SECTION 03310 - CONCRETE WORK

PART 1 - GENERAL

RELATED DOCUMENTS:

Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work specified in this section.

DESCRIPTION OF WORK:

Section includes all concrete, formwork, and reinforcing as shown on drawings, and specified herein, including the following abbreviated list of items:

Footings.
Interior foundation walls, columns, and beams.
Exterior concrete walls, foundations, etc.
Floor slabs.
Miscellaneous other items.

Refer to all other Division 3 sections that relate to this section.

RELATED WORK:

Section 02200, Earthwork.
Section 02514, Portland Cement Concrete Paving.
Section 04200, Unit Masonry.
Section 07900, Joint Sealers, for expansion joints and sealants.

QUALITY ASSURANCE:

1. Codes and Standards: Comply with the latest edition of the following codes and standards except where more stringent requirements are shown or specified:

ACI 301 "Specifications for Structural Concrete for Buildings".

ACI 318 "Building Code Requirements for Reinforced Concrete."

Concrete Reinforcing Steel Institute, "Manual of Standard Practice".

2. Concrete Testing Service: Owner shall engage and pay for a testing laboratory (as selected by Architect) to perform material evaluation tests and to provide concrete design mixes.

3. Contractor shall pay for all necessary, additional testing, as determined by the Architect, in the event that preliminary testing shows failure of the Contractor to meet specifications. This shall be paid for solely be the Contractor and not charged to the Owner.

4. Mandatory Preconstruction Meeting: Prior to, or concurrent with, the submittal of design mixes, the Contractor shall arrange a meeting with Owner, Architect, readymix supplier representative, admixture representative, concrete sub-

contractor and all other associated contractors and suppliers. Discussion shall include proper use of admixtures, proper placement of concrete, curing methods, concerns of weather conditions, timing and all other concerns. Contractor shall be responsible for taking minutes of the meeting and distribute them to all parties present.

SUBMITTALS:

1. Product Data: Submit data for all proprietary materials, including all admixtures, ten days prior to any work being performed.

2. Shop Drawings; Reinforcement: Submit original shop drawings prepared by registered Professional Engineer in the State of Minnesota for fabrication, bending, and placement of concrete reinforcement. Comply with ACI 315 "Manual of Standard Practice for Detailing Reinforced Concrete Structures" showing bar schedules, stirrup spacing, diagrams of bent bars, and arrangement of concrete reinforcement. Include special reinforcement required for openings through concrete structures.

3. Laboratory Test Reports: Submit laboratory test reports for concrete materials and mix design test as specified.

4. Certification: Provide certification from admixture supplier that chloride content complies with specified requirements.

PART 2 - PRODUCTS

FORM MATERIALS:

Forms for Exposed Finish (Architectural) Concrete: Provide products when assembled produce smooth, continuous surfaces including plywood, metal, metal-framed plywood, masonite or other acceptable panel-type materials. Provide materials of the proper thickness for stability, and the proper finish for a smooth, imprinted surface. Use sealant at form joints as necessary to obtain a continuous surface. Final surfaces shall be clean, flush and without blemishes prior to any surface treatment. Furnish in largest practicable sizes to minimize number of joints and to conform to joint system shown on drawings. Rust staining steel forms are not acceptable.

Forms for Unexposed Finish (Structural) Concrete: Form concrete surfaces which will be unexposed in finished structure with plywood, lumber, metal or other acceptable material. Provide lumber dressed on at least 2 edges and one side for tight fit.

Form Coatings: Provide commercial formulation form-coating compounds that will not bond with, stain nor adversely affect concrete surfaces, and will not impair subsequent treatments of concrete surfaces.

Products: Subject to compliance with requirements, provide one of the following:

"Eucoslip" by Euclid Chemical Company.
"Debond" form coating, by L&M Construction Chemicals.
"Nox Crete Form Release" by Nox Crete.

Form Ties: Factory-fabricated, adjustable-length, removable or snapoff metal form ties, designed to prevent form deflecting and to prevent spalling concrete upon removal. Provide units which will leave no metal closer than 1-1/2" to surface, and holes not larger than 1" diameter in concrete surface.

REINFORCING MATERIALS:

Reinforcing Bars: ASTM A 615 or ASTM A 706, Grade 60, deformed. Sizes as shown on the structural drawings.

Steel Wire: ASTM A 82, plain, cold-drawn, steel.

Welded Wire Fabric: ASTM A 185, welded steel wire fabric.

Supports for Reinforcement: Provide plastic tipped bolsters, chairs, spacers and other supports as necessary for spacing, supporting and fastening reinforcing bars and welded wire fabric in place. Use wire bar supports complying with CRSI specifications.

For Exterior slabs-on-grade, use supports with sand plates or horizontal runners where base material will not support chair legs.

For Exposed-to-view concrete surfaces, where legs of supports are in contact with forms, provide supports with legs which are plastic protected (CRSI, Class I) or stainless steel protected (CRSI, Class 2).

CONCRETE MATERIALS:

General: Total water soluble chloride ion content in the total mix for all materials used, including water, shall not exceed 0.15% by weight of cement for reinforced concrete.

Portland Cement: ASTM C 150, Type I. Only one brand of cement shall be used.

Fly-Ash: ASTM C 618, Type C., limited to 25% of cement content by weight, and used only at foundations and interior columns.

Normal Weight Aggregates: ASTM C 33. Do not use fine or coarse aggregates containing spalling-causing deleterious substances.

Water: Drinkable.

Air-Entraining Admixture: ASTM C 260, certified by manufacturer to be compatible with other required admixtures.

Products: Provide one of the following:

"Air Mix"; Euclid Chemical.
"Sika Aer"; Sika Corp.
"Micro Air" or "MB-VR"; Master Builders.
"Darex AEA" or "Daravair"; W.R. Grace.

Water-Reducing Admixture: ASTM C 494, Type A., no chloride ions.

Products: Subject to compliance with requirements, provide one of the following:

"Eucon WR-75"; Euclid Chemical Co.
"Pozzolith 322N"; Master Builders.
"WRDA w/Hycol"; W.R. Grace Co.
"Plastocrete 161;" Sika Chemical Corp.

Water-Reducing, Retarding Admixture: ASTM C 494, Type D.

Products: Subject to compliance with requirements, provide one of the following:

"Eucon Retarder 75"; Euclid Chemical Co.
"Pozzolith 100XR or 300-R"; Master Builders.
"Daratard 17"; W.R. Grace.

High Range Water-reducing Admixture (Superplasticizer): ASTM C 494, type F or type G.

Products: Subject to compliance with requirements, provide one of the following:

"Eucon Super 37 or 537"; Euclid Chemical Corp.
"Rheobuild 716 or 1000"; Master Builders.
"Sikament 300"; Sika Chemical Corp.

Non-corrosive, Non-Chloride Accelerator Admixture: ASTM C 494 Type C or Type E.

Products: Subject to compliance with requirements, provide one of the following:

"Accelguard 80"; Euclid Chemical Company.
"Daraset"; W.R. Grace.
"pozzutech 20"; Master Builders.

RELATED MATERIALS:

Granular Base: Evenly graded mixture of fine and coarse aggregates to provide, when compacted, a smooth and even surface below slabs on grade.

Non-shrink grout: ASTM-C-1107, 28 day strength: 6000 psi.

Products: Subject to compliance with requirements, provide one of the following:

"Euco-NS"; Euclide Chemical.
"Masterflow 713"; Master Builders.
"Five Star Grout"; U.S. Grout Corp.
"Ferrogrout"; by L&M Construction Chemicals, Inc.
"Duragrout"; by L&M Construction Chemicals, Inc.

Vapor Retarder/Moisture-Retaining Membrane: Polyethylene film, 8 mils thick, complying with ASTM C 171.

Clear Curing and Sealing Compound: Liquid type membrane-forming curing compound complying with ASTM C 309, Type 2, Class A. Moisture loss not more than 0.55 kg./m. sq. in 72 hours when applied at 200 sq. ft./gal.

Products: Subject to compliance with requirements, provide one of the following:

"Masterseal"; Master Builders.
"Ecocure"; Euclid Chemical Co.
"Clear Seal 150"; A.C. Horn, Inc.
"S/C 309"; Sonneborn-Rexnord.
"Dress and Seal #18"; by L&M Construction Chemicals, Inc.

Bonding Compound: Acrylic polymer modified type, non-rewetable

bonding compound.

Products: subject to compliance with requirements, provide one of the following:

"Hornweld"; A.C. Horn, Inc.
"Daraweld"; W.R. Grace.
"Sonocrete"; Sonneborn-Rexnord
"SBR Latex"; Euclid Chemical Co.

Epoxy Adhesive: ASTM C 881, two component material suitable for use on dry or damp surfaces. Provide material "Type", "Grade", and "Class" to suit project requirements.

Products: Subject to compliance with requirements, provide one of the following:

"Euco Epoxy 463 or 620"; Euclid Chemical Co.
"Sikadur Hi-Mod"; Sika Chemical Co.
"Epoxtite"; A.C. Horn, Inc.
"Thiopoxy"; W.R. Grace.
"Concresive 1001"; Adhesive Engineering Co.

PROPORTIONING AND DESIGN OF MIXES:

Column & Structural Slab Beam Concrete Design mix: Provide concrete with design strength of 5000 psi @ 28 days. Water/(cement) ratio shall be maximum 0.45. Maximum aggregate size shall not exceed 3/4"

Footings, Walls & Slabs on grade Concrete Design mix: 4000 psi 28-day compressive strength; W/C ratio of 0.45 maximum. This includes non-traffic bearing and non-structural concrete. Maximum aggregate size shall not exceed 3/4" for walls and slabs on grade or 1-1/2" for footings.

Use air-entraining admixture at exterior exposed concrete in accordance with manufacturers instructions: air entrainment shall amount to 6% +/- 1.5, depending on aggregate size.

Slump Limits: Proportion and design mixes as follows:

3", +/-1" for all flatwork and exposed architectural concrete without superplasticizer
6" +/-1-1/2", with superplasticizer included in mix

CONCRETE MIXING:

Ready-Mix Materials: Comply with ASTM C 94.

Reject all concrete brought in by ready-mix truck that exceeds maximum allowable slumps and water-cement ratios, and the following time limits:

60 minutes after inclusion of superplasticizer.
60 minutes for all concrete in temperatures exceeding 80 degrees.
90 minutes for all other concrete.

ADMIXTURES:

Provide superplasticizer at all flatwork, pumped concrete, architectural concrete and as necessary to achieve the specified strengths, water-cement ratios or other items.

Provide air entrainment At all exterior concrete, exposed to freezing and thawing at a rate of 6% +/-1%. At interior floor slabs, provide maximum air content of 3%.

Use water-reducing, retarding or accelerating admixtures, in concrete as required for placement and workability depending on climatic or situational conditions. In general use a non- corrosive, non-chloride accelerator in slabs placed bellow 50 degrees F.

Use admixtures for water-reducing and set-control in strict compliance with manufacturer's directions.

PART 3 - EXECUTION

INSTALLATION, FORMS:

Formwork: Design, erect, support, brace and maintain formwork to support vertical and lateral, static, and dynamic loads that might be applied until such loads can be supported by concrete structure. Construct formwork so concrete members and structures are of correct size, shape, alignment, elevation and position. Maintain formwork construction tolerances complying with ACI 347.

Construct Forms to sizes, shapes, lines and dimensions shown, and to obtain accurate alignment, location, grades, level and plumb work in finished structures. Provide for openings, offsets, sinkages, keyways, recesses, moldings, rustications, reglets, chamfers, blocking, screeds, bulkheads, anchorages and inserts, and other features required in work. Use selected materials to obtain required finishes. Solidly butt joints and provide backup at joints to prevent leakage of cement past.

Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush plates or wrecking plates where stripping may damage cast concrete surfaces. Provide top forms for inclined surfaces where slope is too steep to place concrete with bottom forms only. Kerf wood inserts for forming keyways, reglets, recesses, and the like, to prevent swelling and for easy removal.

Provide temporary openings where interior area of formwork is inaccessible for cleanout, for inspection before concrete placement, and for placement of concrete. Securely brace temporary openings and set tightly to forms to prevent loss of concrete mortar. Locate temporary openings on forms at inconspicuous locations.

Chamfer exposed corners (3/4" x 3/4") and edges as indicated, using wood, metal, PVC or rubber chamfer strips fabricated to produce uniform smooth lines and tight edge joints.

Provisions for Other Trades: Provide openings in concrete formwork to accommodate work of other trades. Determine size and location of openings, recesses and chases from trades providing such items Accurately place and securely support items built into forms. Coordinate with all other trades.

Cleaning and Tightening: Thoroughly clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt or other debris just before concrete is placed. Retightening forms and bracing after concrete placement is required to eliminate mortar leaks and maintain proper alignment.

PLACING REINFORCEMENT:

Comply with Concrete Reinforcing Steel Institute's recommended practice for "Placing Reinforcing Bars", for details

and methods of reinforcement placement and supports, and as herein specified.

Clean reinforcement of materials which reduce or destroy bond with concrete.

Accurately position, support and secure reinforcement against displacement by formwork, construction, or concrete placement operations. Locate and support reinforcing by metal chairs, runners, bolsters, spacers, and hangers, as required.

Place reinforcement to obtain at least minimum coverages for concrete protection. Arrange, space and securely tie bars and bar supports to hold reinforcement in position during concrete placement operations. Set wire ties so ends are directed into concrete, not toward exposed concrete surfaces.

Install welded wire fabric in as long lengths as practicable. Lap adjoining pieces at least one full mesh and lace splices with wire. Install fabric on chairs or other approved product to elevate fabric during pour. Offset end laps in adjacent widths to prevent continuous laps in either direction. Lift fabric up with hook to ensure that material does not lie on grade during placement.

JOINTS:

Construction Joints: Locate and install construction joints where shown on the drawing, and if not shown, locate so as not to impair strength and appearance of the structure, as acceptable to Architect.

Provide keyways at least 1-1/2" deep in construction joints in walls, slabs and between walls and footings; accepted bulkheads designed for this purpose may be used for slabs.

Place construction joints perpendicular to main reinforcement. Continue reinforcement across construction joints, except as otherwise indicated.

Isolation Joints in Slabs-on-Ground: Construct isolation joints in slabs-on-ground at points of contact between slabs-on-ground and vertical surfaces, such as column pedestals, foundation walls, grade beams and elsewhere as indicated.

Contraction (Control) Joints in Slabs-on-Ground: Construct contraction joints in slabs-on-ground to form panels or patterns as shown, with a maximum joint spacing of 36 times slab thickness at any area. Use Soft-Cut saw shortly after pour (without dislodging aggregate), and carefully saw cut, 1/8" wide to a depth of 1/3 of the slab depth. Cut joints between 6 and 12 hours after placement or as soon as possible after slab finishing, without dislodging aggregate.

PREPARATIONS:

At slab-on-ground, completely saturate the ground with water just prior to placement. During hot, dry periods provide several hoses and workers to ensure that base is damp.

At formed concrete, clean re-used forms of concrete matrix residue, repair and patch as required to return forms to acceptable surface condition throughout the project to maintain consistently good standards. Coat contact surfaces of forms with specified form-coating compound before reinforcement is placed. Coat steel forms with a non-staining, rust-preventative form oil or otherwise protect against rusting. Discard forms that do not conform to specified standards.

INSTALLATION OF EMBEDDED ITEMS:

General: Set and build into woik anchorage devices and other embedded items, using setting drawings, required for other work that is attached to, or supported by, cast-in-place concrete. Completely fill separations at setting plates and other materials with specified non-shrink grout.

CONCRETE PLACEMENT:

Preplacement Inspection: Before placing concrete, inspect and complete formwork installation, reinforcing steel, and items to be embedded or cast-in. Notify other trades to permit installation of their work; cooperate with other trades in setting such work. Moisten wood forms and base materials immediately before placing concrete where form coatings are not used.

Apply temporary protective covering to lower 2 feet of finished walls adjacent to poured floor slabs and similar conditions, and guard against spattering during placement.

General: Comply with ACI 304 "Recommended Practice for Measuring, Mixing, Transporting, and Placing Concrete", and as herein specified.

Deposit concrete continuously or in layers of such thickness that no concrete will be placed on concrete which has hardened sufficiently to cause the formation of seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as herein specified. Deposit concrete as nearly as practicable to its final location to avoid segregation.

Placing Concrete in Forms: Deposit concrete in forms in horizontal layers not deeper than 24" and in a manner to avoid inclined construction joints. Where placement consists of several layers, place each layer while preceding layer is still plastic to avoid cold joints.

Consolidate placed concrete per ACI recommended practices.

Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations not farther than visible effectiveness of machine. Place vibrators to rapidly penetrate placed layer and at least 6" into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to set. At each insertion limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing segregation of mix.

Placing Concrete Slabs: Just prior to placement, dampen all areas of the base material. Deposit and consolidate concrete slabs in a continuous operation, within limits of construction joints, until the placing of a panel or section is completed.

Bring slab surfaces to correct level with straightedge and strikeoff. Use bull floats or darbies to smooth surface, free of humps or hollows. Do not disturb slab surfaces prior to beginning finishing operations.

Maintain reinforcing in proper position during concrete placement operations.

PLACING CONCRETE IN TEMPERATURE EXTREMES:

Hot Weather Placement: When hot weather conditions exist that would seriously impair quality and strength of concrete, place concrete in compliance with ACI 305 and as herein specified.

Cover reinforcing steel with water-soaked burlap if it becomes too hot, so that steel temperature will not exceed the ambient air temperature immediately before embedment in concrete.

Fog spray forms, reinforcing steel and subgrade just before concrete is placed. During and after placement, provide fog spray over, but not directly on concrete.

Use water-reducing retarding admixture (Type D) when required by high temperatures, low humidity, or other adverse placing conditions.

Cool ingredients before mixing to maintain concrete temperature at time of placement below 90° F (32° C). Mixing water may be chilled, or chopped ice may be used to control temperature provided water equivalent of ice is calculated to total amount of mixing water. Use of liquid nitrogen to cool concrete is Contractor's option.

Cold Weather Placement: Comply with ACI 306. When air temperature is expected to fall below 40°, uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 50° F (10° C), and not more than 80° F (27° C) at point of placement. Provide protection as required when overnight temperatures are expected to drop below 34° F. Cover slabs and exposed concrete as required through below freezing temperatures at all times. If temperatures drop below 26° F, reschedule placement until weather permits.

Do not use frozen materials or materials containing ice or show. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.

Do not use Calcium Chloride, salt and other materials containing antifreeze agents or chemical accelerators, unless otherwise accepted in mix designs.

Concrete shall be in mixer no more than the maximum time specified. Trucks shall be ordered to return to the plant, with the load rejected if concrete exceeds this condition.

CONCRETE FINISH:

Rough Form Finish: For formed concrete surfaces not exposed to view in the finish work or by other construction, unless otherwise indicated. This is the concrete surface having texture imparted be form facing material used, with tie holes and defective areas repaired and patched and fins and other projections exceeding 1/4" in height rubbed down or chipped off.

Smooth Form Finish: For formed concrete surfaces exposed to view, or that are to be covered with a coating material applied directly to concrete, or a covering material applied directly to concrete, such as waterproofing, painting or other similar system. This is as-cast concrete surface obtained with selected form facing material, arranged orderly and symmetrically with a minimum of seams. Repair and patch defective areas with fins or other projections completely removed and smoothed.

Levelness and flatness: Flatwork shall conform to the following after finishing. The work and any testing methods shall be based on ASTM E 115 (as developed by Edward W. Face Company of Norfolk, VA).

F_F = 20 (flatness)*
F_L = 20 (levelness)*

*Exception shall be made for pitched drainage areas.

MONOLITHIC SLAB FINISHES:

Float Finish: Apply float finish to monolithic slab surfaces to receive trowel finish and other finishes as hereinafter

specified, and slab surfaces which are to be covered with membrane or elastic waterproofing, membrane or elastic roofing, self-draining "river rock" pool deck topping, and as otherwise indicated..

After screeding, consolidating, and leveling concrete slabs, do not work surface until ready for floating. Begin floating when surface water has disappeared or when concrete has stiffened sufficiently to permit operation of power-driven floats, or both. Consolidate surface with power-driven floats, or by hand-floating if area is small or inaccessible to power units. Check and level surface plane so that depressions between high spots do not exceed $F_F 18$ - $F_L 15$. Cut down high spots and fill low spots. Uniformly slope surfaces to drains. Immediately after leveling, refloat surface to a uniform, smooth, granular texture.

Trowel Finish: Apply trowel finish to monolithic slab surfaces to be exposed-to-view, and slab surfaces to be covered with resilient flooring, carpet, ceramic or quarry tile, paint or sealer system.

After floating, begin first trowel finish operation using a power- driven trowel. Begin final troweling when surface produces a ringing sound as trowel is moved over surface. Consolidate concrete surface by final hand-troweling operation, free of trowel marks, uniform in texture and appearance, and with a level surface plane so that depressions between high spots do not exceed tolerances listed below. Grind smooth defects which would telegraph through applied floor covering system only if acceptable to Architect.

Fine Broom Finish: At thin set tile location lightly scarify surface after troweling. Provide a sample for Architect to review.

Non-Slip Broom Finish: Apply non-slip broom finish to exterior concrete platforms, steps and ramps, and elsewhere as indicated.
Immediately after trowel finishing, slightly roughen concrete surface by brooming with fiber bristle broom perpendicular to main traffic route. Coordinate required final finish with Architect before application.

Smooth Floated Finish: Provide smooth surface at all interior floor slabs that remain uncovered, and provide sample for Architect to review.

CONCRETE CURING AND PROTECTION:

General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures.

Start initial curing as soon as free water has disappeared from concrete surface after placing and finishing. Weather permitting, keep continuously moist for not less than 7 days.

Initially, apply dissipating sealer at all exposed concrete.

Begin final curing procedures immediately following initial curing and before concrete has dried. Continue final curing for at least 7 days in accordance with ACI 301 procedures. Avoid rapid drying at end of final curing period.

Curing Methods: Perform curing of concrete by curing and sealing compound, by moist curing, by moisture-retaining cover curing, and by combinations thereof, as herein specified.

Curing formed surfaces: Cure formed concrete surfaces, including undersides of beams, supported slabs and other similar surfaces by moist curing with forms in place for full curing period or until forms are removed. If forms are removed, continue curing by methods specified above, as applicable. Apply curing compound to columns when forms are removed.

Provide dissipating curing compound to interior slabs that are to receive resilient flooring, carpet, tile or paint coating, and to exterior slabs, walks, and curbs, per manufacturer's recommendations.

After the recommended period of time, after the initial dissipating sealer is gone, provide curing and sealing compound with 30% solids at all floor slabs that remain uncovered including vehicle storage areas, maintenance areas and work areas with no other floor covering.

Install curing and sealing compounds immediately after final finishing.

Provide blankets on slabs in below freezing temperatures. Use polyethylene moisture cover over interior slab on grade if required to limit curling, to control evaporation, and to maintain flatness and levelness requirements.

Curing and Sealing compound (30% solids type): Apply a specified curing and sealing compound to surfaces that remain exposed including vehicle storage, vehicle maintenance, shops and storage areas.

REMOVAL OF FORMS:

Formwork not supporting weight of concrete, such as sides of beams, walls, columns, and similar parts of the work, may be removed after cumulatively curing at not less than 50° F (10° C) for 36 hours after placing concrete, provided concrete is sufficiently hard to not be damaged by form removal operations, and provided curing and protection operations are maintained (minimum strength of 750 psi)

Formwork supporting weight of concrete, such as beam soffits, joints, slabs and other structural elements, may not be removed in less than 7 days and until concrete has attained 75% of its design minimum compressive strength at 28 days. Determine potential compressive strength of in-place concrete by testing field-cured specimens representative of concrete location or members..

MISCELLANEOUS CONCRETE ITEMS:

Filling-In: Fill-in holes and openings left in concrete structures for passage of work by other trades, unless otherwise shown or directed, after work of other trades is in place. Mix, place and cure concrete as herein specified, to blend with in-place construction. Provide other miscellaneous concrete filling shown or required to complete work.

Grout base plates and foundations as indicated, using specified non-shrink grout. Use non-metallic grout for exposed conditions, unless otherwise indicated. Refer to Structural Steel section.

Reinforced Masonry: Provide concrete fill for reinforced masonry lintels, core fills and bond beams where indicated on drawings and as scheduled. Maintain accurate location of reinforcing steel during concrete placement.

CONCRETE SURFACE REPAIRS:

Patching Defective Areas: Repair and patch defective areas with cement mortar immediately after removal of forms, when acceptable to Architect. It shall be up to the Architect if inferior areas of the work shall be replaced rather than repaired: verify with the Architect before proceeding. When areas are to be replaced they shall be done so within the area up to the nearest control or expansion joint.

Repair Areas: Cut out honeycomb, rock pockets, voids over 1/4" in any dimension, and holes left by tie rods and bolts, down to solid concrete but, in no case to a depth of less than 1". Make edges of cuts perpendicular to the concrete surface. Thoroughly clean, dampen with water and brush-coat the area to be patched with specified bonding agent. Place patching mortar after bonding compound has dried.

For exposed-to-view surfaces, blend white portland cement and standard portland cement so that, when dry, patching

mortar will match color surrounding. Provide test areas at inconspicuous location to verify mixture and color match before proceeding with patching. Compact mortar in place and strike-off slightly higher than surrounding surface.

Repair of Formed Surfaces: Remove and replace concrete having defective surfaces if defects cannot be repaired to satisfaction of Architect. Surface defects, as such, include color and texture irregularities, cracks, spalls, air bubbles, honeycomb, rock pockets; fins and other projections on surface; and stains and other discolorations that cannot be removed by cleaning. Flush out form tie holes, fill with dry pack mortar, or precast cement cone plugs secured in place with bonding agent.

Repair concealed formed surfaces, where possible, that contain defects that affect the durability of concrete. If defects cannot be repaired, remove and replace concrete.

Repair of Unformed Surfaces: Test unformed surfaces, such as monolithic slabs, for smoothness and verify surface plane to tolerances specified for each surface and finish. Correct low and high areas as herein specified. Test unformed surfaces sloped to drain for trueness of slope, in addition to smoothness, using a template having required slope.

Repair finished unformed surfaces that contain defects which affect durability of concrete. Surface defects, as such, include crazing, cracks in excess of 0.01" wide or which penetrate to reinforcement or completely through non-reinforced sections regardless of width, spalling, pop-outs, honeycomb, rock pockets, and other objectionable conditions.

Correct high areas in unformed surfaces by grinding, after concrete has cured at least 14 days.

Correct low areas in unformed surfaces during, or immediately after completion of surface finishing operations by cutting out low areas and replacing with fresh concrete. Finish repaired areas to blend into adjacent concrete. Patching compounds may be used when acceptable to Architect.

Repair defective areas, except random cracks and single holes not exceeding 1" diameter, by cutting out and replacing with fresh concrete. Remove defective areas to sound concrete with clean, square cuts and expose reinforcing steel with at least 3/4" clearance all around. Dampen concrete surfaces in contact with patching concrete and apply bonding compound. Mix patching concrete of same materials to provide concrete of same type or class as original concrete. Place, compact and finish to blend with adjacent finished concrete. Cure in the same manner as adjacent concrete.

Repair isolated random cracks and single holes not over 1" in diameter by dry-pack method. Groove top of cracks and cut-out holes to sound concrete and clean of dust, dirt and loose particles. Dampen cleaned concrete surfaces and apply bonding compound. Mix dry-pack, consisting of one part portland cement to 2- 1/2 parts fine aggregate passing a No. 16 mesh sieve, using only enough water as required for handling and placing. Place dry-pack after bonding compound has dried. Compact dry-pack mixture in place and finish to match adjacent concrete. Keep patched area continuously moist for not less than 72 hours.

Perform structural repairs with prior approval of Architect for method and procedure, using specified epoxy adhesive mortar.

Repair methods not specified above may be used, subject to acceptance of Architect.

FIELD QUALITY CONTROL:

The Owner shall employ a testing laboratory, and work in conjunction with the Contractor, to perform tests and to submit test reports. Sampling and testing for quality control during placement of concrete shall include the following:

Sampling Fresh Concrete: ASTM C 172, except modified for slump to comply with ASTM C 94.

Slump: ASTM C 143; one test at point of discharge for each truck.

Air Content: ASTM C 173, volumetric method for lightweight or normal weight concrete; ASTM C 231 pressure method for normal weight concrete; one for each truck of each type of air entrained concrete.

Concrete Temperature: Test hourly when air temperature is 40° F (4° C) and below, and when 80°C (27°C) and above; and each time a set of compression test specimens made.

Compression Test Specimen: ASTM C 31; one set of 4 standard cylinders for each compressive strength test, unless otherwise directed. Mold and store cylinders for laboratory cured test specimens except when field-cure test specimens are required.

Compressive Strength Tests: ASTM C 39; one set for each day's pour exceeding 5 cu. yds. plus additional sets for each 50 cu. yds. over and above the first 25 cu. yds. of each concrete class placed in any one day; one specimen tested at 7 days, one specimen tested at 28 days, and one specimen retained in reserve for later testing if required.

When frequency of testing will provide less than 5 strength tests for a given class of concrete, conduct testing from at least 5 randomly selected batches or from each batch if fewer than 5 are used.

When strength of field-cured cylinders is less than 85% of companion laboratory-cured cylinders, evaluate current operations and provide corrective procedures for protecting and curing the in-place concrete.

Strength level of concrete will be considered satisfactory if averages of sets of three consecutive strength test results equal or exceed specified compressive strength, and no individual strength test result falls below specified compressive by more than 500 psi.

Test results will be reported in writing to Architect and Contractor no later than 24 hours after tests. Reports of compressive strength tests shall contain the project identification name and number, date of concrete placement, name of concrete testing service, concrete type and class, location of concrete batch in structure, design compressive strength at 28 days, concrete mix proportions and materials; compressive breaking strength and type of break for both 7-day tests and 28-day tests.

Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted but shall not be used as the sole basis for acceptance or rejection.

Additional Tests: The testing service will make additional tests of in-place concrete when test results indicate specified concrete strengths and other characteristics have not been attained in the structure, as directed by Architect. Testing service may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42, or by other methods as directed. Contractor shall pay for such tests conducted, and any other additional testing as may be required, when unacceptable concrete is verified.

END OF SECTION 03310