.1 INSTALLATION - GENERAL

Condition woodwork to average prevailing humidity prior to installation. Install carpentry and woodwork plumb, level, true and straight with no distortions. Shim as required using concealed shims. Where woodwork abuts other finished work, scribe and cut for accurate fit. Before making cutouts, drill pilot holes at corners. Distribute defects (as permitted by specified quality grade) to best over-all advantage.

3.2 INSTALLATION - WOOD TRIM

Install trim in single, unjointed lengths for openings and runs less than 10 feet. For longer runs, use only one piece less than 10 feet in any straight run. Stagger joints in adjacent members. Cope at returns and miter corners. Attach trim securely with uniform joints providing for building movements. Secure woodwork to anchors or blocking built-in or directly attached to substrates. Blind nail where possible. Use fine finishing nails where exposed. Set exposed nail heads for filling, except for exterior wood which receives natural finish (if any). Clean woodwork and fill nail holes in preparation for finishes specified under Section 09900 PAINTING, GENERAL. Where woodwork is to receive transparent finish, use matching wood filler.

3.3 FINISH

See Section 09900 PAINTING, GENERAL.

3.4 CLEANUP AND ADJUSTMENT

Repair defective work. Adjust and lubricate hardware for proper operation. Clean exposed interior and exterior surfaces. Clean woodwork and touch-up finish as required. Replace damaged areas.

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SECTION 07220

ROOF INSULATION

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SECTION 07220

ROOF INSULATION

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 C 1289 | (1998) Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board |
| ASTM D 41 | (1994) Asphalt Primer Used in Roofing, Dampproofing, and Waterproofing |
| ASTM D 312 | (1995a) Asphalt Used in Roofing |
| ASTM D 4586 | (1993) Asphalt Roof Cement, Asbestos Free |

FACTORY MUTUAL ENGINEERING AND RESEARCH (FM)

- | | |
|-----------|---|
| FM P9513 | (1996) Loss Prevention Data for Roofing Contractors |
| FM P7825c | (1998) Approval Guide Building Material |

1.2 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-13 Certificates

Insulation; FIO

Certificate attesting that the expanded perlite or polyisocyanurate insulation contains recovered material and showing estimated percent of recovered material. Certificates of compliance for felt materials.

1.3 STORAGE OF MATERIALS

Insulation materials shall be stored in accordance with manufacturer's instructions. Insulation, base sheet, and felt shall be kept dry at all times, before, during, and after delivery to the site and shall be stored in an enclosed building or in a closed trailer. Wet insulation, wet base sheet or wet felt shall be permanently removed from the site. Felts shall be stacked on end one level high. Felt rolls shall be maintained at a

temperature above 50 degrees F for 24 hours immediately before laying.

PART 2 PRODUCTS

2.1 BITUMINOUS MATERIALS

Bituminous materials shall conform to the following requirements:

2.1.1 Asphalt Bitumen

ASTM D 312, Type III or IV. Asphalt flash point, finished blowing temperature, and equiviscous temperature (EVT) for mop and for mechanical spreader application shall be indicated on bills of lading or on individual containers.

2.1.2 Asphalt Cement

ASTM D 4586, Type I for surfaces sloped from 0 to 3 inches per foot; Type II for slopes greater than 3 inches per foot.

2.1.3 Asphalt Primer

ASTM D 41.

2.2 INSULATION

Insulation shall be a standard product of the manufacturer and shall be factory marked with the manufacturer's name or trade mark, the material specification number, the R-value at 75 degrees F, and the thickness. Minimum thickness shall be as recommended by the manufacturer. Boards shall be marked individually. The thermal resistance of insulation shall be not less than the R-value shown on the drawings. The insulation manufacturing process shall not include chlorofluoro carbons (CFC) or formaldehydes. Insulation and fiberboard shall contain the highest practicable percentage of material which has been recovered or diverted from solid waste (e.g., postconsumer waste), but not including material reused in a manufacturing process. Where two materials have comparable price and performance, the one having the higher recovered material content shall be selected. Insulation shall be the following material:

2.2.1 Polyisocyanurate

ASTM C 1289 Type II, tapered insulation, having minimum recovered material content of 9 percent by weight of the polyisocyanurate portion of the board.

2.3 FASTENERS

Fasteners shall be specifically designed screws and plates or spikes and plates of sufficient length to hold insulation securely in place. Fasteners shall conform to insulation manufacturer's recommendations. Fasteners for steel or concrete decks shall conform to FM P7825c for Class I roof deck construction, and shall be spaced to withstand an uplift pressure of 90 pounds per square foot.

2.4 WOOD NAILERS

Wood nailers shall conform to Section 06100 ROUGH CARPENTRY, including preservative treatment. Edge nailers shall be not less than nominal 6 inches wide and of thickness to finish flush with the top surface of the

insulation. Surface mounted nailers shall be a nominal 3 inches wide by the full thickness of the insulation.

PART 3 EXECUTION

3.1 COORDINATION REQUIREMENTS

Insulation and roofing membrane shall be finished in one operation up to the line of termination at the end of each day's work. Completed sections shall be glaze coated when more than one day is required to finish the roofing. Phased construction will not be permitted.

3.2 ENVIRONMENTAL CONDITIONS

The temperature of the roofing materials shall be as required by the manufacturer. Air temperature shall be above 40 degrees F and there shall be no visible ice, frost, or moisture on the roof deck when the insulation and roofing are installed. Wind conditions shall be suitable for installation of insulation: Wind chill may affect the proper application temperatures of materials; hot materials may be blown about, creating safety dangers; insulation boards may become difficult and hazardous to handle; wrappers, coverings, and other debris may become airborne, and possibly contaminate laps and seams.

3.3 SUBSTRATE PREPARATION

The substrate construction of any bay or section of the building shall be completed before insulation work is begun thereon. Insulation to be applied directly on concrete shall not be scheduled until deck has been primed and allowed to dry, frothing or bubbling does not occur when hot bitumen is applied to the concrete and until the hot bitumen sticks tightly to the concrete. Vents and other items penetrating the roof shall be secured in position and properly prepared for flashing. Substrate surface shall be smooth, clean, and dry at time of application.

3.4 HEATING OF ASPHALT

Asphalt shall not be heated higher than 105 degrees F above the EVT or 50 degrees F below the flash point, or 525 degrees F, whichever is lower. EVT and flash point temperatures of asphalt in the kettle shall be conspicuously posted on the kettle. Kettle shall be provided with automatic thermostatic controls and an accurate thermometer. Kettle operators shall be in attendance at all times during heating to ensure that the maximum temperature is not exceeded. Asphalt shall be applied within a range of 25 degrees F below or above the EVT, or as specified by the manufacturer. Application temperature shall be measured at the mop bucket or mechanical applicator. Asphalt at a temperature below this range shall be returned to the kettle. Flame-heated equipment shall not be placed on the roof.

3.5 INSTALLATION OF WOOD NAILERS

Nailers shall be secured to cast-in-place deck materials by not less than 3/8 inch diameter anchors embedded in the deck not over 47 inches on centers. Nailers shall be secured to deck materials as indicated. Bolt anchors shall have nuts and washers countersunk, and bolts shall be cut flush with top of nailer. Powder-actuated fasteners, sized and spaced for nailer anchorage equivalent to that specified and indicated, may be used when approved. Surface mounted nailers shall be installed parallel with

the roof slope and shall be spaced not over 47 inches face-to-face, except that where the insulation units are less than 47 inches in length the nailers shall be spaced to minimize cutting of the insulation.

3.6 APPLICATION OF INSULATION

Insulation shall be laid in two or more layers. Units of insulation shall be laid in courses parallel with the roof slope. End joints shall be staggered. Insulation shall be cut to fit neatly against adjoining surfaces. Joints between insulation boards shall not exceed 1/4 inch. Joints in successive layers shall be staggered with respect to joints of preceding layer. Insulation which can be readily lifted after installation is not considered to be adequately secured. Insulation shall be applied so that all roof insulation applied each day is waterproofed the same day. Phased construction will not be permitted. Application of impermeable faced insulation shall be performed without damage to the facing.

3.6.1 Mechanical Fastening

Method of attachment shall be in accordance with recommendations of the insulation manufacturer and requirements specified.

3.6.2 Installation

Insulation layers shall be laid in solid moppings of hot asphalt applied at a rate of at least 20 pounds per square. Asphalt shall not be applied further than one panel length ahead of roof insulation being installed. Where roof slopes are greater than 1/2 inch/foot, roof insulation shall be held in place by both asphalt mopping and mechanical fasteners. Asphalt primer shall be applied at the rate of 1 gallon per square over the entire surface to be mopped when the insulation is applied over concrete deck. The edges of insulation boards adjoining vented nailers shall be kept free of asphalt.

3.6.3 Protection Requirements

The insulation shall be kept dry at all times. Insulation boards shall not be kicked into position. Exposed edges of the insulation shall be protected by cutoffs at the end of each work day or whenever precipitation is imminent. Cutoffs shall be 2 layers of bituminous-saturated felt set in plastic bituminous cement. Cutoffs shall be removed when work is resumed. Edges of insulation at open spaces between insulation and parapets or other walls and spaces at curbs, scuttles, and expansion joints, shall be protected until permanent roofing and flashing is applied. Storing, walking, wheeling, or trucking directly on insulation or on roofed surfaces will not be permitted. Smooth, clean board or plank walkways, runways, and platforms shall be used, as necessary to distribute weight to conform to indicated live load limits of roof construction.

3.7 INSPECTION

The Contractor shall establish and maintain an inspection procedure to assure compliance of the installed roof insulation with the contract requirements. Any work found not to be in compliance with the contract shall be promptly removed and replaced or corrected in an approved manner. Quality control shall include, but not be limited to, the following:

a. Observation of environmental conditions; number and skill level of insulation workers; start and end time of work.

Grand Forks Phase 1 Levees

b. Verification of certification, listing or label compliance with FM P9513.

c. Verification of proper storage and handling of insulation and vapor retarder materials before, during, and after installation.

d. Inspection of mechanical fasteners; type, number, length, and spacing.

e. Coordination with other materials, cants, sleepers, and nailing strips.

f. Inspection of insulation joint orientation and laps between layers, joint width and bearing of edges of insulation on deck.

g. Installation of cutoffs and proper joining of work on subsequent days.

h. Continuation of complete roofing system installation to cover insulation installed same day.

-- End of Section --

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SECTION 07311

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 - 3.2.4 Shingles

-- End of Section Table of Contents --

SECTION 07311

ROOFING, STRIP SHINGLES

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 D 226	(1997a) Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing
ASTM D 1970	(1997) Self-Adhering Polymer Modified Bituminous Sheet Materials Used as Steep Roofing Underlayment for Ice Dam Protection
ASTM D 3018	(1990; R 1994) Class A Asphalt Shingles Surfaced With Mineral Granules
ASTM D 3161	(1995a) Wind-Resistance of Asphalt Shingles (Fan-Induced Method)
ASTM D 3462	(1997) Asphalt Shingles Made From Glass Felt and Surfaced with Mineral Granules
ASTM D 4869	(1988; R 1993) Asphalt-Saturated Organic Felt Shingle Underlayment Used in Roofing
ASTM E 108	(1996) Fire Tests of Roof Coverings

NATIONAL ROOFING CONTRACTORS ASSOCIATION (NRCA)

NRCA Asph Shing Roof Mnl	(1996) Asphalt Shingle Roofing Manual
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1.2 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-14 Samples

Shingles; GA

Full shingle sample and manufacturer's standard size samples of materials and products requiring color or finish selection.

1.3 DELIVERY AND STORAGE OF MATERIALS

Grand Forks Phase 1 Levees

Materials shall be delivered in manufacturer's unopened bundles and containers with the manufacturer's brand and name marked clearly thereon. Shingles shall be stored in accordance with manufacturer's printed instructions. Roll goods shall be stored on end in an upright position or in accordance with manufacturer's recommendations. Immediately before laying, roofing felt shall be stored for 24 hours in an area maintained at a temperature not lower than 50 degrees F.

1.4 WARRANTY

Manufacturer's standard performance guarantees or warranties that extend beyond a 1 year period shall be provided.

PART 2 PRODUCTS

2.1 MATERIALS

Materials shall conform to the following requirements:

2.1.1 Metal Drip Edges

Metal drip edges shall be minimum 26 gauge galvanized steel or an equivalent non-corrosive non-staining material, as shown.

2.1.2 Underlayment

Organic felt; ASTM D 4869 or ASTM D 226, non perforated Type II, heavy-duty number 30.

2.1.3 Leak Barrier Underlayment

Self-adhering leak barrier or ice dam underlayment shall comply with ASTM D 1970 for sealability around nails.

2.1.4 Nails

Nails shall be round head 11 or 12 gauge galvanized steel or equivalent corrosion resistant roofing nails. Nail heads shall be 3/8 inch minimum diameter, with flat and smooth low profile. Shanks shall be barbed or otherwise deformed for added pull-out resistance. Nails shall be long enough to penetrate all layers of roofing materials and achieve secure anchorage into the roof deck. Nails shall extend through the underside of plywood or wood panel roof decks, and shall penetrate at least 3/4 inch into wood plank decks.

2.1.5 Shingles

Shingles shall be approximately 12 by 36 inches in dimension and three-tab strip design. Shingles shall have self-sealing adhesive strips and shall meet a wind velocity rating of 80 mph plus or minus 5 percent in accordance with ASTM D 3161. Shingles shall be manufacturer's standard type for project area. Glass felt shingles shall comply with ASTM D 3018 and ASTM D 3462 Type I (self-sealing), ASTM E 108 Class A (a light degree of fire protection), and shall weigh not less than 340 lbs.

2.2 COLOR

Shingle color shall be in accordance with Section 09915 COLOR SCHEDULE.

PART 3 EXECUTION

3.1 PREPARATION OF SURFACES

The construction of any bay or section of roof decking shall be completed before roofing work is started. Roof surfaces shall be smooth, firm, dry, and free from loose boards, large cracks, and projecting ends that might damage the roofing. Vents and other projections through roofs shall be properly flashed and secured in position, and projecting nails shall be driven flush with the deck.

3.2 APPLICATION OF ROOFING MATERIALS

3.2.1 Flashings

Metal flashings shall conform to Section 07600 SHEET METALWORK, GENERAL. Metal flashings shall be provided at the intersections of roofs and adjoining walls and at projections through the deck such as vent stacks. Valley flashing shall be of the woven type, in accordance with NRCA Asph Shing Roof Mnl.

3.2.2 Metal Drip Edges

Metal drip edges shall be provided along the eaves and rakes. The metal drip edge shall be applied directly over the underlayment along the rakes and directly on the wood deck at the eaves. Metal drip edges shall extend back from the edge of the deck not less than 3 inches and shall be secured with compatible nails spaced not more than 10 inches on center along the inner edge.

3.2.3 Underlayment

Before any shingles are applied, a single layer of asphalt-saturated-felt underlayment shall be applied to the roof deck sheathing. In areas subject to ice damming, two plies of organic felt set in hot asphalt or asphalt lap cement, or an adhered polymer modified bitumen membrane underlayment shall be applied starting from the eaves to a point 24 inches inside the interior wall line.

3.2.4 Shingles

Shingles with the correct recommended exposure shall be applied in accordance with the manufacturer's printed instructions as they appear on the bundle wrapping.

-- End of Section --

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SECTION 07412

NON-STRUCTURAL METAL ROOFING

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SECTION 07412

NON-STRUCTURAL METAL ROOFING

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 A 463/A 463M	(1999a) Steel Sheet, Aluminum-Coated, by the Hot-Dip Process
ASTM A 653/A 653M	(1999a) Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM A 792/A 792M	(1999) Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process
ASTM D 226	(1997a) Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing
ASTM D 522	(1993a) Mandrel Bend Test of Attached Organic Coatings
ASTM D 610	(1995) Evaluating Degree of Rusting on Painted Steel Surfaces
ASTM D 714	(1987; R 1994e1) Evaluating Degree of Blistering of Paints
ASTM D 1654	(1992) Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments
ASTM D 2244	(1995) Calculation of Color Differences from Instrumentally Measured Color Coordinates
ASTM D 4214	(1998) Evaluating Degree of Chalking of Exterior Paint Films
ASTM D 5894	(1996) Standard Practice for Cyclic Salt Fog/UV Exposure of Painted Metal, (Alternating Exposures in a Fog/Dry Cabinet and a UV/Condensation Cabinet

UNDERWRITERS LABORATORIES (UL)

UL 580

(1994; Rev thru Feb 1998) Tests for Uplift
Resistance of Roof Assemblies

1.2 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-04 Drawings

Metal Roofing; GA

a. Drawings consisting of catalog cuts, flashing details, erection drawings, shop coating and finishing specifications, and other data as necessary to clearly describe materials, sizes, layouts, construction details, fasteners, and erection. Drawings shall be provided by the metal roofing manufacturer.

b. Drawings showing the UL 580, Class 90 tested roof system assembly.

SD-13 Certificates

Roof Panels; GA
Installation; GA
Accessories; GA

Certificates attesting that the panels and accessories conform to the specified requirements. Certificate for the roof assembly shall certify that the assembly complies with the material and fabrication requirements specified and is suitable for the installation at the indicated design slope. Certified laboratory test reports showing that the sheets to be furnished are produced under a continuing quality control program and that at least 3 representative samples of similar material to that which will be provided on this project have been previously tested and have met the quality standards specified for factory color finish.

Installer; GA

Certification of installer.

Warranties; GA

At the completion of the project, signed copies of the 5-year Warranty for Non-Structural Metal Roofing System, a sample copy of which is attached to this section, and the 20-year Manufacturer's Material Warranties.

SD-14 Samples

Accessories; GA

One sample of each type of flashing, trim, fascia, closure, cap and similar items. Size shall be sufficient to show construction and configuration.

Roof Panels; GA

One piece of each type and finish to be used, 9 inches long, full width.

Fasteners; GA

Two samples of each type to be used with statement regarding intended use. If so requested, random samples of screws, bolts, nuts, and washers as delivered to the jobsite shall be taken in the presence of the Contracting Officer and provided to the Contracting Officer for testing to establish compliance with specified requirements.

Gaskets and Insulating Compounds; GA

Two samples of each type to be used and descriptive data.

Sealant; GA

One sample, approximately 1 pound, and descriptive data.

1.3 GENERAL REQUIREMENTS

The Contractor shall furnish a commercially available roofing system which satisfies the specified design and additional requirements contained herein. The roofing system shall be provided by the Contractor as a complete system, as tested and approved in accordance with UL 580. Roof panels, components, transitions, accessories, and assemblies shall be supplied by the same roofing system manufacturer.

1.3.1 Non-Structural Metal Roof System

The Non-Structural Metal Roof System covered under this specification shall include the entire roofing system; the metal roof panels, fasteners, connectors, roof securement components, and assemblies tested and approved in accordance with UL 580. The system shall be installed on a substrate specified in Section 06100 ROUGH CARPENTRY. In addition, the system shall consist of panel finishes, slip sheet, insulation, vapor retarder, all accessories, components, and trim and all connections with roof panels. This includes roof penetration items such as vents, curbs, skylights; interior or exterior gutters and downspouts, eaves, ridge, hip, valley, rake, gable, wall, or other roof system flashings installed and any other components specified within this contract to provide a weathertight roof system; and items specified in other sections of the specifications that are part of the system.

1.3.2 Manufacturer

The non-structural metal roofing system shall be the product of a manufacturer who has been in the practice of manufacturing metal roofs for a period of not less than 3 years and has been involved in at least five projects similar in size and complexity to this project.

1.3.3 Installer

The installer shall be certified by the metal roof manufacturer to have experience in installing at least three projects that are of comparable size, scope and complexity as this project for the particular roof system furnished. The installer may be either employed by the manufacturer or be

an independent installer.

1.4 DESIGN LOADS

Non-structural Metal Roof System assemblies shall be tested as defined in UL 580 and shall be capable of resisting the wind uplift pressures shown on the contract drawings or, as a minimum, shall be approved to resist wind uplift pressures of UL 580, Class 90.

1.5 PERFORMANCE REQUIREMENTS

The metal roofing system supplied shall conform to the roof slope, the underlayment, and uplift pressures shown on the contract drawings. The Contractor shall furnish a commercially available roofing system which satisfies all the specified requirements.

1.6 DELIVERY AND STORAGE

Materials shall be delivered to the site in a dry and undamaged condition and stored out of contact with the ground. Materials shall be covered with weather tight coverings and kept dry. Material shall not be covered with plastic where such covering will allow sweating and condensation. Plastic may be used as tenting with air circulation allowed. Storage conditions shall provide good air circulation and protection from surface staining.

1.7 WARRANTIES

The Non-Structural Metal Roofing System shall be warranted as outlined below. Any emergency temporary repairs conducted by the owner shall not negate the warranties.

1.7.1 Contractor's Weathertightness Warranty

The Non-Structural Metal Roofing System shall be warranted by the Contractor on a no penal sum basis for a period of five years against material and workmanship deficiencies; system deterioration caused by exposure to the elements and/or inadequate resistance to specified service design loads, water leaks, and wind uplift damage. The roofing covered under this warranty shall include the entire roofing system, including but not limited to, the roof panels, fasteners, connectors, roof securement components, and assemblies tested and approved in accordance with UL 580. In addition, the system shall consist of panel finishes, slip sheet, insulation, vapor retarder, all accessories, components, and trim and all connections with roof panels. This includes roof penetration items such as vents, curbs, skylights; interior or exterior gutters and downspouts; eaves, ridge, hip, valley, rake, gable, wall, or other roof system flashings installed and any other components specified within this contract to provide a weathertight roof system; and items specified in other sections of the specifications that are part of the roof system. All material and workmanship deficiencies, system deterioration caused by exposure to the elements and/or inadequate resistance to service design loads, water leaks and wind uplift damage shall be repaired as approved by the Contracting Officer. See the attached Contractor's required warranty for issue resolution of warrantable defects. This warranty shall warrant and cover the entire cost of repair or replacement, including all material, labor, and related markups. The Contractor shall supplement this warranty with written warranties from the installer and system manufacturer, which shall be submitted along with Contractor's warranty; however, the Contractor shall be ultimately responsible for this warranty. The

Contractor's written warranty shall be as outlined in attached WARRANTY FOR NON-STRUCTURAL METAL ROOF SYSTEM, and shall start upon final acceptance of the facility. It is required that the Contractor provide a separate bond in an amount equal to the installed total roofing system cost in favor of the owner (Government) covering the Contractor's warranty responsibilities effective throughout the 5 year Contractor's warranty period for the entire roofing system as outlined above.

1.7.2 Manufacturer's Material Warranties

The Contractor shall furnish, in writing, the following manufacturer's material warranties which cover all Non-Structural Metal Roofing System components such as roof panels, flashing, accessories, and trim, fabricated from coil material:

a. A manufacturer's 20 year material warranty warranting that the aluminum, zinc-coated steel, aluminum-zinc alloy coated steel or aluminum-coated steel as specified herein will not rupture, fail structurally, or perforate under normal atmospheric conditions at the site. Liability under this warranty shall be limited exclusively to the cost of either repairing or replacing nonconforming, ruptured, perforated, or structurally failed coil material.

b. A manufacturer's 20 year exterior material finish warranty warranting that the factory color finish, under normal atmospheric conditions at the site, will not crack, peel, or delaminate; chalk in excess of a numerical rating of 8 when measured in accordance with ASTM D 4214; or fade or change colors in excess of 5 NBS units as measured in accordance with ASTM D 2244. Liability under this warranty is exclusively limited to refinishing or replacing the defective coated coil material.

1.8 COORDINATION MEETING

A coordination meeting shall be held within 45 days after contract award for mutual understanding of the metal roofing system contract requirements.

This meeting shall take place at the building site and shall include representatives from the Contractor, the roofing system manufacturer, the roofing supplier, the erector, the designer, and the Contracting Officer. All items required by paragraph SUBMITTALS shall be discussed, including applicable standard manufacturer shop drawings, and the approval process. The Contractor shall coordinate time and arrangements for the meeting.

PART 2 PRODUCTS

2.1 ROOF PANELS

Panels shall be steel and shall have a factory color finish. Length of sheets shall be sufficient to cover the entire length of any unbroken roof slope for slope lengths that do not exceed 30 feet. Sheets longer than 30 feet may be furnished if approved by the Contracting Officer. Width of sheets shall provide nominal 12 inches of coverage in place. Design provisions shall be made for thermal expansion and contraction consistent with the type of system to be used. All sheets shall be either square-cut or miter-cut. The ridge cap shall be installed as recommended by the metal roofing manufacturer. Height of corrugations, ribs, or seams, at overlap of adjacent roof sheets shall be the building manufacturer's standard for the indicated roof slope.

2.1.1 Steel Panels

Zinc-coated steel conforming to ASTM A 653/A 653M; aluminum-zinc alloy coated steel conforming to ASTM A 792/A 792M, AZ 50 coating; or aluminum-coated steel conforming to ASTM A 463/A 463M, Type 2, coating designation T2 65. Uncoated roof panels shall be 0.024 inch thick minimum. Panels shall be within 95 percent of the nominal thickness.

2.2 ACCESSORIES

Accessories shall be compatible with the roofing furnished. Flashing, trim, metal closure strips, caps, and similar metal accessories shall be not less than the minimum thicknesses specified for roof panels. Exposed metal accessories shall be finished to match the panels furnished. Molded closure strips shall be bituminous-saturated fiber, closed-cell or solid-cell synthetic rubber or neoprene, or polyvinyl chloride premolded to match configuration of the panels and shall not absorb or retain water.

2.3 FASTENERS

Fasteners for roof panels shall be zinc-coated steel, aluminum, or nylon capped steel, type and size as recommended by the manufacturer to meet the performance requirements. Fasteners for accessories shall be the manufacturer's standard. Exposed roof fasteners shall be gasketed or have gasketed washers on the exterior side of the roofing to waterproof the fastener penetration. Washer material shall be compatible with the panels; and gasketed portion of fasteners or washers shall be neoprene or other equally durable elastomeric material approximately 1/8 inch thick.

2.4 FACTORY COLOR FINISH

Panels shall have a factory applied polyvinylidene fluoride finish on the exposed side. The exterior finish shall consist of a baked-on topcoat with an appropriate prime coat. Color shall match the color indicated in Section 09915 COLOR SCHEDULE. The exterior coating shall be a nominal 1 mil thickness consisting of a topcoat of not less than 0.7 mil dry film thickness and the paint manufacturer's recommended primer of not less than 0.2 mil thickness. The exterior color finish shall meet the test requirements specified below.

2.4.1 Cyclic Salt Fog/UV Test

A sample of the sheets shall withstand a cyclic corrosion test for a minimum of 2016 hours in accordance with ASTM D 5894, including the scribe requirement in the test. Immediately upon removal of the panel from the test, the coating shall receive a rating of not less than 10, no blistering, as determined by ASTM D 714; 10, no rusting, as determined by ASTM D 610; and a rating of 6, over 1/16 to 1/8 inch failure at scribe, as determined by ASTM D 1654.

2.4.2 Formability Test

When subjected to testing in accordance with ASTM D 522 Method B, 1/8 inch diameter mandrel, the coating film shall show no evidence of fracturing to the naked eye.

2.5 UNDERLAYMENTS

2.5.1 Felt Underlayment

Grand Forks Phase 1 Levees

Felt underlayment shall be No. 30 felt in accordance with ASTM D 226, Type II.

2.5.2 Rubberized Underlayment

Rubberized underlayment shall be equal to "Ice and Water Shield" as manufactured by Grace Construction Products, "Winterguard" as manufactured by CertainTeed Corporation, or "Weather Watch Ice and Water Barrier" as manufactured by GAF Building Materials Corporation.

2.5.3 Slip Sheet

Slip Sheet shall be 5 pounds per 100 sf rosin sized unsaturated building paper.

2.6 SEALANT

Sealant shall be an elastomeric type containing no oil or asphalt. Exposed sealant shall be colored to match the applicable building color and shall cure to a rubberlike consistency. Sealant placed in the roof panel standing seam ribs shall be provided in accordance with the manufacturer's recommendations.

2.7 GASKETS AND INSULATING COMPOUNDS

Gaskets and insulating compounds shall be nonabsorptive and suitable for insulating contact points of incompatible materials. Insulating compounds shall be nonrunning after drying.

PART 3 EXECUTION

3.1 INSTALLATION

Installation shall be in accordance with the manufacturer's erection instructions and drawings. Dissimilar materials which are not compatible when contacting each other shall be insulated by means of gaskets or insulating compounds. Improper or mislocated drill holes shall be plugged with an oversize screw fastener and gasketed washer; however, sheets with an excess of such holes or with such holes in critical locations shall not be used. Exposed surfaces and edges shall be kept clean and free from sealant, metal cuttings, hazardous burrs, and other foreign material. Stained, discolored, or damaged sheets shall be removed from the site.

3.1.1 Roofing

Side laps shall be laid away from the prevailing winds. Side and end lap distances, joint sealing, and fastening and spacing of fasteners shall be in accordance with manufacturer's standard practice. Spacing of exposed fasteners shall present an orderly appearance. Side laps and end laps of roof panels and joints at accessories shall be sealed. Fasteners shall be driven normal to the surface. Method of applying joint sealant shall conform to the manufacturer's recommendation to achieve a complete weathertight installation. Accessories shall be fastened into substrate, except as otherwise approved. Closure strips shall be provided as indicated and where necessary to provide weathertight construction.

3.1.2 Field Forming of Roof Panels for Unique Areas

When roofing panels are formed from factory-color-finished steel coils at

the project site, the same care and quality control measures that are taken in shop forming of roofing panels shall be observed. Rollformer shall be operated by the metal roofing manufacturer's approved installer. In cold weather conditions, preheating of the steel coils to be field formed shall be performed as necessary just prior to the rolling operations.

3.1.3 Underlayment

Underlayment types shall be installed where shown on the drawings; they shall be installed directly over the substrate. If a roof panel rests directly on the underlayments, a slip sheet shall be installed as a top layer, beneath the metal roofing panels, to prevent adhesion. All underlayments shall be installed so that successive strips overlap the next lower strip in shingle fashion. Underlayments shall be installed in accordance with the manufacturer's written instructions. The underlayments shall ensure that any water that penetrates below the metal roofing panels will drain outside of the building envelope.

CONTRACTOR'S FIVE (5) YEAR NO PENAL SUM WARRANTY
FOR
NON-STRUCTURAL METAL ROOF SYSTEM

FACILITY DESCRIPTION _____

BUILDING NUMBER: _____

CORPS OF ENGINEERS CONTRACT NUMBER: _____

CONTRACTOR

CONTRACTOR: _____

ADDRESS: _____

POINT OF CONTACT: _____

TELEPHONE NUMBER: _____

OWNER

OWNER: _____

ADDRESS: _____

POINT OF CONTACT: _____

TELEPHONE NUMBER: _____

CONSTRUCTION AGENT

CONSTRUCTION AGENT: _____

ADDRESS: _____

POINT OF CONTACT: _____

TELEPHONE NUMBER: _____

CONTRACTOR'S FIVE (5) YEAR NO PENAL SUM WARRANTY
FOR
NON-STRUCTURAL METAL ROOF SYSTEM
(continued)

THE NON-STRUCTURAL METAL ROOF SYSTEM INSTALLED ON THE ABOVE NAMED BUILDING IS WARRANTED BY _____ FOR A PERIOD OF FIVE (5) YEARS AGAINST WORKMANSHIP AND MATERIAL DEFICIENCIES, WIND DAMAGE, STRUCTURAL FAILURE, AND LEAKAGE. THE NON-STRUCTURAL METAL ROOFING SYSTEM COVERED UNDER THIS WARRANTY SHALL INCLUDE, BUT SHALL NOT BE LIMITED TO, THE FOLLOWING: THE ENTIRE ROOFING SYSTEM, MANUFACTURER SUPPLIED FRAMING AND STRUCTURAL MEMBERS, METAL ROOF PANELS, FASTENERS, CONNECTORS, ROOF SECUREMENT COMPONENTS, AND ASSEMBLIES TESTED AND APPROVED IN ACCORDANCE WITH UL 580. IN ADDITION, THE SYSTEM PANEL FINISHES, SLIP SHEET, INSULATION, VAPOR RETARDER, ALL ACCESSORIES, COMPONENTS, AND TRIM AND ALL CONNECTIONS ARE INCLUDED. THIS INCLUDES ROOF PENETRATION ITEMS SUCH AS VENTS, CURBS, SKYLIGHTS; INTERIOR OR EXTERIOR GUTTERS AND DOWNSPOUTS; EAVES, RIDGE, HIP, VALLEY, RAKE, GABLE, WALL, OR OTHER ROOF SYSTEM FLASHINGS INSTALLED AND ANY OTHER COMPONENTS SPECIFIED WITHIN THIS CONTRACT TO PROVIDE A WEATHERTIGHT ROOF SYSTEM; AND ITEMS SPECIFIED IN OTHER SECTIONS OF THE SPECIFICATIONS THAT ARE PART OF THE NON-STRUCTURAL METAL ROOFING SYSTEM.

ALL MATERIAL DEFICIENCIES, WIND DAMAGE, STRUCTURAL FAILURE, AND LEAKAGE ASSOCIATED WITH THE NON-STRUCTURAL METAL ROOF SYSTEM COVERED UNDER THIS WARRANTY SHALL BE REPAIRED AS APPROVED BY THE CONTRACTING OFFICER. THIS WARRANTY SHALL COVER THE ENTIRE COST OF REPAIR OR REPLACEMENT, INCLUDING ALL MATERIAL, LABOR, AND RELATED MARKUPS. THE ABOVE REFERENCED WARRANTY COMMENCED ON THE DATE OF FINAL ACCEPTANCE ON _____ AND WILL REMAIN IN EFFECT FOR STATED DURATION FROM THIS DATE.

SIGNED, DATED, AND NOTARIZED (BY COMPANY PRESIDENT)

(Company President) (Date)

CONTRACTOR'S FIVE (5) YEAR NO PENAL SUM WARRANTY
FOR
NON-STRUCTURAL METAL ROOFING SYSTEM
(continued)

THE CONTRACTOR SHALL SUPPLEMENT THIS WARRANTY WITH WRITTEN WARRANTIES FROM THE MANUFACTURER AND/OR INSTALLER OF THE NON-STRUCTURAL METAL ROOFING SYSTEM, WHICH SHALL BE SUBMITTED ALONG WITH THE CONTRACTOR'S WARRANTY. HOWEVER, THE CONTRACTOR WILL BE ULTIMATELY RESPONSIBLE FOR THIS WARRANTY AS OUTLINED IN THE SPECIFICATIONS AND AS INDICATED IN THIS WARRANTY EXAMPLE.

EXCLUSIONS FROM COVERAGE

1. NATURAL DISASTERS, ACTS OF GOD (LIGHTNING, FIRE, EXPLOSIONS, SUSTAINED WIND FORCES IN EXCESS OF THE DESIGN CRITERIA, EARTHQUAKES, AND HAIL).
2. ACTS OF NEGLIGENCE OR ABUSE OR MISUSE BY GOVERNMENT OR OTHER PERSONNEL, INCLUDING ACCIDENTS, VANDALISM, CIVIL DISOBEDIENCE, WAR, OR DAMAGE CAUSED BY FALLING OBJECTS.
3. CORROSION CAUSED BY EXPOSURE TO CORROSIVE CHEMICALS, ASH OR FUMES GENERATED OR RELEASED INSIDE OR OUTSIDE THE BUILDING FROM CHEMICAL PLANTS, FOUNDRIES, PLATING WORKS, KILNS, FERTILIZER FACTORIES, PAPER PLANTS, AND THE LIKE.
4. FAILURE OF ANY PART OF THE NON-STRUCTURAL METAL ROOF DUE TO ACTIONS BY THE OWNER TO INHIBIT FREE DRAINAGE OF WATER FROM THE ROOF AND GUTTERS AND DOWNSPOUTS OR ALLOW PONDING WATER TO COLLECT ON THE ROOF SURFACE. CONTRACTOR'S DESIGN SHALL INSURE FREE DRAINAGE FROM THE ROOF AND NOT ALLOW PONDING WATER.
5. THIS WARRANTY APPLIES TO THE NON-STRUCTURAL METAL ROOFING SYSTEM. IT DOES NOT INCLUDE ANY CONSEQUENTIAL DAMAGE TO THE BUILDING INTERIOR OR CONTENTS WHICH IS COVERED BY THE WARRANTY OF CONSTRUCTION CLAUSE INCLUDED IN THIS CONTRACT.
6. THIS WARRANTY CANNOT BE TRANSFERRED TO ANOTHER OWNER WITHOUT WRITTEN CONSENT OF THE CONTRACTOR; AND THIS WARRANTY AND THE CONTRACT PROVISIONS WILL TAKE PRECEDENCE OVER ANY CONFLICTS WITH STATE STATUTES.

**

CONTRACTOR'S FIVE (5) YEAR NO PENAL SUM WARRANTY
FOR
NON-STRUCTURAL METAL ROOF SYSTEM
(continued)

**REPORTS OF LEAKS AND ROOF SYSTEM DEFICIENCIES SHALL BE RESPONDED TO WITHIN 48 HOURS OF RECEIPT OF NOTICE, BY TELEPHONE OR IN WRITING, FROM EITHER THE OWNER OR CONTRACTING OFFICER. EMERGENCY REPAIRS TO PREVENT FURTHER ROOF LEAKS SHALL BE INITIATED IMMEDIATELY; A WRITTEN PLAN SHALL BE SUBMITTED FOR APPROVAL TO REPAIR OR REPLACE THIS ROOF SYSTEM WITHIN SEVEN (7) CALENDAR DAYS. ACTUAL WORK FOR PERMANENT REPAIRS OR REPLACEMENT SHALL BE STARTED WITHIN 30 DAYS AFTER RECEIPT OF NOTICE, AND COMPLETED WITHIN A REASONABLE TIME FRAME. IF THE CONTRACTOR FAILS TO ADEQUATELY RESPOND TO THE WARRANTY PROVISIONS, AS STATED IN THE CONTRACT AND AS CONTAINED HEREIN, THE CONTRACTING OFFICER MAY HAVE THE NON-STRUCTURAL METAL ROOF SYSTEM REPAIRED OR REPLACED BY OTHERS AND CHARGE THE COST TO THE CONTRACTOR.

IN THE EVENT THE CONTRACTOR DISPUTES THE EXISTENCE OF A WARRANTABLE DEFECT, THE CONTRACTOR MAY CHALLENGE THE OWNER'S DEMAND FOR REPAIRS AND/OR REPLACEMENT DIRECTED BY THE OWNER OR CONTRACTING OFFICER EITHER BY REQUESTING A CONTRACTING OFFICER'S DECISION UNDER THE CONTRACT DISPUTES ACT, OR BY REQUESTING THAT AN ARBITRATOR RESOLVE THE ISSUE. THE REQUEST FOR AN ARBITRATOR MUST BE MADE WITHIN 48 HOURS OF BEING NOTIFIED OF THE DISPUTED DEFECTS. UPON BEING INVOKED, THE PARTIES SHALL, WITHIN TEN (10) DAYS, JOINTLY REQUEST A LIST OF FIVE (5) ARBITRATORS FROM THE FEDERAL MEDIATION AND CONCILIATION SERVICE. THE PARTIES SHALL CONFER WITHIN TEN (10) DAYS AFTER RECEIPT OF THE LIST TO SEEK AGREEMENT ON AN ARBITRATOR. IF THE PARTIES CANNOT AGREE ON AN ARBITRATOR, THE CONTRACTING OFFICER AND THE PRESIDENT OF THE CONTRACTOR'S COMPANY WILL STRIKE ONE (1) NAME FROM THE LIST ALTERNATIVELY UNTIL ONE (1) NAME REMAINS. THE REMAINING PERSON SHALL BE THE DULY SELECTED ARBITRATOR. THE COSTS OF THE ARBITRATION, INCLUDING THE ARBITRATOR'S FEE AND EXPENSES, COURT REPORTER, COURTROOM OR SITE SELECTED, ETC., SHALL BE BORNE EQUALLY BETWEEN THE PARTIES. EITHER PARTY DESIRING A COPY OF THE TRANSCRIPT SHALL PAY FOR THE TRANSCRIPT. A HEARING WILL BE HELD AS SOON AS THE PARTIES CAN MUTUALLY AGREE. A WRITTEN ARBITRATOR'S DECISION WILL BE REQUESTED NOT LATER THAN 30 DAYS FOLLOWING THE HEARING. THE DECISION OF THE ARBITRATOR WILL NOT BE BINDING; HOWEVER, IT WILL BE ADMISSIBLE IN ANY SUBSEQUENT APPEAL UNDER THE CONTRACT DISPUTES ACT.

A FRAMED COPY OF THIS WARRANTY SHALL BE POSTED IN THE MECHANICAL ROOM OR OTHER APPROVED LOCATION DURING THE ENTIRE WARRANTY PERIOD.

-- End of Section --

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SECTION 07469

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SECTION 07469

METAL SIDING

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 ARCHITECTURAL MANUFACTURERS ASSOCIATION (AAMA)

AAMA 1402.86 Standard Specifications for Aluminum Siding, Soffit and Fascia

1.2 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-01 Data

Aluminum Siding; GA.
Aluminum Soffit; GA.
Aluminum Gutters and Downspouts; GA.

Manufacturer's standard printed product data and installation instructions for specified products.

SD-14 Samples

Aluminum Siding; GA.
Aluminum Soffit; GA.
Aluminum Gutters and Downspouts; GA.

- a. Selection Samples: Submit color chips of manufacturer's full range of colors for Architect's selection.
- b. Verification Samples: Submit three samples, each 12 inches in length, of each specified product in specified color.

1.3 DELIVERY, STORAGE, AND HANDLING

Deliver metal siding and soffit products to project site in original packaging. Store siding and soffit products in original packaging, on flat surface under cover, stacked no more than 12 boxes high.

1.4 WARRANTY

Provide manufacturer's standard limited lifetime warranty that products are free from manufacturing defects when installed according to manufacturer's

specifications. Warranty period shall be lifetime for original owner; 50-year from date of purchase transferable to subsequent owners.

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Aluminum Siding

3105-H27P aluminum sheet. Minimum tensile strength shall be 28,000 psi and minimum yield strength shall be 25,000 psi. Conform to AAMA 1402.86.

Double 4-inch profile, 8 inches exposure; nominal 12 feet 6 inch piece length. Thickness: 0.024 inch. Finish shall be 2-phase operation including corrosion-inhibiting primer and baked-on high-performance acrylic topcoat.

Accessories shall be aluminum of same thickness, finish, and color as siding and shall include the following:

- a. Louvers - closed.
- b. Starter strips.
- c. Outside corner posts.
- d. Inside corner posts.
- e. J-channels.
- f. General purpose trim.

2.1.2 Aluminum Soffit

3105 aluminum sheet. Minimum tensile strength shall be 26,000 psi and minimum yield strength shall be 22,000 psi. Conform to AAMA 1402.86.

12 inch wide panels with interlocking edges and elongated nailing hems, 3/8 inch deep, with double 5.5 inch wide faces forming V-grooves at 6 inches on center. Perforations shall be 1/16 inch diameter holes on 5/32 inch staggered centers in a uniform 5 inch wide pattern along entire panel length. Ventilation shall be 15 square inches per square foot net free area. Material thickness shall be 0.019 inch. Finish shall be 2-phase operation including corrosion-inhibiting primer and baked-on high-performance acrylic topcoat. Provide all accessories for complete watertight installation.

2.1.3 Aluminum Gutters and Downspouts

2.1.3.1 Gutters

6 inch standard OG gutter. Material thickness shall be 0.032 inch. Finish shall be 2-phase operation including corrosion-inhibiting primer and baked-on high-performance acrylic topcoat. Provide all accessories for complete watertight installation.

2.1.3.2 Downspouts

3 inch by 4 inch standard rectangular corrugated downspout. Material

thickness shall be 0.027 inch. Finish shall be 2-phase operation including corrosion-inhibiting primer and baked-on high-performance acrylic topcoat. Provide all accessories for complete watertight installation.

2.1.4 Vapor Retarder

See Section 07311 ROOFING, STRIP SHINGLES.

2.1.5 Joint Sealers

See Section 07900 JOINT SEALING

PART 3 EXECUTION

3.1 EXAMINATION

Examine substrate conditions before beginning installation of metal siding, soffit, gutters and downspout products; verify dimensions and acceptability of substrate. Do not proceed with installation until unacceptable conditions have been corrected.

3.2 INSTALLATION

Installation of vapor retarder is specified in Section 07311 ROOFING, STRIP SHINGLES. Install metal siding, soffit, gutters and downspout products in accordance with manufacturer's printed installation instructions. Attach siding and soffit panels to substrate interlocked and lapped for weathertight installation, nails concealed; install horizontal components true to level and vertical components true to plumb. Space siding nails at 16 inches on center; center nails in nailing slots without binding to allow for thermal movement. Paint or otherwise protect dissimilar metals in contact. Installation of joint sealers is specified in Section 07900 JOINT SEALING.

3.3 ADJUSTING AND CLEANING

Clean dirt from surface of installed products, using mild soap and water. After completing installation, remove from project site excess materials and debris resulting from installation.

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SECTION 07530

ELASTOMERIC ROOFING (EPDM)

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 D 4637 (1996) EPDM Sheet Used in Single-Ply Roof Membrane

ASTM E 108 (1996) Fire Tests of Roof Coverings

FACTORY MUTUAL ENGINEERING AND RESEARCH (FM)

FM P9513 (1996) Loss Prevention Data for Roofing Contractors

UNDERWRITERS LABORATORIES (UL)

UL 580 (1994; Rev thru Feb 1998) Tests for Uplift Resistance of Roof Assemblies

UL 790 (1997; Rev thru Jul 1998) Tests for Fire Resistance of Roof Covering Materials

UL 1256 (1998) Fire Test of Roof Deck Constructions

1.2 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-13 Certificates

Materials; FIO

Certificates of compliance attesting that the roofing system and materials meet specification requirements. The certificates shall list the components required for the specified fire and wind uplift resistance ratings.

1.3 GENERAL REQUIREMENTS

Elastomeric membrane roofing shall be fully adhered to the roof surfaces indicated. Roofing membrane sheet widths shall be consistent with membrane attachment methods and wind uplift requirements, and shall be as large as

practical to minimize joints. Membrane shall be free of defects and foreign material. Flashing work shall be coordinated to permit continuous membrane installation operations. Applied insulation shall be weatherproofed by the membrane on the same day.

1.3.1 Delivery and Storage

Materials shall be delivered to the jobsite in the manufacturer's original, unopened packages, clearly marked with the manufacturer's name, brand name, and description of contents. Materials shall be stored in clean, dry areas. Storage temperatures shall be as specified by the manufacturer. Materials other than ballast stored on the roof shall not exceed one day's supply and shall be distributed so as not to exceed the roof live load capacity.

1.3.2 Fire Resistance

The completed roof system shall have a ASTM E 108 (same test as UL 790 and FM P9513, Appendix A) Class B classification, and meet fire test requirements of UL 1256 or FM P9513, Appendix B for roof deck construction. Compliance of each component of the roofing system shall be evidenced by label or by written certification from the manufacturer.

1.3.3 Wind Uplift Requirements

Fully adhered roofing systems shall have a 90 UL 580 Class Rating or FM P9513, Appendix C Windstorm Classification. Ratings from other independent laboratories may be substituted provided that the tests, requirements and ratings are documented to be equivalent, to the satisfaction of the Contracting Officer.

1.3.4 Warranty

Manufacturer's standard warranty for the roofing system shall be provided for not less than 10 years from acceptance of the work. Warranty shall state that manufacturer shall repair or replace defective materials if the roofing system leaks or allows the insulation beneath the membrane to become wet during the period of the warranty.

PART 2 PRODUCTS

2.1 ADHESIVES

Adhesives, splicing cements, solvents, and sealants shall be as recommended by the membrane manufacturer.

2.2 FASTENERS

Fasteners for sheet-metal flashing shall be corrosion resistant steel annular-type nails or screws.

2.3 FLASHING

Flashing shall be of ultra-violet resistant materials as recommended by the membrane manufacturer. Prefabricated shaped flashings shall be used where possible. Sheared edges of metal flashings that contact the membrane shall be turned into a tight hem.

2.4 MEMBRANE

Grand Forks Phase 1 Levees

Membrane shall conform to ASTM D 4637, Type I EPDM, Grade 1; Class U, 0.060 inch minimum thickness.

2.5 PREFABRICATED ACCESSORIES

Pipe seals and expansion joint covers shall be types and sizes recommended by the membrane manufacturer.

2.6 WALKWAYS

Walkways shall be rubber mats, roofing manufacturer's standard size and thickness. Where drainage would be blocked by walkway, spaces shall be provided between or below to facilitate drainage. Alternative walkway material may be used if recommended by the manufacturer and approved by the Contracting Officer.

PART 3 EXECUTION

3.1 ENVIRONMENTAL CONDITIONS

Membrane shall not be installed in high wind, inclement weather or when there is visible ice, frost or moisture on the deck, insulation or membrane. Membrane shall not be installed when air temperature is below the minimum specified by the membrane manufacturer.

3.2 PREPARATION

The substrate of any bay or section of the building shall be complete and suitable for insulation and membrane installation before roofing is begun. Insulation over which elastomeric roofing is installed shall conform to Section 07220 ROOF INSULATION. Surfaces against which membrane is applied shall be smooth, clean, and free from dirt, water, dew, oil, grease, sharp edges and construction debris; all joints over 1/4 inch wide shall be sealed; joints over 1/2 inch between insulation boards shall be filled with the same insulation. Wood nailers shall comply with Section 06100 ROUGH CARPENTRY.

3.3 INSTALLATION

Installation shall comply with the manufacturer's approved instructions, except as otherwise specified.

3.3.1 Flashing

Edges of membrane, projections through the roof and changes in roof planes shall be flashed. The flashing material shall be extended and sealed a minimum of 3 inches on each side of the fasteners which attach the membrane to nailers. The installed flashing shall be fastened at the top of the flashing a maximum of 12 inches on center under metal counter-flashing or cap.

3.3.2 Membrane Installation

Membrane shall be applied in accordance with the manufacturer's instructions and the following requirements. Adjoining sheets comprising the membrane shall be adhered one to another using a butyl-based contact adhesive. Minimum width of the laps shall be 3 in. A primer shall be used before applying the contact adhesive if required by the membrane

manufacturer. In applying the contact adhesive, the minimum thickness of the wet film shall be in accordance with the membrane manufacturer's recommendations. If manufacturer's recommendations are not available, the minimum thickness shall be 0.025 inch. A wet film thickness gage shall be used to determine wet film thickness. Direction of lap shall be such that water flows over lap. Membrane joints shall be free of wrinkles or fishmouths. Before application of the contact adhesive, the rubber surfaces to be mated shall be well cleaned. Joints shall be inspected over entire length after completion and defective areas shall be resealed and patched. Damaged areas of membrane shall be removed and replaced with new materials, lapping underlying membrane by at least 3 inches on all sides.

3.3.3 Installation of Walkways

Walkways shall be installed as specified by the manufacturer.

3.4 PROTECTION OF FINISHED ROOFING

The roofing membrane shall be protected from damage by other trades. After completion of work by other trades, the protection shall be removed and the roof shall be inspected. Any damage shall be repaired in accordance with the recommendations of the roofing manufacturer.

3.5 INSPECTION

The Contractor shall establish and maintain an inspection procedure to assure compliance of the installed elastomeric roofing with the contract requirements. The procedure shall include a checklist of points to be observed. Any work found not to be in compliance with the contract shall be promptly removed and replaced or corrected in an approved manner. Quality control shall include, but not be limited to, the following:

- a. Observation of environmental conditions; number and skill level of roofing workers; start and end time of various tasks; condition of substrate.
- b. Verification of compliance of materials before, during and after installation.
- c. Inspection of insulation, nailers, flashings, penetrations and work requiring coordination with roofing.
- d. Inspection of membrane placement, splicing, and attachment.
- e. Inspection of placement of ballast and walkways.
- f. Verification of ballast weight.

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SECTION 07600

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SECTION 07600

SHEET METALWORK, GENERAL

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 A 167	(1999) Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip
ASTM B 32	(1996) Solder Metal
ASTM B 209M	(1995) Aluminum and Aluminum-Alloy Sheet and Plate (Metric)
ASTM B 221M	(1996) Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric)
ASTM B 370	(1998) Copper Sheet and Strip for Building Construction
ASTM D 226	(1997a) Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing
ASTM D 1784	(1999a) Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds
ASTM D 2822	(1991; R 1997e1) Asphalt Roof Cement
ASTM D 4022	(1994) Coal Tar Roof Cement, Asbestos Containing
ASTM D 4586	(1993) Asphalt Roof Cement, Asbestos Free

SHEET METAL & AIR CONDITIONING CONTRACTORS NATIONAL ASSOCIATION (SMACNA)

SMACNA Arch. Manual	(1993; Errata; Addenda Oct 1997) Architectural Sheet Metal Manual
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1.2 GENERAL REQUIREMENTS

Sheet metalwork shall be accomplished to form weathertight construction without waves, warps, buckles, fastening stresses or distortion, and shall

allow for expansion and contraction. Cutting, fitting, drilling, and other operations in connection with sheet metal required to accommodate the work of other trades shall be performed by sheet metal mechanics. Installation of sheet metal items used in conjunction with roofing shall be coordinated with roofing work to permit continuous roofing operations. Sheet metalwork pertaining to heating, ventilating, and air conditioning is specified in Section 15895 AIR SUPPLY, DISTRIBUTION, VENTILATION, AND EXHAUST SYSTEM.

1.3 DELIVERY, STORAGE, AND HANDLING

Materials shall be adequately packaged and protected during shipment and shall be inspected for damage, dampness, and wet-storage stains upon delivery to the jobsite. Materials shall be clearly labeled as to type and manufacturer. Sheet metal items shall be carefully handled to avoid damage. Materials shall be stored in dry, ventilated areas until immediately before installation.

PART 2 PRODUCTS

2.1 MATERIALS

Lead, lead-coated metal, and galvanized steel shall not be used. Any metal listed by SMACNA Arch. Manual for a particular item may be used, unless otherwise specified or indicated. Materials shall conform to the requirements specified below and to the thicknesses and configurations established in SMACNA Arch. Manual. Different items need not be of the same metal, except that if copper is selected for any exposed item, all exposed items shall be copper.

2.1.1 Formed Aluminum Gravel Stop

Type shall be similar to "Formed Gravel Stop - Fascia System" Chapter 2, figure 2-1, SMACNA Arch. Manual and as shown on drawings. Material shall be 0.040 inch aluminum. Finish shall be factory-applied "Kynar 500" PVF coating, or equal. Color shall be selected from manufacturer's standard colors after award of contract. Continuous concealed clip shall be same material as fascia. Provide fasteners of correct length and type.

2.1.2 Scupper and Conductor Head

Type shall be similar to "Scupper Design and Installation," Figure 1-26, page 1.59, SMACNA Arch. Manual and as shown on drawings. Material shall be 0.040 inch aluminum. Finish shall be factory-applied "Kynar 500" PVF coating, or equal. Color shall be selected from manufacturer's standard colors after award of contract. Provide necessary fasteners, hangers and accessories.

2.1.3 Gutters and Downspouts

Material shall be 0.032 inch prefinished aluminum. Rectangular design. Provide necessary clips, fasteners, hangers and accessories. Finish shall be factory-applied "Kynar 500" PVF coating, or equal. Finish shall be color selected from manufacturer's standard colors after award of contract.

2.1.4 Miscellaneous Flashing

Base flashing, counterflashings, roof penetration flashings, and miscellaneous flashings as shown on drawings. Material shall be 0.032 inch aluminum; same finish as adjacent construction.

2.1.5 Sculptured Metal Cornice

Type: See drawings for shape. Material shall be 0.40 inch aluminum. Finish shall be factory-applied "Kynar 500" PVF coating, or equal.

2.1.6 Fabrication

Form sections true to shape, accurate in size, square, and free from distortion or defects. Hem exposed edges on underside 1/2 inch; miter and seam corners. Weld aluminum seams.

2.1.7 Accessories

Accessories and other items essential to complete the sheet metal installation, though not specifically indicated or specified, shall be provided. Fastener shall be stainless steel, aluminum, or galvanized steel. Finish exposed fasteners same as adjacent construction.

2.1.8 Aluminum Extrusions

ASTM B 221M, Alloy 6063, Temper T5.

2.1.9 Bituminous Cement

Type I asphalt cement conforming to ASTM D 2822 or ASTM D 4586. For coal tar roofing; coal tar cement conforming to ASTM D 4022.

2.1.10 Sealant

Unless otherwise specified, sealant shall be an elastomeric weather resistant sealant as specified in Section 07900 JOINT SEALING.

2.1.11 Fasteners

Fasteners shall be compatible with the fastened material and shall be the type best suited for the application.

2.1.12 Felt

ASTM D 226, Type I.

2.1.13 Polyvinyl Chloride (PVC) Reglets

ASTM D 1784, Class 14333D, 0.075 inch minimum thickness.

2.1.14 Aluminum Alloy Sheet and Plate

ASTM B 209M, anodized clear form, alloy, and temper appropriate for use.

2.1.15 Copper

ASTM B 370, Temper H 00.

2.1.16 Stainless Steel

ASTM A 167, Type 302 or 304; fully annealed, dead soft temper.

2.1.17 Solder

ASTM B 32, 95-5 tin-antimony.

2.1.18 Through-Wall Flashing

- a. Stainless steel, Type 304, not less than 0.003 inch thick, completely encased by and permanently bonded on both sides to 50 pound high strength bituminized crepe kraft paper, using hot asphalt, heat, and pressure.
- b. Three ounce copper sheet, with 2 mils of dense, clear, polyethylene sheet bonded to each side of the copper.

PART 3 EXECUTION

3.1 GENERAL REQUIREMENTS

Unless otherwise specified or indicated, exposed edges shall be folded back to form a 1/2 inch hem on the concealed side, and bottom edges of exposed vertical surfaces shall be angled to form drips. Bituminous cement shall not be placed in contact with roofing membranes other than built-up roofing.

3.2 PROTECTION OF ALUMINUM

Aluminum shall not be used where it will be in contact with copper or where it will contact water which flows over copper surfaces. Aluminum that will be in contact with wet or pressure-treated wood, mortar, concrete, masonry, or ferrous metals shall be protected against galvanic or corrosive action by one of the following methods:

3.2.1 Paint

Aluminum surfaces shall be solvent cleaned and given one coat of zinc-molybdate primer and one coat of aluminum paint as specified in Section 09900 PAINTING, GENERAL.

3.2.2 Nonabsorptive Tape or Gasket

Nonabsorptive tape or gasket shall be placed between the adjoining surfaces and cemented to the aluminum surface using a cement compatible with aluminum.

3.3 CONNECTIONS AND JOINTING

3.3.1 Soldering

Soldering shall apply to copper, and stainless steel items. Edges of sheet metal shall be pretinned before soldering is begun. Soldering shall be done slowly with well heated soldering irons so as to thoroughly heat the seams and completely sweat the solder through the full width of the seam. Edges of stainless steel to be pretinned shall be treated with soldering acid flux. Soldering shall follow immediately after application of the flux. Upon completion of soldering, the acid flux residue shall be thoroughly cleaned from the sheet metal with a water solution of washing soda and rinsed with clean water.

3.3.2 Riveting

Joints in aluminum sheets 0.040 inch or less in thickness shall be

mechanically made.

3.3.3 Seaming

Flat-lock and soldered-lap seams shall finish not less than 1 inch wide. Unsoldered plain-lap seams shall lap not less than 3 inches unless otherwise specified. Flat seams shall be made in the direction of the flow.

3.4 CLEATS

A continuous cleat shall be provided where indicated or specified to secure loose edges of the sheet metalwork. Butt joints of cleats shall be spaced approximately 1/8 inch apart. The cleat shall be fastened to supporting wood construction with nails evenly spaced not over 12 inches on centers. Where the fastening is to be made to concrete or masonry, screws shall be used and shall be driven in expansion shields set in concrete or masonry.

3.5 FLASHINGS

Flashings shall be installed at locations indicated and as specified below. Sealing shall be according to the flashing manufacturer's recommendations. Flashings shall be installed at intersections of roof with vertical surfaces and at projections through roof, except that flashing for heating and plumbing, including piping, roof, and floor drains, and for electrical conduit projections through roof or walls are specified in other sections. Except as otherwise indicated, counter flashings shall be provided over base flashings. Perforations in flashings made by masonry anchors shall be covered up by an application of bituminous plastic cement at the perforation. Flashing shall be installed on top of joint reinforcement. Flashing shall be formed to direct water to the outside of the system.

3.5.1 Counter Flashings

Except as otherwise indicated, counter flashings shall be provided over base flashings. Counter flashing shall be installed as shown on the drawings. Counter flashing shall be factory formed to provide spring action against the base flashing.

3.5.2 Stepped Flashing

Stepped flashing shall be installed where sloping roofs surfaced with shingles abut vertical surfaces. Separate pieces of base flashing shall be placed in alternate shingle courses.

3.5.3 Through-Wall Flashing

Through-wall flashing includes sill, lintel, and spandrel flashing. The flashing shall be laid with a layer of mortar above and below the flashing so that the total thickness of the two layers of the mortar and flashing are the same thickness as the regular mortar joints. Flashing shall not extend further into the masonry backup wall than the first mortar joint. Joints in flashing shall be lapped and sealed. Flashing shall be one piece for lintels and sills.

3.5.3.1 Lintel Flashing

Lintel flashing shall extend the full length of lintel. Flashing shall extend through the wall one masonry course above the lintels and shall be bent down over the vertical leg of the outer steel lintel angle not less

than 2 inches, or shall be applied over top of masonry and precast concrete lintels. Bedjoints of lintels at control joints shall be underlaid with sheet metal bond breaker.

3.5.4 Valley Flashing

Valley flashing shall be installed as specified in SMACNA Arch. Manual and as indicated.

3.6 CONTRACTOR QUALITY CONTROL

The Contractor shall establish and maintain a quality control procedure for sheet metal used in conjunction with roofing to assure compliance of the installed sheet metalwork with the contract requirements. Any work found not to be in compliance with the contract shall be promptly removed and replaced or corrected in an approved manner. Quality control shall include, but not be limited to, the following:

- a. Observation of environmental conditions; number and skill level of sheet metal workers; condition of substrate.
- b. Verification of compliance of materials before, during, and after installation.
- c. Inspection of sheet metalwork for proper size and thickness, fastening and joining, and proper installation.

The actual quality control observations and inspections shall be documented and a copy of the documentation furnished to the Contracting Officer at the end of each day.

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SECTION 07720

ROOF VENTILATORS

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 B 209M (1995) Aluminum and Aluminum-Alloy Sheet and Plate (Metric)

ASTM B 221M (1996) Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric)

AMERICAN SOCIETY OF CIVIL ENGINEERS (ASCE)

ASCE 7 (1995) Minimum Design Loads for Buildings & Other Structures

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

SMACNA Arch. Manual (1993; Errata; Addenda Oct 1997) Architectural Sheet Metal Manua

1.2 DESIGN REQUIREMENTS

Ventilators shall be designed for use with the specific type of project roofing system, and shall provide uniform and continuous air flow. Ventilator design shall provide protection against rain and snow, and shall be provided with a continuous weep along the bottom of both sides of wind band. Units shall be self-cleaning by the action of the elements, and shall have provisions for carrying water and normal wind-transported soil matter to the outside. Units shall be designed for windspeeds of not less than 80 mph in accordance with ASCE 7. Ventilators shall be free of internal obstructions or moving parts which will require maintenance, and shall be complete with type of mounting indicated on drawings.

1.3 QUALIFICATION

Manufacturer shall specialize in design and manufacture of the type of roof ventilators specified in this section, and shall have a minimum of 3 years of documented successful experience. Ventilator installer shall be experienced in the installation of ventilator types specified.

1.4 DELIVERY, STORAGE AND HANDLING

Grand Forks Phase 1 Levees

Roof ventilators shall be cartoned or crated prior to shipment. Ventilators shall be protected from moisture and damage. Damaged items shall be removed from site.

1.5 PROJECT/SITE CONDITIONS

Rough openings shall be field-measured and recorded on shop drawings prior to fabrication of roof ventilators. Fabrication shall be scheduled with construction schedule.

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Aluminum Extrusions

Aluminum extrusions shall be alloy 6063, temper T5 in compliance with ASTM B 221M.

2.1.2 Aluminum Sheets

Aluminum sheets shall be alloy 5005, temper H15 or alloy 3003, temper H14 in compliance with ASTM B 209M.

2.2 STATIONARY VENTILATORS

Stationary roof ventilators shall be fabricated of aluminum with seamless spun conical-shaped weathercap, and shall have straight-through drainage for eliminating the possibility of air-borne debris collecting in the ventilator openings. Insect screens shall be provided.

2.3 RIDGE VENT

Fabricate of 0.019 inch thick sheet aluminum with baffles to prevent snow and rain entering and weepholes to allow water to drain to roof. Vent shall have minimum net free area of 16 square inches per linear feet. Provide splice plates and end caps as required.

2.4 FABRICATION

Welds, soldered seams, rivets and fasteners shall be clean, secure, watertight, and smooth. Edges shall be wired or beaded, where necessary, to ensure rigidity. Joints between sections shall be watertight and shall allow for expansion and contraction. Galvanic action between different metals in direct contact shall be prevented by nonconductive separators.

2.5 SCREENS

Screens shall be furnished by ventilator manufacturer as part of ventilator assembly. Screen (with frames) shall be manufactured of material to match ventilators, and shall be designed to be easily removed for cleaning purposes.

PART 3 EXECUTION

3.1 PREPARATION

Rough openings and other roof conditions shall be prepared in accordance with approved shop drawings and manufacturer's recommendations. Before

starting the ventilator work, surrounding roof surfaces shall be protected from damage.

3.2 INSTALLATION

Roof ventilator installation shall be coordinated with roofing work, and shall be installed in accordance with approved shop drawings, manufacturer's published instructions, and chapter 8 of SMACNA Arch. Manual.

The ventilator installation shall be watertight and shall be free of vibration noise. Aluminum surfaces shall be protected from direct contact with incompatible materials. Aluminum surfaces which will be in contact with sealant shall not be coated with a protective material. Aluminum shall not be used with copper or with water which flows over copper surfaces. Roof ventilators shall be cleaned in accordance with ventilator manufacturer's recommendations.

3.3 PROTECTION

Exposed ventilator finish surfaces shall be protected against the accumulation of paint, grime, mastic, disfigurement, discoloration and damage for duration of construction activities.

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SECTION 07900

JOINT SEALING

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 C 509	(1994) Elastomeric Cellular Preformed Gasket and Sealing Material
ASTM C 920	(1998) Elastomeric Joint Sealants
ASTM D 1056	(1998) Flexible Cellular Materials - Sponge or Expanded Rubbe

1.2 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-01 Data

Sealant; G .

Manufacturer's descriptive data including storage requirements, shelf life, curing time, instructions for mixing and application, and primer data (if required). A copy of the Material Safety Data Sheet shall be provided for each solvent, primer or sealant material. Include color charts for color selection.

1.3 ENVIRONMENTAL REQUIREMENTS

The ambient temperature shall be within the limits of 40 to 90 degrees F when the sealants are applied.

1.4 DELIVERY AND STORAGE

Materials shall be delivered to the job in the manufacturer's original unopened containers. The container label or accompanying data sheet shall include the following information as applicable: manufacturer, name of material, formula or specification number, lot number, color, date of manufacture, mixing instructions, shelf life, and curing time at the standard conditions for laboratory tests. Materials shall be handled and stored to prevent inclusion of foreign materials. Materials shall be stored at temperatures between 40 and 90 degrees F unless otherwise specified by the manufacturer.

PART 2 PRODUCTS

2.1 BACKING

Backing shall be 25 to 33 percent oversize for closed cell and 40 to 50 percent oversize for open cell material, unless otherwise indicated.

2.1.1 Rubber

Cellular rubber sponge backing shall be ASTM D 1056, Type 2, closed cell, Class A, round cross section.

2.1.2 Synthetic Rubber

Synthetic rubber backing shall be ASTM C 509, Option I, Type I preformed rods or tubes.

2.1.3 Neoprene

Neoprene backing shall be ASTM D 1056, closed cell expanded neoprene cord Type 2, Class C, Grade 2C2.

2.2 BOND-BREAKER

Bond-breaker shall be as recommended by the sealant manufacturer to prevent adhesion of the sealant to backing or to bottom of the joint.

2.3 PRIMER

Primer shall be non-staining type as recommended by sealant manufacturer for the application.

2.4 SEALANT

2.4.1 Elastomeric

Elastomeric sealants shall conform to ASTM C 920 and the following:

- a. Polyurethane sealant: Grade NS, Class 12.5, Use NT.

2.4.2 Toilet Room Sealant

For plumbing fixtures, provide white silicone rubber, mildew-resistant; GE SCS 1702, Dow Corning 786, or approved equal.

2.5 SOLVENTS AND CLEANING AGENTS

Solvents, cleaning agents, and accessory materials shall be provided as recommended by the manufacturer.

PART 3 EXECUTION

3.1 GENERAL

3.1.1 Surface Preparation

The surfaces of joints to receive sealant or caulk shall be free of all frost, condensation and moisture. Oil, grease, dirt, chalk, particles of

mortar, dust, loose rust, loose mill scale, and other foreign substances shall be removed from surfaces of joints to be in contact with the sealant.

Oil and grease shall be removed with solvent and surfaces shall be wiped dry with clean cloths. For surface types not listed below, the sealant manufacturer shall be contacted for specific recommendations.

3.1.2 Concrete and Masonry Surfaces

Where surfaces have been treated with curing compounds, oil, or other such materials, the materials shall be removed by sandblasting or wire brushing. Laitance, efflorescence and loose mortar shall be removed from the joint cavity.

3.1.3 Steel Surfaces

Steel surfaces to be in contact with sealant shall be sandblasted or, if sandblasting would not be practical or would damage adjacent finish work, the metal shall be scraped and wire brushed to remove loose mill scale. Protective coatings on steel surfaces shall be removed by sandblasting or by a solvent that leaves no residue.

3.1.4 Aluminum Surfaces

Aluminum surfaces to be in contact with sealants shall be cleaned of temporary protective coatings. When masking tape is used for a protective cover, the tape and any residual adhesive shall be removed just prior to applying the sealant. Solvents used to remove protective coating shall be as recommended by the manufacturer of the aluminum work and shall be non-staining.

3.1.5 Wood Surfaces

Wood surfaces to be in contact with sealants shall be free of splinters and sawdust or other loose particles.

3.2 APPLICATION

3.2.1 Masking Tape

Masking tape may be placed on the finish surface on one or both sides of a joint cavity to protect adjacent finish surfaces from primer or sealant smears. Masking tape shall be removed within 10 minutes after joint has been filled and tooled.

3.2.2 Backing

Backing shall be installed to provide the indicated sealant depth. The installation tool shall be shaped to avoid puncturing the backing.

3.2.3 Bond-Breaker

Bond-breaker shall be applied to fully cover the bottom of the joint without contaminating the sides where sealant adhesion is required.

3.2.4 Primer

Primer shall be used on concrete masonry units, wood, or other porous surfaces in accordance with instructions furnished with the sealant. Primer shall be applied to the joint surfaces to be sealed. Surfaces

adjacent to joints shall not be primed.

3.2.5 Sealant

Sealant shall be used before expiration of shelf life. Multi-component sealants shall be mixed according to manufacturer's printed instructions. Sealant in guns shall be applied with a nozzle of proper size to fit the width of joint. Sealant shall be forced into joints with sufficient pressure to expel air and fill the groove solidly. Sealant shall be installed to the indicated depth without displacing the backing. Unless otherwise indicated, specified, or recommended by the manufacturer, the installed sealant shall be dry tooled to produce a uniformly smooth surface free of wrinkles and to ensure full adhesion to the sides of the joint; the use of solvents, soapy water, etc., will not be allowed. Sealants shall be installed free of air pockets, foreign embedded matter, ridges and sags. Sealer shall be applied over the sealant when and as specified by the sealant manufacturer.

3.3 CLEANING

The surfaces adjoining the sealed joints shall be cleaned of smears and other soiling resulting from the sealant application as work progresses.

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SECTION 08110

STEEL DOORS AND FRAMES

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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 NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI A250.8 (1998) Steel Doors and Frames

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 236 (1989; R 1993) Steady-State Thermal Performance of Building Assemblies by Means of a Guarded Hot Box

ASTM C 976 (1990; R 1996) Thermal Performance of Building Assemblies by Means of a Calibrated Hot Box

ASTM D 2863 (1997) Measuring the Minimum Oxygen Concentration to Support Candle-Like Combustion of Plastics (Oxygen Index)

ASTM E 283 (1991) Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen

DOOR AND HARDWARE INSTITUTE (DHI)

DHI A115.1G (1994) Installation Guide for Doors and Hardware

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 80 (1999) Fire Doors and Fire Windows

NFPA 80A (1996) Protection of Buildings from Exterior Fire Exposures

NFPA 101 (1997; Errata 97-1; TIA 97.1) Life Safety Code

STEEL DOOR INSTITUTE (SDOI)

SDOI SDI-106 (1996) Standard Door Type Nomenclature

SDOI SDI-107

(1997) Hardware on Steel Doors
(Reinforcement - Application)

1.2 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-04 Drawings

Doors; GA

Drawings using standard door type nomenclature in accordance with SDOI SDI-106 indicating the location of each door and frame, elevation of each model of door and frame, details of construction, method of assembling sections, location and extent of hardware reinforcement, hardware locations, type and location of anchors for frames, and thicknesses of metal. Drawings shall include catalog cuts or descriptive data for the doors, frames, and weatherstripping including air infiltration data and manufacturers printed instructions.

1.3 DELIVERY AND STORAGE

During shipment, welded unit type frames shall be strapped together in pairs with heads at opposite ends or shall be provided with temporary steel spreaders at the bottom of each frame. Materials shall be delivered to the site in undamaged condition, and stored out of contact with the ground and under a weathertight covering permitting air circulation. Doors and assembled frames shall be stored in an upright position in accordance with DHI A115.1G. Abraded, scarred, or rusty areas shall be cleaned and touched up with matching finishes.

1.4 WARRANTY

Manufacturer's standard performance guarantees or warranties shall be provided.

PART 2 PRODUCTS

2.1 DOORS AND FRAMES

Doors and frames shall be factory fabricated in accordance with ANSI A250.8 and the additional requirements specified herein. Door grade shall be heavy duty (Grade II) unless otherwise indicated on the door and door frame schedules. Exterior doors and frames shall be designation G60 galvanized. Interior doors and frames shall be designation G60 galvanized. Doors and frames shall be prepared to receive hardware conforming to the templates and information provided under Section 08700 BUILDERS' HARDWARE. Doors and frames shall be reinforced, drilled, and tapped to receive mortised hinges, locks, latches, and flush bolts as required. Doors and frames shall be reinforced for surface applied hardware. Frames shall be welded type. Door frames shall be furnished with a minimum of three jamb anchors and one floor anchor per jamb. Anchors shall be not less than 18 gauge steel or 7 gauge diameter wire. For wall conditions that do not allow the use of a floor anchor, an additional jamb anchor shall be provided. Rubber silencers shall be furnished for installation into factory predrilled holes in door frames; adhesively applied silencers are not acceptable. Where frames are installed in masonry walls, plaster guards shall be provided on door frames

at hinges and strikes. Reinforcing of door assemblies for closers and other required hardware shall be in accordance with ANSI A250.8. Exterior doors shall have top edges closed flush and sealed against water penetration.

2.2 THERMAL INSULATED DOORS

The interior of thermal insulated doors shall be completely filled with rigid plastic foam permanently bonded to each face panel. The thermal conductance (U-value) through the door shall not exceed 0.41 btu/hr times sq f times f when tested as an operational assembly in accordance with ASTM C 236 or ASTM C 976. Doors with cellular plastic cores shall have a minimum oxygen index rating of 22 percent when tested in accordance with ASTM D 2863.

2.3 WEATHERSTRIPPING

Unless otherwise specified in Section 08700 BUILDERS' HARDWARE, weatherstripping shall be as follows: Weatherstripping for head and jamb shall be manufacturer's standard elastomeric type of synthetic rubber, vinyl, or neoprene and shall be installed at the factory or on the jobsite in accordance with the door frame manufacturer's recommendations. Weatherstripping for bottom of doors shall be as shown. Air leakage rate of weatherstripping shall not exceed 0.20 cfm per linear foot of crack when tested in accordance with ASTM E 283 at standard test conditions.

2.4 TRANSOM AND SIDELIGHT PANELS

Panels for transom and sidelight shall be constructed in accordance with ANSI A250.8. Panels shall be nonremovable from the outside.

2.5 DOOR LOUVERS (GRILLE)

Provide door louvers (grilles) of size as indicated; see drawings and schedules. Louvers shall be split-Y, security type. Face plate and frame shall be 12 gauge steel. Louvers shall be 18 gauge steel. Steel shall have prime finish. Include insect screen. Provide Air Louvers Model 1500-A, Anemostat Model PLSL, or approved equal.

2.6 FACTORY FINISH

Doors and frames shall be phosphatized and primed with standard factory primer system.

PART 3 EXECUTION

3.1 INSTALLATION

Installation shall be in accordance with DHI A115.1G. Preparation for surface applied hardware shall be in accordance with SDOI SDI-107. Rubber silencers shall be installed in door frames after finish painting has been completed; adhesively applied silencers are not acceptable. Weatherstripping shall be installed at exterior door openings to provide a weathertight installation. Installation and operational characteristics of fire doors shall be in accordance with NFPA 80, NFPA 80A and NFPA 101. Hollow metal door frames shall be solid grouted.

3.1.1 Thermal Insulated Doors

Hardware and perimeter seals shall be adjusted for proper operation. Doors shall be sealed weathertight after installation of hardware and shall be in accordance with Section 07900 JOINT SEALING.

3.2 FIELD PAINTED FINISH

Steel doors and frames shall be field painted in accordance with Section 09900 PAINTING, GENERAL. Weatherstrips shall be protected from paint. Finish shall be free of scratches or other blemishes. Color shall be in accordance with Section 09915 COLOR SCHEDULE.

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SECTION 08330

OVERHEAD ROLLING DOORS

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 A 653/A 653M | (1999a) Steel Sheet, Zinc-Coated
(Galvanized) or Zinc-Iron Alloy-Coated
(Galvannealed) by the Hot-Dip Process |
| ASTM E 84 | (1999) Surface Burning Characteristics of
Building Materials |

AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING ENGINEERS (ASHRAE)

- | | |
|----------------|---|
| ASHRAE HDBK-IP | (1997) Handbook, Fundamentals I-P Edition |
| ASHRAE HDBK-SI | (1997) Handbook, Fundamentals SI Editio |

1.2 DESCRIPTION

Overhead rolling doors shall be spring counterbalanced, rolling type, with interlocking slats, complete with guides, fastenings, hood, brackets, and operating mechanisms, and shall be designed for use on openings as indicated. Each door shall be provided with a permanent label showing the manufacturer's name and address and the model/serial number of the door. Doors in excess of the labelled size shall be deemed oversize and shall be provided with a listing agency oversize label, or a listing agency oversize certificate, or a certificate signed by an official of the manufacturing company certifying that the door and operator have been designed to meet the specified requirements.

1.2.1 Wind Load Requirements

Doors and components shall be designed to withstand the minimum design wind load of 20 psf. Doors shall be constructed to sustain a superimposed load, both inward and outward, equal to 1-1/2 times the minimum design wind load. Recovery shall be at least 3/4 of the maximum deflection within 24 hours after the test load is removed. Sound engineering principles may be used to interpolate or extrapolate test results to door sizes not specifically tested.

1.2.2 Operational Cycle Life

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All portions of the door and door operating mechanism that are subject to movement, wear, or stress fatigue shall be designed to operate through a minimum number of 10 cycles per day. One complete cycle of door operation is defined as when the door is in the closed position, moves to the full open position, and returns to the closed position.

1.3 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-04 Drawings

Overhead Rolling Door Unit; GA.

Drawings showing the location of each door including schedules. Drawings shall include elevations of each door type, details and method of anchorage, details of construction, location and installation of hardware, shape and thickness of materials, details of joints and connections, and details of guides, power operators, controls, and other fittings.

SD-19 Operation and Maintenance Manuals

Operation Manual; FIO

Maintenance and Repair Manual; FIO

Six copies of the system operation manual and system maintenance and repair manual for each type of door and control system.

1.4 DELIVERY AND STORAGE

Doors shall be delivered to the jobsite wrapped in a protective covering with the brands and names clearly marked thereon. Doors shall be stored in a dry location that is adequately ventilated and free from dirt and dust, water, and other contaminants, and in a manner that permits easy access for inspection and handling.

1.5 WARRANTY

Manufacturer's standard performance guarantees or warranties shall be provided.

1.6 OPERATION AND MAINTENANCE MANUALS

The instructions shall include the manufacturer's name, model number, service manual, parts list, and brief description of all equipment and their basic operating features. Maintenance instructions listing routine maintenance procedures, possible breakdowns and repairs, troubleshooting guides, and simplified diagrams for the equipment as installed shall be provided. A complete list of parts and supplies, source of supply, and a list of the high mortality maintenance parts shall be provided.

PART 2 PRODUCTS

2.1 OVERHEAD ROLLING DOORS

Doors shall be surface-mounted type with guides at jambs set back a sufficient distance to clear the opening. Exterior doors shall be mounted on interior side of walls.

2.1.1 Curtains

The curtains shall roll up on a barrel supported at the head of opening on brackets, and shall be balanced by helical torsion springs. Steel slats for doors less than 15 feet wide shall be minimum bare metal thickness of 0.0281 inches. Slats shall be of the minimum bare metal decimal thickness required for the width indicated and the wind pressure specified above.

2.1.1.1 Insulated Curtains

The slat system shall supply a minimum R-value of 4 when calculated in accordance with ASHRAE HDBK-IP ASHRAE HDBK-SI. Slats shall be of the flat type as standard with the manufacturer. Slats shall consist of a urethane core not less than 11/16 inch thick, completely enclosed within metal facings. Exterior face of slats shall be gauge as specified for curtains. Interior face shall be not lighter than 0.0219 inches. The insulated slat assembly shall have a flame spread rating of not more than 25 and a smoke development factor of not more than 50 when tested in accordance with ASTM E 84.

2.1.2 Endlocks and Windlocks

The ends of each alternate slat for interior doors shall have endlocks of manufacturer's stock design. In addition to endlocks, non-rated exterior doors shall have the manufacturer's standard windlocks as required to withstand the wind load. Windlocks shall prevent the curtain from leaving guides because of deflection from specified wind pressure.

2.1.3 Bottom Bar

The curtain shall have a standard bottom bar consisting of two hot-dip galvanized steel angles for steel doors.

2.1.4 Guides

Guides shall be steel structural shapes or formed steel shapes, of a size and depth to provide proper clearance for operation and resistance under the design windload. Guides shall be attached to adjoining construction with fasteners recommended by the manufacturer. Spacing of fasteners shall be as required to meet the minimum design windload. Doors and guides in hazardous areas shall have static grounding.

2.1.5 Barrel

The barrel shall be steel pipe or commercial welded steel tubing of proper diameter for the size of curtain. Deflection shall not exceed 0.03 inch per foot of span. Ends of the barrel shall be closed with metal plugs, machined to fit the pipe. Aluminum plugs are acceptable on non-fire door barrels.

2.1.6 Springs

Oil tempered helical steel counter-balance torsion springs shall be installed within the barrel and shall be capable of producing sufficient torque to assure easy operation of the door curtain. Access shall be

provided for spring tension adjustment from outside of the bracket without removing the hood.

2.1.7 Brackets

Brackets shall be of steel plates to close the ends of the roller-shaft housing, and to provide mounting surfaces for the hood. An operation bracket hub and shaft plugs shall have sealed prelubricated ball bearings.

2.1.8 Hoods

Hoods shall be steel with minimum bare metal thickness of 0.0219 inches formed to fit contour of the end brackets, and shall be reinforced with steel rods, rolled beads, or flanges at top and bottom edges. Multiple segment and single piece hoods shall be provided with support brackets of the manufacturer's standard design as required for adequate support.

2.1.9 Weatherstripping

Exterior doors shall be fully weatherstripped. A compressible and replaceable weather seal shall be attached to the bottom bar. Weather seal at door guides shall be continuous vinyl or neoprene, bulb or leaf type, or shall be nylon-brush type. A weather baffle shall be provided at the lintel or inside the hood. Weatherstripping shall be easily replaced without special tools.

2.1.10 Operation

Doors shall be operated by means of manual hand-chain. Equipment shall be designed and manufactured for usage in non-hazardous areas.

2.1.10.1 Manual Hand-Chain Operation

Operation shall be by means of a galvanized endless chain extending to within 3 feet of floor. Reduction shall be provided by use of roller chain and sprocket drive or suitable gearing, to reduce the pull required on hand chain to not over 35 lbf. Gears shall be high grade gray cast iron.

2.1.11 Locking

Locking shall consist of chain lock keeper, suitable for padlock by others, for chain operated doors.

2.1.12 Finish

Steel slats and hoods shall be hot-dip galvanized G60 in accordance with ASTM A 653/A 653M, and shall be treated for paint adhesion and shall receive a factory baked-on prime coat for field finishing. The paint system shall withstand a minimum of 1500 hours without blistering, bubbling, or rust. Surfaces other than slats, hood, and faying surfaces shall be cleaned and treated to assure maximum paint adherence and shall be given a factory dip or spray coat of rust inhibitive metallic oxide or synthetic resin primer. Color shall be in accordance with Section 09915 COLOR SCHEDULE.

PART 3 EXECUTION

3.1 INSTALLATION

Doors shall be installed in accordance with approved detail drawings and manufacturer's instructions. Anchors and inserts for guides, brackets, hardware, and other accessories shall be accurately located. Upon completion, doors shall be free from warp, twist, or distortion. Doors shall be lubricated, properly adjusted, and demonstrated to operate freely.

3.2 FIELD PAINTED FINISH

Steel doors and frames shall be field painted in accordance with Section 09900 PAINTING, GENERAL. Weatherstrips shall be protected from paint. Finish shall be free of scratches or other blemishes. Color shall be in accordance with Section 09915 COLOR SCHEDULE.

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SECTION 08520

ALUMINUM AND ENVIRONMENTAL CONTROL ALUMINUM WINDOWS

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.

ALUMINUM ASSOCIATION (AA)

AA DAF-45 (1997) Designation System for Aluminum Finishes

AMERICAN ARCHITECTURAL MANUFACTURERS ASSOCIATION (AAMA)

AAMA 101 (1997) Voluntary Specifications for Aluminum, Vinyl (PVC) and Wood Windows and Glass Doors

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM E 283 (1991) Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen

ASTM E 330 (1997e1) Structural Performance of Exterior Windows, Curtain Walls, and Doors by Uniform Static Air Pressure Difference

ASTM E 547 (1996) Water Penetration of Exterior Windows, Curtain Walls, and Doors by Cyclic Static Air Pressure Differential

INSECT SCREENING WEAVERS ASSOCIATION (ISWA)

ISWA IWS 089 (1990) Recommended Standards and Specifications for Insect Wire Screening (Wire Fabric)

NATIONAL FENESTRATION RATING COUNCIL (NFRC)

NFRC 100 (1997) Procedure for Determining Fenestration Product U-factors

NFRC 200 (1997) Procedure for Determining Fenestration Product Solar Heat Gain Coefficients at Normal Incidence

SCREEN MANUFACTURERS ASSOCIATION (SMA)

SMA ANSI/SMA 1004

(1987) Aluminum Tubular Frame Screens for Windows

1.2 WINDOW PERFORMANCE

Aluminum windows shall meet the following performance requirements. Testing requirements shall be performed by an independent testing laboratory or agency.

1.2.1 Structural Performance

Structural test pressures on window units shall be for positive load (inward) and negative load (outward) in accordance with ASTM E 330. After testing, there shall be no glass breakage, permanent damage to fasteners, hardware parts, support arms or actuating mechanisms or any other damage which could cause window to be inoperable. There shall be no permanent deformation of any main frame, sash or ventilator member in excess of the requirements established by AAMA 101 for the window types and classification specified in this section.

1.2.2 Air Infiltration

Air infiltration shall not exceed the amount established by AAMA 101 for each window type when tested in accordance with ASTM E 283.

1.2.3 Water Penetration

Water penetration shall not exceed the amount established by AAMA 101 for each window type when tested in accordance with [ASTM E 547.

1.2.4 Thermal Performance

Thermal transmittance for thermally broken aluminum windows with insulating glass shall not exceed a U-factor of 0.35 Btu/hr-ft²-F determined according to NFRC 100. Window units shall comply with the U.S. Department of Energy, Energy Star Window Program for the Northern Climate Zone.

1.3 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-01 Data

Aluminum Windows; GA

Manufacturer's descriptive data and catalog cut sheets.

Manufacturer's preprinted installation instructions and cleaning instructions.

SD-04 Drawings

Aluminum Windows; GA

Insect Screens; GA

Drawings indicating elevations of window, rough-opening dimensions for each type and size of window, full-size sections, thicknesses of metal, fastenings, methods of installation and anchorage, connections with other work, type of wall construction, size and spacing of anchors, method of glazing, types and locations of operating hardware, mullion details, weatherstripping details, screen details including method of attachment, window cleaner anchor details, and window schedules showing locations of each window type.

SD-09 Reports

Aluminum Windows; GA

Reports for each type of aluminum window attesting that identical windows have been tested and meet all performance requirements established under paragraph WINDOW PERFORMANCE.

SD-13 Certificates

Aluminum Windows; GA

Certificates stating that the aluminum windows are AAMA certified conforming to requirements of this section. Labels or markings permanently affixed to the window will be accepted in lieu of certificates. Product ratings determined using NFRC 100 and NFRC 200 shall be authorized for certification and properly labeled by the manufacturer.

SD-14 Samples

Aluminum Windows; GA

Manufacturer's standard color samples of the specified finishes.

1.4 QUALIFICATION

Manufacturer shall have the facilities capable of meeting contract requirements, single-source responsibility and warranty.

1.5 DELIVERY AND STORAGE

Aluminum windows shall be delivered to project site and stored in accordance with manufacturer's recommendations. Damaged windows shall be replaced with new windows.

1.6 WARRANTY

Manufacturer's standard performance guarantees or warranties shall be provided.

PART 2 PRODUCTS

2.1 ALUMINUM WINDOW TYPES

Aluminum windows shall consist of complete units including sash, glass, frame, weatherstripping, and hardware. Windows shall conform to AAMA 101. Windows shall be double-glazed. Thermal barrier shall be neoprene, rigid vinyl, or polyurethane and shall be resistant to weather. Window members

shall be heli-arc welded or angle-reinforced and mechanically joined and sealed. Exposed welded joints shall be dressed and finished. Joints shall be permanent and weathertight. Frames shall be constructed to provide a minimum 1/4 inch thermal break between the exterior and interior frame surfaces. Sash corners shall be internally sealed to prevent air and water leaks. Inner sash shall be key-controlled to swing to the interior to allow maintenance and replacement of the glass. Operable windows shall permit cleaning the outside glass from inside the building.

2.1.1 Fixed Half-Round Windows

Aluminum fixed (F) windows shall conform to AAMA 101 F-HC40 type, non-operable glazed frame, complete with provisions for reglazing in the field.

2.1.2 Horizontal-Sliding Windows

Aluminum horizontal (HS) sliding windows shall conform to AAMA 101 HS-HC40 type consisting of sliding sash and fixed lite. Sash guides shall be nylon wheels. Windows shall be provided with locking devices to secure the sash in the closed position.

All aluminum frame and sash extrusions shall have a minimum wall thickness of 0.62 inch. Frame sill members shall have a minimum wall thickness of 0.078 inch. Mechanical fasteners, welded components and hardware items shall not bridge thermal barriers. Thermal barriers shall align at all frame and sash corners. Depth of frame and sash shall not be less than 2-7/16 inches.

Frame components shall be mechanically fastened. Frame and sash shall have a continuous interlock at the meeting rail.

2.2 WEATHERSTRIPPING

Weatherstripping for ventilating sections shall be of type designed to meet water penetration and air infiltration requirements specified in this section in accordance with AAMA 101, and shall be manufactured of material compatible with aluminum and resistant to weather. Weatherstrips shall be factory-applied and easily replaced in the field. Neoprene or polyvinylchloride weatherstripping are not acceptable where exposed to direct sunlight.

2.3 INSECT SCREENS

Insect screens shall be aluminum window manufacturer's standard design, and shall be provided where scheduled on drawings. Insect screens shall be fabricated of extruded tubular-shaped aluminum frames conforming to SMA ANSI/SMA 1004 and (18 x 16) aluminum mesh screening conforming with ISWA IWS 089.

2.4 ACCESSORIES

2.4.1 Fasteners

Fastening devices shall be window manufacturer's standard design made from aluminum, in compliance with AAMA 101. Self-tapping sheet metal screws will not be acceptable for material thicker than 1/16 inch.

2.4.2 Hardware

Hardware shall be as specified for each window type and shall be fabricated of aluminum, stainless steel, cadmium-plated steel, zinc-plated steel or nickel/chrome-plated steel in accordance with requirements established by AAMA 101.

2.4.3 Window Anchors

Anchoring devices for installing windows shall be made of aluminum, cadmium-plated steel, stainless steel, or zinc-plated steel conforming to AAMA 101.

2.5 GLASS AND GLAZING

Aluminum windows shall be designed for inside glazing, field glazing, and for glass types scheduled on drawings and specified in Section 08810 GLASS AND GLAZING. Units shall be complete with glass and glazing provisions to meet AAMA 101. Glazing material shall be compatible with aluminum, and shall not require painting.

2.6 FINISH

2.6.1 Anodized Aluminum Finish

Exposed surfaces of aluminum windows shall be finished with anodic coating conforming to AA DAF-45: Architectural Class I, AA-M10-C22-A44, color anodic coating, 0.7 mil or thicker. Finish shall be free of scratches and other blemishes.

2.6.2 Color

Color shall be Roman Bronze.

PART 3 EXECUTION

3.1 INSTALLATION

Aluminum windows shall be installed in accordance with approved shop drawings and manufacturer's published instructions. Aluminum surfaces in contact with masonry, concrete, wood and dissimilar metals other than stainless steel, zinc, cadmium or small areas of white bronze, shall be protected from direct contact using protective materials recommended by AAMA 101. The completed window installation shall be watertight in accordance with Section 07900 JOINT SEALING. Glass and glazing shall be installed in accordance with requirements of this section and Section 08810 GLASS AND GLAZING.

3.2 ADJUSTMENTS AND CLEANING

3.2.1 Hardware Adjustments

Final operating adjustments shall be made after glazing work is complete. Operating sash or ventilators shall operate smoothly and shall be weathertight when in locked position.

3.2.2 Cleaning

Aluminum window finish and glass shall be cleaned on exterior and interior sides in accordance with window manufacturer's recommendations. Alkaline

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or abrasive agents shall not be used. Precautions shall be taken to avoid scratching or marring window finish and glass surfaces.

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TUBULAR SKYLIGHTS

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SECTION 08625

TUBULAR SKYLIGHTS

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 B 209	(1996) Aluminum and Aluminum-Alloy Sheet and Plate
ASTM E 283	(1991) Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen
ASTM E 330	(1997e1) Structural Performance of Exterior Windows, Curtain Walls, and Doors by Uniform Static Air Pressure Difference
ASTM E 331	(1996) Water Penetration of Exterior Windows, Curtain Walls, and Doors by Uniform Static Air Pressure Difference

1.2 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-04 Drawings

Tubular Skylights; GA

Submit shop drawings showing construction, dimensions, and details of all components.

SD-09 Reports

Tubular Skylights; GA

Submit certified, independent laboratory test report showing compliance with the performance requirements specified below.

1.3 PERFORMANCE REQUIREMENTS

Skylights shall meet the following requirements:

- a. Air Infiltration: Maximum 0.10 cfm per ft of crack length at 6.24 psf pressure differential when tested in accordance with ASTM E 283.
- b. Water Resistance: No uncontrolled water leakage at 6.00 psf pressure differential with water rate of 5 gallon/hour/square feet when tested in accordance with ASTM E 331.
- c. Uniform Load Deflection: No breakage, permanent damage to fasteners, hardware parts, or damage to make tubular skylight inoperable at both a positive and a negative load. All tests shall be in accordance with ASTM E 330.
- d. Uniform Load Structural: Unit to be tested at 3 X positive wind and 2 X negative wind pressure design wind pressure, acting normal to plane of roof in accordance with ASTM E 330. No breakage, permanent damage to fasteners, hardware parts, or damage to make tubular skylight inoperable or permanent deflection of any section in excess of 0.2 percent of its span.

PART 2 PRODUCTS

2.1 TUBULAR SKYLIGHTS

2.1.1 Roof Dome

Injection molded polycarbonate classified as CC1 material. Thickness shall be not less than 0.125 inch. Visible light transmission shall be 92 percent or greater. Roof dome shall contain a series of concentric, light refracting etched lines a minimum of 2 inches high to improve light input when sun is low on horizon.

2.1.2 Ceiling Diffuser

Injection molded, acrylic plastic classified as CC2 Plexiglas. Thickness shall be not less than 0.087 inch. Provide prismatic design to maximize light output.

2.1.3 Roof Flashing

Aluminized steel manufactured in a single piece without seams, joints or welds and pitched for roof slope.

2.1.4 Main Tube and Reflector

Fabricate from aluminum sheet meeting the requirements of ASTM B 209, alloy and temper as required by manufacturer to suit forming operations and finish requirements, 0.020 inch thick. Provide exposed aluminum surface with high polished specular finish meeting AAMA designation M21C31A31. Specular reflectance to be 92 percent and total reflectance to be 95 percent.

2.1.5 Accessories

- a. Dress Ring: 30 percent talc filled polypropylene or high impact ABS.
- b. Sealant: Polyurethane or copolymer - based elastomeric sealant as recommended by skylight manufacturer.

- c. Weather Seal: Medium density pile weatherstripping and light density polyvinyl chloride foam tape or UV resistant EPDM rubber.
- d. Ceiling Diffuser Seal: Closed cell polyethylene foam, 3 pounds per cubic foot, and white polyvinyl chloride seal butt joint welded or EPDM rubber.
- e. Fasteners: Same as metals being fastened or non-magnetic stainless steel or other non-corrosive metal as recommended by skylight manufacturer.

2.1.6 Fabrication

Finish, fabricate, and shop prepare all assemblies under responsibility of one manufacturer. Fabricate to allow for thermal movement of materials when subject to a temperature differential from -30 degrees F to +180 degrees F. Provision shall be made to insure that water will not accumulate and remain in contact within system components.

PART 3 EXECUTION

3.1 INSTALLATION

Install skylights in accordance with shop drawings and manufacturer's recommendations.

-- End of Section --

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SECTION 08700

BUILDERS' HARDWARE

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 283 (1991) Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen

BUILDERS HARDWARE MANUFACTURERS ASSOCIATION (BHMA)

BHMA A156.1 (1997) Butts and Hinges
BHMA A156.3 (1994) Exit Devices
BHMA A156.4 (1992) Door Controls - Closers
BHMA A156.5 (1992) Auxiliary Locks & Associated Products
BHMA A156.7 (1997) Template Hinge Dimensions
BHMA A156.18 (1993) Materials and Finishes
BHMA A156.21 (1996) Thresholds

DOOR AND HARDWARE INSTITUTE (DHI)

DHI Keying Systems (1989) Keying Systems and Nomenclature
DHI Locations for CSD (1997) Recommended Locations for Builders' Hardware for Custom Steel Doors and Frames
DHI Locations for SSD (1990) Recommended Locations for Architectural Hardware for Standard Steel Doors and Frames
DHI ANSI/DHI A115.1G (1994) Installation Guide for Doors and Hardware
DHI ANSI/DHI A115-W (Varies) Wood Door Hardware Standards (Incl A115-W1 thru A115-W9)

1.2 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-01 Data

Hardware Schedule; GA

Hardware schedule listing all items to be furnished. The schedule shall include for each item: the quantities; manufacturer's name and catalog numbers; the ANSI number specified, sizes; detail information or catalog cuts; finishes; door and frame size and materials; location and hardware set identification cross-references to drawings; corresponding reference standard type number or function number from manufacturer's catalog if not covered by ANSI or BHMA; and list of abbreviations and template numbers.

Keying; GA

Keying schedule developed in accordance with DHI Keying Systems, after the keying meeting with the user.

1.3 DELIVERY, STORAGE, AND HANDLING

Hardware shall be delivered to the project site in the manufacturer's original packages. Each article of hardware shall be individually packaged in the manufacturer's standard commercial carton or container, and shall be properly marked or labeled to be readily identifiable with the approved hardware schedule. Each change key shall be tagged or otherwise identified with the door for which its cylinder is intended. Manufacturer's printed installation instructions, fasteners, and special tools shall be included in each package.

1.4 SPECIAL TOOLS

Special tools, such as those supplied by the manufacturer, unique wrenches, and dogging keys, shall be provided as required to adjust hardware items.

1.5 WARRANTY

Manufacturer's standard performance guarantees or warranties shall be provided.

1.6 OPERATION AND MAINTENANCE MANUALS

Six complete copies of maintenance instructions listing routine maintenance procedures, possible breakdowns and repairs, and troubleshooting guides shall be provided.

PART 2 PRODUCTS

2.1 GENERAL HARDWARE REQUIREMENTS

Hardware shall conform to the requirements specified herein and the HARDWARE SETS listing at the end of this section. The following hardware shall be provided matching Owner's existing. No substitutes allowed.

Grand Forks Phase 1 Levees

- a. Locks: Russwinn ML2265 with LWA handle stainless steel.
- b. Cylinders: MEDCO.
- c. HingesL Stanley FBB199 - stainless steel.

Hardware set numbers correspond to the set numbers shown on the drawings.

2.2 TEMPLATES

Requirements for hardware to be mounted on metal doors or metal frames shall be coordinated between hardware manufacturer and door or frame manufacturer by use of templates and other information to establish location, reinforcement required, size of holes, and similar details. Templates of hinges shall conform to BHMA A156.7.

2.3 HINGES

Hinges shall conform to BHMA A156.1. Hinges used on metal doors and frames shall also conform to BHMA A156.7. Except as otherwise specified, hinge sizes shall conform to the hinge manufacturer's printed recommendations.

2.3.1 Hinges for Reverse Bevel Doors with Locks

Hinges for reverse bevel doors with locks shall have pins that are made nonremovable by means such as a set screw in the barrel, or safety stud, when the door is in the closed position.

2.3.2 Contractor's Option

Hinges with antifriction bearings may be furnished in lieu of ball bearing hinges.

2.4 EXIT DEVICES AND EXIT DEVICE ACCESSORIES

Exit devices and exit device accessories shall conform to BHMA A156.3, Grade 1. To the maximum extent possible, exit devices and all components thereof, including cylinders, shall be the products of a single manufacturer.

2.4.1 Exit Devices and Auxiliary Items

Touch bars shall be provided in lieu of conventional crossbars and arms.

2.4.2 Auxiliary Locks and Associated Products

Bored and mortise dead locks and dead latches, narrow style dead locks and dead latches, rim latches, dead latches, and dead bolts, shall conform to BHMA A156.5. Bolt and latch retraction shall be dead bolt style. Strike boxes shall be furnished with dead bolt and latch strikes for Grade 1.

2.4.3 Lock Cylinders (Mortise, Rim and Bored)

Lock cylinders shall comply with BHMA A156.5. Lock cylinder shall have not less than six pins. A master keying system shall be provided.

2.4.4 Lock Trim

Lock trim shall be heavy wrought construction of commercial plain design.

Lever handles and escutcheons shall be 0.050 inch thick, if unreinforced. If reinforced, the outer shell shall be 0.035 inch thick and the combined thickness shall be 0.070 inch except that knob shanks shall be 0.060 inch thick. Lever handles shall be of plain design with ends returned to no more than 1/2 inch from the door face. Adjustable strikes shall be provided for rim type devices. Escutcheons shall be provided not less than 7 by 2-1/4 inches. Escutcheons shall be cut to suit cylinders and operating trim.

2.5 KEYING

Locks shall be keyed in sets or subsets as scheduled. Change keys for locks shall be stamped with change number and the inscription "U.S. Property - Do Not Duplicate." Keys shall be supplied as follows:

Locks:	3 change keys each lock.
Master keyed sets:	3 keys each set.

The keys shall be furnished to the Contracting Officer arranged in sets or subsets as scheduled. Review the keying system with the Contracting Officer and provide the type required (master, grandmaster or great-grandmaster). Comply with Contracting Officer's instructions for masterkeying and, except as otherwise indicated, provide individual change key for each lock that is not designated to be keyed alike with a group of related locks.

2.6 DOOR CLOSING DEVICES

Door closing devices shall conform to BHMA A156.4, Grade 1. Closing devices shall be products of one manufacturer for each type specified. The opening resistance of closing devices shall not exceed 15 lbf applied at the latch stile or exceed 5 lbf.

2.6.1 Surface Type Closers

Surface type closers shall be Grade 1, Series C02000 Standard Cover with options PT-4C, Size 1 or 2 through Size 6. Except as otherwise specified, sizes shall conform to the manufacturer's published recommendations. Closers for outswinging exterior doors shall have parallel arms or shall be top jamb mounted.

2.7 ARCHITECTURAL DOOR TRIM

2.7.1 Door Protection Plates

2.7.1.1 Kick Plates

Kick plates shall be Type J102 stainless steel. Width of plates shall be 2 inches less than door width for single doors and 1 inch less for pairs of doors. Height shall be 16 inches. Edges of metal plates shall be beveled.

2.8 MISCELLANEOUS

2.8.1 Metal Thresholds

Thresholds shall conform to BHMA A156.21. Thresholds for exterior doors shall be extruded aluminum of the type indicated and shall provide proper clearance and an effective seal with specified weather stripping. Thresholds shall be beveled with slopes not exceeding 1:2 and with heights

not exceeding 1/2 inch.

2.8.2 Rain Drips

Extruded aluminum, not less than 0.07 inch thick, clear anodized. Door sill rain drips shall be 1-1/2 inches to 1-3/4 inches high by 5/8 inch projection. Overhead rain drips shall be approximately 1-1/2 inches high by 2-1/2 inches projection and shall extend 2 inches on either side of the door opening width.

2.8.3 Aluminum Housed Type Weatherseals

Weatherseals of the type indicated shall consist of extruded aluminum retainers not less than 0.07 inch wall thickness with vinyl, neoprene, silicone rubber, polyurethane or vinyl brush inserts. Aluminum shall be clear (natural) anodized. Weatherseal material shall be of an industrial/commercial grade. Seals shall remain functional through all weather and temperature conditions. Air leakage rate of weatherstripping shall not exceed 0.5 cubic feet per minute per lineal foot of crack when tested in accordance with ASTM E 283 at standard test conditions.

2.9 FASTENINGS

Fastenings of proper type, size, quantity, and finish shall be supplied with each article of hardware. Machine screws and expansion shields shall be used for attaching hardware to concrete or masonry. Fastenings exposed to the weather in the finished work shall be of brass, bronze, or stainless steel.

2.10 FINISHES

Unless otherwise specified, finishes shall conform to those identified in BHMA A156.18. Where painting of primed surfaces is required, painting is specified in Section 09900 PAINTING, GENERAL.

PART 3 EXECUTION

3.1 APPLICATION

Hardware shall be located in accordance with DHI Locations for CSD and DHI Locations for SSD, except that deadlocks shall be mounted 48 inches above finish floor. When approved, slight variations in locations or dimensions will be permitted. Application shall be in accordance with DHI ANSI/DHI A115.1G or DHI ANSI/DHI A115-W. Door control devices for exterior doors such as closers and holders, shall be attached to doors with thru bolts and nuts or sex bolts. Alternate fastening methods may be approved by the Contracting Officer when manufacturers' documentation is submitted to verify that the fastening devices and door reinforcements are adequate to resist wind induced stresses.

3.1.1 Door-Closing Devices

Door-closing devices shall be installed and adjusted in accordance with the templates and printed instructions supplied by the manufacturer of the devices. Doors opening to the exterior shall have the closer mounted on the interior side of the door.

3.1.2 Kick Plates and Mop Plates

Kick plates shall be installed on the push side of doors.

3.1.3 Thresholds

Thresholds shall be secured with a minimum of three fasteners per single door width and six fasteners per double door width with a maximum spacing of 12 inches. Exterior thresholds shall be installed in a bed of sealant with expansion anchors and stainless steel screws, except that bronze or anodized bronze thresholds shall be installed with expansion anchors with brass screws. Minimum screw size shall be No. 10 length, dependent on job conditions, with a minimum of 3/4 inch thread engagement into the floor or anchoring device used.

3.1.4 Rain Drips

Door sill rain drips shall align with the bottom edge of the door. Overhead rain drips shall align with bottom edge of door frame rabbet. Drips shall be set in sealant and fastened with stainless steel screws.

3.1.5 Weatherseals

Weatherseals shall be located as indicated, snug to door face and fastened in place with color matched metal screws after door and frames have been finish painted. Screw spacing shall be as recommended by manufacturer.

3.2 HARDWARE SETS

HW-1 Pump Station Doors

1-1/2 pr.	Hinges, A2111, 626, hinge height: 4-1/2 inches
1 ea.	Exit Device, Type 1, Function 08-Grade 1, 626
1 ea.	Closer, C02021, 628
1 ea.	Kick Plate, J102, 630
1 set	Weatherseals, 628
1 ea.	Rain drip, 628
1 ea.	Threshold, J603 J32130

HW-2 Pump Station Pipe Chase and Mechanical Room Doors

1-1/2 pr.	Hinges, A2111, 626, hinge height: 4-1/2 inches
1 ea.	Mortise Lockset, Type 1, Function 04-Grade 1, 626
1 ea.	Closer, C02021, 628
1 ea.	Raindrip, 628
1 ea.	Threshold, J603 J32130

HW-3 Restroom Toilet and Changing Room Doors

1-1/2 pr.	Hinges, A2111, 626, hinge height: 4-1/2 inches
1 ea.	Deadlock, Type 1, Function E06072, Grade 1, 626
1 ea.	Pushplate, J301, 8 inch x 16 inches x 16 gauge, 626
1 ea.	Pullplate, J405, 8 inch x 16 inches x 16 gauge, 626
1 ea.	Closer, C02021, 628
1 ea.	Kick Plate, J102, 630
1 set	Weatherseals, 628
1 ea.	Rain drip, 628
1 ea.	Threshold, J603 J32130

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SECTION 08810

GLASS AND GLAZING

PART 1 GENERAL

This section covers the furnishing and installation of glass and glazing throughout as required by the drawings and specifications, except for overhead rolling door windows specified in SECTION: OVERHEAD ROLLING DOORS.

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 NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI Z97.1 (1984; R 1994) Safety Performance Specifications and Methods of Test for Safety Glazing Materials Used in Buildings

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 1036 (1991; R 1997) Flat Glass
ASTM C 1048 (1997b) Heat-Treated Flat Glass - Kind HS, Kind FT Coated and Uncoated Glass
ASTM E 773 (1997) Accelerated Weathering of Sealed Insulating Glass Units
ASTM E 774 (1997) Classification of the Durability of Sealed Insulating Glass Units
ASTM E 1300 (1998) Determining the Minimum Thickness and Type of Glass Required to Resist a Specified Load

GLASS ASSOCIATION OF NORTH AMERICA (GANA)

GANA Glazing Manual (1997) Glazing Manual
GANA Standards Manual (1995) Engineering Standards Manual

1.2 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-01 Data

Insulating Glass; GA. Glazing Accessories; GA.

Manufacturer's descriptive product data, handling and storage recommendations, installation instructions, and cleaning instructions.

SD-04 Drawings

Installation; GA.

Drawings showing complete details of the proposed setting methods, mullion details, edge blocking, size of openings, frame details, materials, and types and thickness of glass.

SD-13 Certificates

Insulating Glass; GA.

Certificates stating that the glass meets the specified requirements. Labels or manufacturers marking affixed to the glass will be accepted in lieu of certificates.

SD-14 Samples

Insulating Glass; GA.

Two 8 x 10 inch samples of each of the following: tinted glass, patterned glass, heat-absorbing glass, and insulating glass units.

1.3 SYSTEM DESCRIPTION

Glazing systems shall be fabricated and installed watertight and airtight to withstand thermal movement and wind loading without glass breakage, gasket failure, deterioration of glazing accessories, and defects in the work. Glazed panels shall comply with the safety standards, as indicated in accordance with ANSI Z97.1. Glazed panels shall comply with indicated wind/snow loading in accordance with ASTM E 1300.

1.4 DELIVERY, STORAGE AND HANDLING

Glazing compounds shall be delivered to the site in the manufacturer's unopened containers. Glass shall be stored indoors in a safe, well ventilated dry location in accordance with manufacturer's instructions, and shall not be unpacked until needed for installation. Glass shall not be stored on site over 1 month.

1.5 PROJECT/SITE CONDITIONS

Glazing work shall not be started until outdoor temperature is above 40 degrees F and rising, unless procedures recommended by glass manufacturer and approved by Contracting Officer are made to warm the glass and rabbet surfaces. Ventilation shall be provided to prevent condensation of moisture on glazing work during installation. Glazing work shall not be performed during damp or raining weather.

1.6 WARRANTY

1.6.1 Insulating Glass

Manufacturer shall warrant the insulating glass to be free of fogging or

Grand Forks Phase 1 Levees

film formation on the internal glass surfaces caused by failure of the hermetic seal for a period of 10 years from Date of Substantial Completion. Warranty shall be signed by manufacturer.

PART 2 PRODUCTS

2.1 GLASS

Glass shall conform to the requirements of ASTM C 1036, unless specified otherwise.

2.1.1 Insulating Glass

Shall be formed of two pieces of Type I, Class I, Quality q3, 1/4-inch thick glass, separated by a 1/2-inch dehydrated air space, hermetically sealed. Exterior light of insulating units shall be tempered glass with a VE2-85 low emissivity coating and a base glass color of green as manufactured by Viracon or approved equal. Insulating glass units shall have polyisobutylene primary seal with two part silicone secondary seals. Aluminum spacer frame shall be desiccant filled with a mill finish and have bent or soldered corners. Insulating glass units shall conform to ASTM E 773 and ASTM E 774. Low emissivity coating shall be applied to second surface of insulating glass units. The insulating glass units shall have a maximum winter, nighttime U-value of 0.30, with a maximum shading coefficient of .43 and a maximum relative heat gain of 91".

2.1.2 Tempered Glass

Tempered glass shall be Kind FT (fully tempered transparent), Type 1 (flat), Class 1-clear, Condition A uncoated surface, conforming to ASTM C 1048 and GANA Standards Manual. Color shall be clear.

2.2 GLAZING ACCESSORIES

2.2.1 Glazing Compound and Preformed Glazing Sealants

Suitable type approved for the application and in accordance with applicable portions of the FGMA Glazing Manual. Materials used with aluminum frames shall be colored, as selected, nonstaining, and not require painting. Other materials which will be exposed to view and unpainted shall be selected color from manufacturer's standard colors.

2.2.2 Glazing Accessories

As required to supplement the accessories provided with the items to be glazed and to provide a complete installation, including glazing points, clips, shims, angles, beads, setting blocks, and spacer strips. Ferrous metal accessories which will be exposed in the finished work shall be a finish that will not corrode or stain while in service.

PART 3 EXECUTION

3.1 PREPARATION AND INSTALLATION

Openings and framing systems scheduled to receive glass shall be examined for compliance with GANA Glazing Manual and glass manufacturer's approved installation instructions. Glazing surfaces shall be dry and free of frost.

3.2 CLEANING

Upon completion of project, outside surfaces of glass shall be washed clean and the inside surfaces of glass shall be washed and polished in accordance with glass manufacturer's recommendations.

3.3 PROTECTION

Glass work shall be protected immediately after installation. Glass units which are broken, chipped, cracked, abraded, or otherwise damaged during construction activities shall be removed and replaced with new units.

-- End of Section --