

SECTION 03311
NORMAL WEIGHT CONCRETE

1. GENERAL:

1.01 CODES AND STANDARDS: Comply with the provisions of the following codes, specifications and standards, except as otherwise shown or specified.

ACI 301 "Specifications for Structural Concrete for Buildings"

ACI 318 "Building Code Requirements for Reinforced Concrete"

ACI 614 "Recommended Practice for Measuring, Mixing and Placing Concrete"

ACI 311 "Recommended Practice for Concrete Inspection"

Where provisions of the above codes and standards are in conflict with the building code in force for this project, the building code shall govern.

1.02 WORKMANSHIP: All Concrete work which does not conform to the specified requirements, including strength, tolerances, and finishes, shall be corrected as directed by the Engineer at the Contractor's expense, without extension of the time therefore. The Contractor shall also be responsible for the cost of corrections to any other work affected by or resulting from corrections to the concrete work.

2. CONCRETE MATERIALS:

2.01 PORTLAND CEMENT: Comply with the requirements of ASTM C150.

Provide Type I cement, except as otherwise indicated. Type III cement may be used in lieu of Type I as Contractor's option, when acceptable to the Engineer.

Only one brand of cement may be used for each required type throughout the project, unless otherwise accepted by the Engineer.

2.02 AGGREGATES, NORMAL WEIGHT CONCRETE: Comply with the requirements of ASTM C33 and as herein specified.

Do not use aggregates containing soluble salts or other substrates such as iron sulfides, pyrite, marcasite or ochre which can cause stains on exposed concrete surfaces.

A. Fine Aggregate: Clean, sharp, natural sand free from loam, clay lumps or other deleterious substances.

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Dune sand, bank-run sand, and manufactured sand are not acceptable.

- B. Coarse Aggregate: Clean, uncoated, processed aggregate containing no clay, mud, loam, or foreign matter, as follows:

Crushed stone, processed from natural rock or stone.

Washed gravel, either natural or crushed. Use of pit or bank-run gravel is not permitted.

Use Size 467 (maximum aggregate size 1-1/2") for footings, foundations, beams and slabs on ground, except as otherwise specified or noted on the drawings.

- 2.03 SUPPLY OF AGGREGATES: Provide aggregates for each type of concrete from one source of supply to ensure uniformity in color, size and shape.
- 2.04 Water for Washing Aggregates, Mixing and Curing shall be clean, fresh, free from oil, acid, organic matter or other deleterious substances. Provide water for curing that does not contain impurities in sufficient amount to etch concrete surfaces, or cause discoloration to concrete indicated to remain exposed and unpainted.
3. CONCRETE SAMPLING AND TESTING:
- 3.01 The Contractor shall employ a separate testing laboratory, accepted by the Engineer, to perform all tests and to submit test reports to the Engineer. The testing laboratory shall be responsible for conducting and interpreting the tests, and shall state in each report whether or not the test specimens comply to the specified requirements, and shall indicate any deviations therefrom. Slump testing and preparation of compression test cylinders shall be done by contractor's personnel after proving to the Engineer that correct procedures and equipment are in accordance with the ASTM Specifications. If the Contractor cannot comply with the ASTM specifications, the testing laboratory shall perform these functions at the Contractor's expense.
- 3.02 Materials and Installed Work may require testing and re-testing as directed by the Engineer at any time during the progress of the work. Allow free access to material stockpiles and facilities at all times. Tests not specifically indicated to be done, including the re-testing or rejected materials and installed work, shall be done at the Contractor's Expense.
- 3.03 QUALITY CONTROL TESTING DURING CONSTRUCTION: Concrete shall be sampled and tested for quality control during the placement of the concrete as follows:
- A. Sampling Fresh Concrete: ASTM C172, except modified for slump to comply with ASTM C94.

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- B. Slump: ASTM C143, one test for each concrete load at point of discharge; and one for each set of compressive strength test specimens.
- C. Compression Test Specimens: ASTM C34, one set of three standard cylinders for each compressive strength test.

For test cylinders for 28 days compressive strength determination, during the first 24 hours after molding, store all test cylinders under conditions that maintain the temperature immediately adjacent to the cylinder in the range or 60°F to 80°F. And prevent loss to the cylinders in the range or 60°F to 80°F and prevent loss of moisture from the specimens. If the Engineer or testing laboratory have questions concerning the storage temperature, they may require that the Contractor provide a temperature record of the cylinders by mean of maximum-minimum thermometers. At the end of 20 hours plus or minus four hours, cylinders are to be transported to the laboratory, removed from the molds, and placed in a moist condition at 73.4 plus or minus 3°F. until the moment of testing.

Cure test cylinders to be used for determining strength for form removal time as nearly as practical in the same manner as the concrete in the structure. Cylinders shall be stored in or on the structure. Cylinders shall be stored in or in the structures as near the point for use as possible, and as far as is practicable, with the same exposure to the elements. Remove test cylinders from field storage and store in lime water at 73.4 plus or minus 3°F for 24 hours plus or minus four hours immediately before testing.

Cylinders shipped from the field to the laboratory shall be packed in sturdy wood boxes or other suitable containers surrounded by wet sawdust or other suitable packing material and shall be protected from freezing during shipment.

- D. Compressive Strength Tests: ASTM C39, one set for each 50 cubic yards or fraction thereof, of each concrete class placed in any one day; one specimen tested at seven days, one specimen tested at 28 days. If the 28-day strength test is 10% (or greater) more than specified 28-day strength, the third cylinder shall be disposed of by the laboratory. If the 28 day strength test is less than 10% more than specified strength, the third cylinder shall be tested and reported to the Engineer along with other tests.

3.04 Test results shall be reported in writing to the Engineer and the Contractor on the same day that tests are made. Reports of compressive strength tests shall contain the project identification name and number, date of placement, name of contractor, name of concrete supplier and truck number, name or concrete testing service, concrete type and class, location of concrete batch in the structure, slump, design compressive strength at

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28 days, concrete mix proportions and materials; compressive breaking strength and the type of break for both 7-day tests, and 28-day tests.

- 3.05 ADDITIONAL TESTS: The testing service shall take core samples of in-place concrete when the test results are such that there is reasonable doubt that the specified concrete strengths and other characteristics have not been attained in the structure. The testing service shall conduct tests to determine the strength and other characteristics of the in-place concrete by compression tests on cored cylinders complying with ASTM C42, or by load as outlined in ACI 318, or others as directed. The Contractor shall pay for such tests conducted and any other additional testing as may be required.

Correct all concrete work that is found structurally inadequate by core tests as directed by the Engineer.

4. CONCRETE MIXES: Provide the following classes of concrete where shown on the drawings:

- 4.01 STANDARD WEIGHT CONCRETE:

3,000 psi (minimum) at 28 days.

5.5 sacks of cement per cu. yd. of concrete (minimum).

6.0 gal. of water per sack (94 lb.) of cement (maximum).

Cement content may be reduced by ½-sack per cubic yard when an approved plasticizing admixture is used in accordance with the manufacturer's recommendations, provided that mix tests yield concrete of not less than the specified strength and such reduction of cement is accepted in writing by the Engineer. Do not use fly ash in concrete mix.

- 4.02 ADMIXTURES: Use air-entraining admixtures in all concrete, unless otherwise shown or specified. Add air-entraining admixture at the manufacturer's prescribed rate of result in concrete at the point of placement having air content within the following limits: 2% of 4% air.

When air-entrainment is used, reduce the maximum water content of the design mixes.

Use water-reducing admixtures in strict compliance with the manufacturer's directions. Admixtures to increase cement dispersion, or provide increased workability for low-slump concrete, may be used at the Contractor's option subject to the Engineer's acceptance. When water-reducing admixtures are used, a reduction in the cement content of concrete mixes will not be permitted, except as noted in accordance with paragraph 4.01.

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Use amounts of admixtures as recommended by the manufacturer for climatic conditions prevailing at the time of placing. Adjust quantities of admixtures as required to maintain quality control.

Calcium Chloride: Do not use calcium chloride in concrete, except as otherwise authorized in writing by the Engineer. Do not use any admixtures containing calcium chloride where concrete is placed against any galvanized steel, or in any mix using high-early strength cement.

- 4.03 SLUMP LIMITS: Proportion and design mixes to result in concrete slump at the point of placement as follows:

Not less than 1" and not more than 5".

- 4.04 CONCRETE MIX DESIGN: The testing laboratory shall submit concrete mix designs and aggregate analysis for each type and class of concrete specified including lightweight structural and architectural concrete. Submittal of mix design shall also include seven and 28 day compressive strengths obtained. Designs shall be submitted to the Engineer with an adequate time for checking prior to time of batching and placement of any class of concrete submitted.

5. JOINTS:

- 5.01 CONSTRUCTION JOINTS: Locate and install construction joints, which are not shown on the drawings, so as not to impair the strength and appearance of the structure, as acceptable to the Engineer. The Contractor shall submit one reproducible print (sepia) and one print indicating the proposed construction joints to the Engineer at least 14 days prior to beginning formwork on the portion of the building in question. Locate construction joints if required, but not shown so as to divide the slab into areas not in excess of 6,000 sq. ft., unless otherwise accepted by the Engineer. Conform to slab placement, where shown. Before adjacent pour is made, the surface shall be roughened to an amplitude of a minimum of ¼" except at exposed surfaces.

Provide keyways at least 1-½" deep in all construction joints in walls, slabs, and between walls and footings. Accepted bulkheads designed for this purpose may be used for slabs. Keyways are to be horizontal or vertical as directed by the Engineer.

Place construction joints perpendicular to the main reinforcement. Continue all reinforcement across construction joints unless detailed otherwise and place additional reinforcing in accordance with Engineer's written instructions.

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- 5.02 CONTROL JOINTS: Provide control joints in slabs on ground to form panels or patterns as shown. Use inserts ¼" wide x 1/5 to ¼ of the slab depth, unless otherwise shown.

Form control joints by inserting a premolded hardboard or fiberboard strip into the fresh concrete until the top surface of the strip is flush with the slab surface. After the concrete has cured for at least seven days, remove inserts and clean groove of loose debris. Metal keyways pre-formed for this purpose may be used in independent slabs on fill. Keyways are to be full depth of the slab and flush with the top.

6. INSTALLATION OF EMBEDDED ITEMS:

- 6.01 GENERAL: Set and build into the work anchorage devices and other embedded items required for other work that is attached to, or supported by, cast-in-place concrete. Use setting drawings, diagrams, instructions and directions provided by suppliers of the items to be attached thereto. Where conduit, pipe, or other items are to be embedded in concrete beams, slabs, or columns, they shall be placed not closer than the diameter of the largest of the adjacent items and with a new reduction on the concrete area (of a 12" wide strip in slabs) not in excess of 9% without prior approval of the Engineer. The location of such embedded items shall generally be at the middle or centered of the member.

- 6.02 EDGE FORMS AND SCREED STRIPS FOR SLABS: Set edge forms or bulkheads and intermediate screed strips for slabs to obtain the required elevations and contours in the finished slab surface. Provide and secure units sufficiently strong to support the types of screeds required. Align the concrete surface to the elevation of the screed strips by the use of strike-off templates or accepted compacting type screeds.

7. CONCRETE MIXING:

- 7.01 GENERAL: Concrete may be mixed at batch plants or it may be transit-mixed as specified herein. Batch plants must comply with the requirements of ACI 614, with sufficient capacity to produce concrete of the quality specified, in quantities required to meet the construction schedule. All plant facilities are subject to the acceptance of the Engineer. Plant facilities shall be calibrated by testing agencies specifically qualified for this as frequently as necessary to ensure accuracy to +/- 4% of the total capacity of the components of the plant, but at a frequency not to exceed six months.
- 7.02 JOB SITE MIXING: Mix all materials for concrete in an acceptable drum type batch machine mixer. For mixers of one cubic yard or smaller capacity, continue mixing at least 1-½ minutes, but not more than five minutes after all ingredients are in the mixer, before any part of the batch is released. For mixers of capacity larger than one cubic yard, increase the minimum 1-½ minutes of mixing time by 15 seconds for each

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additional cubic yard, or fraction thereof. Do not exceed the catalog rating or nameplate capacity for a total volume of materials used per batch. Equip the mixer with automatic controls, or semiautomatic controls, if acceptable, for proportioning materials and the proper measured quantities. So not exceed 30 minutes total elapsed time between intermingling of damp aggregates and cement to the discharge of the completed mix.

Provide a batch ticket for each batch discharged and used in the work, indicating the project identification name and number, date, mix type, mix time, quantity and amount of water introduced.

- 7.03 READY-MIX CONCRETE: Comply with the requirements of ASTM C94, and as herein specified, provided the quantity and rate of delivery will permit unrestricted progress of the work in accordance with the placement schedule. Discharge of the concrete shall be completed within 1-½ hours after water is added to the mix or by the time the drum has revolved 300 times, whichever occurs first. During hot weather, or under conditions contributing to rapid setting of concrete, a shorter mixing time than specified in ASTM C94 may required, i.e., the time limit shall be reduced to between 45 minutes and one hour after adding water, for completion of discharge depending on severity of conditions. Proposed changes in mixing procedure other than herein specified, must be accepted by the Engineer before implementation.

8. CONCRETE PLACEMENT:

- 8.01 GENERAL: Place concrete in compliance with the practices and recommendation of ACI 614, 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 or weakness within the section. If a section cannot be placed continuously, provide construction joints as herein specified. Perform concrete placing at such a rate that concrete which is being integrated with fresh concrete is still plastic. Deposit concrete as nearly as practicable to its final location to avoid segregation due to rehandling or flowing. Do not subject concrete to any procedure which will cause segregation.

Screed concrete which is to receive other construction to the proper level to avoid excessive skimming or grouting.

Do not use concrete which becomes non-plastic and unworkable, or does not meet the requirements quality control limits, or which has been contaminated by foreign materials. Do not use retempered concrete. Remove rejected concrete from the project site and dispose of it in an acceptable location.

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8.02 PRE-PLACEMENT INSPECTION: Before placing concrete, inspect and complete the formwork installation, reinforcing steel, and items to be imbedded or cast-in. Notify other crafts involved in ample time to permit the installation of their work; cooperate with other trades in setting such work, as required. Thoroughly wet wood forms immediately before placing concrete, as required where form coating are not used. Notify the Engineer and testing laboratory 24 hours before placing concrete.

8.03 CONCRETE CONVEYING: Handle concrete from the point of delivery and transfer to the concrete conveying equipment and the locations of final deposit as rapidly as practicable by methods which will prevent segregation and loss of concrete mix materials.

Provide mechanical equipment of such size and design for conveying concrete to ensure a continuous flow of concrete at the delivery end. Provide runways above top of finished slab in all places for wheeled concrete conveying equipment for the concrete delivery point to the locations of final deposit. Do not wheel concrete directly over steel reinforcement. Keep interior surfaces of conveying equipment, including chutes, free of hardened concrete, debris, water, snow, ice, and other deleterious materials.

PUMPING CONCRETE: The Contractor may at his option use pumping machines for placing the concrete subject to the following requirements:

If for pumping requirements the mix design is other than specified, the Contractor shall furnish to the Engineer a mix for approval not less than 15 days prior to the time required for its use. The laboratory will make and test this mix design. After the results of these tests are noted and approval is received, this mix can be used. Cost of this laboratory work shall be paid by the Contractor.

Whenever concrete is placed by pumping, a second pump complete with sufficient pipes and hose for a complete and independent setup shall be at the job prior to any placing of concrete. The Contractor shall include the cost of this standby equipment in his base bid.

8.04 PLACING CONCRETE IN FORMS: Deposit concrete in forms in horizontal layers not deeper than 18" and in a manner to avoid inclined construction joints.

Remove temporary spreaders in forms when concrete placing has reached the elevation of such spreaders.

Consolidate all concrete placed in forms by mechanical vibrating equipment supplemented by hand-spading, rodding or tamping. Use vibrators designed to operate with vibratory elements submerged in concrete, maintaining a speed of not less than 6,000 impulses per minute when submerged in the concrete. Vibration of forms and reinforcing will not be permitted, unless otherwise accepted by the Engineer.

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

- 8.05 PLACING CONCRETE SLABS: Deposit and consolidate concrete slabs in a continuous operation, within the limits of construction joints, until the placing of a panel or section is completed.

Consolidate concrete during placing operations using mechanical vibrating equipment, so that concrete is thoroughly worked around reinforcement and other embedded items and into corners. Consolidate concrete placed in beams and girders of supported slabs, and against bulkheads of slabs on ground, as specified for formed concrete structures. Consolidate concrete in the remainder of slabs by vibrating bridge screeds, roller pipe screed, or other acceptable methods. Limit the time of vibrating consolidation to prevent bringing an excess of fine aggregate to the surface.

Bring slab surfaces to the correct level with a straight edge and strike off. Use bull floats or darbies to smooth the surface, leaving it free of humps or hollows. Do not sprinkle water on the plastic surface. Do not disturb the slab surfaces prior to beginning finishing operations.

Maintain reinforcing steel in the proper position continuously during concrete placement operations.

- 8.06 BONDING: Roughen surfaces of set concrete at all joints, except where bonding is obtained by use of a concrete bonding agent, and clean surfaces of laitance, coatings, loose particles, and foreign matter. Roughen surfaces in a manner to expose bonded aggregate uniformly and to not leave laitance, loose particles of aggregate, or damaged concrete at the surface.

9. MONOLITHIC SLAB FINISHES:

- 9.01 SCRATCH FINISH: Apply scratch finish to monolithic slab surfaces that are to receive concrete floor topping or mortar setting beds for tile, Portland cement terrazzo, and other bonded applied cementitious finish flooring material, and as shown on the Drawings.

After placing slabs, plane the surface to a tolerance not exceeding 1/4" in 2' when tested with a 2' straight edge. Slope surfaces uniformly to drains where required. After leveling, roughen the surface before the final set with stiff brushes, brooms or rakes.

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- 9.02 FLOAT FINISH: Apply float finish to monolithic slab surfaces that are to receive trowel finish and other finishes as hereinafter specified and as shown on the Drawings or in schedule.

After placing concrete slabs, do not work the surface further until ready for floating. Begin floating when the surface water has disappeared or when the concrete has stiffened sufficiently to permit the operation of the power-driven float, or both. Consolidate the surface with power-driven floats, and by hand-floating if area is small or inaccessible to power units. Check and level the surface plane to a tolerance not exceeding $\frac{1}{4}$ " in 10' when tested with a 10' straight edge placed on the surface at not less than two different angles. Cut down high spots and fill all low spots. Uniformly slope surfaces to drains. Immediately after leveling, refloat the surface to a uniform smooth, granular texture.

- 9.03 TROWEL FINISH: Apply trowel finish to monolithic slab surfaces that are to be exposed to view, unless otherwise shown, and slab surfaces that are to be covered with resilient flooring, paint, or other thin film finish coating system.

After floating, begin the first trowel finish operation using a power-driven trowel. Begin final troweling when the surface produces a ringing sound as the trowel is moved over the surface.

Consolidate the concrete surface by the final hand troweling operation free of trowel marks, uniform in texture and appearance, and with a surface plane tolerance not exceeding $\frac{1}{8}$ " in 10' when tested with a 10' straight edge. Grind smooth surface defects which would telegraph through applied floor covering system.

- 9.04 NON-SLIP BROOM FINISH: Apply non-slip broom finish to exterior concrete platforms, walks, steps and ramps, and elsewhere as shown on the Drawings or schedules.

Immediately after trowel finishing, slightly roughen the concrete surface by brooming in the direction perpendicular to the main traffic route. Coordinate the required final finish with the Engineer before application.

- 9.05 GROUT FINISH: Provide grout finish to all interior and exterior concrete vertical surfaces which are exposed to view in the finish structure, and which are not shown or specified as "tan" or "architectural" concrete, consisting of one part Portland Cement to 1- $\frac{1}{2}$ parts of fine aggregate passing a No. 30 mesh by volume, mixed with only enough water to produce a consistency of thick paint.

Thoroughly wet the concrete surface and apply grout immediately to the wetted surfaces. Spread grout with clean burlap pads or sponge rubber floats to fill all pits, air bubbles, and surface holes. Remove excess grout by scraping, followed by rebbing with clean burlap to

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remove any visible grout film. Keep grout damp during the setting period by means of fog spray in hot, dry weather. Complete any area in the same day it is started, with the limits of any area being the natural breaks in the finished surface.

- 9.06 HARDNER: On concrete floors which will remain exposed, Lapidolith by Sonneborn shall be sprayed on the concrete, ten days after concrete placement, at the rate of 200 square feet per gallon. An air pressure or gravity sprayer which will break up, but not atomize the liquid should be used. An unbroken, glossy appearance for a few minutes after spraying will indicate full coverage. Complete coverage is mandatory; flooding is unnecessary - avoid puddling.

10. CONCRETE CURING AND PROTECTION:

- 10.01 GENERAL: Protect freshly placed concrete from premature drying and excessive cold or hot temperature, and maintain without drying at a relatively constant temperature for the period of time necessary for hydration of the cement and proper hardening of the concrete.

Start initial curing as soon as free water has disappeared from the concrete surface after placing and finishing. Weather permitting, keep continuously moist for not less than 72 hours.

Begin final curing procedures immediately following initial curing and before the concrete has dried. Continue final curing for at least 168 cumulative hours (not necessarily consecutive) during which the concrete has been exposed to air temperatures above 50°F. Avoid rapid drying at the end of the final curing period.

- 10.02 CURING METHODS: Perform curing of concrete by moist curing or by moisture-retaining cover curing by any of the following methods:

Keeping the surface of the concrete continuously wet by covering with water.

Continuous water-fog spray.

Covering the concrete surface with the specified absorptive cover, thoroughly saturating the cover with water, and keeping the absorptive cover continuously wet. Place absorptive cover so as to provide coverage of the concrete surfaces and edges, with a 4" lap over adjacent absorptive corners.

Membrane-forming liquid curing compounds, followed by shading or moist curing adequate to keep temperature of the concrete at 80°F. or below during the curing period.

- 10.03 CURING FORMED SURFACES: Cure formed concrete surfaces, including the undersides of girders, beams, supported slabs and other similar surfaces by moist during

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with the forms in place for the full curing period or until forms are removed. If form are removed, continue curing by any of the methods specified above, as applicable.

10.04 TEMPERATURE OF CONCRETE DURING CURING: When the atmospheric temperature is 80°F. and above, or during other climatic conditions which will cause too rapid drying of the concrete, make arrangements before the start of concrete placing for the installation of wind breaks or shading, and for fog spraying, wet sprinkling, or moisture retaining covering. Protect the concrete continuously for the concrete curing period. Provide hot weather protection complying with the requirements of ACI 605.

Maintain concrete temperature as uniformly as possible, and protect from rapid atmospheric temperature changes. Avoid temperature changes in concrete which exceed 5° F. in any one hour and 50° F. in any 24 hour period.

10.05 PROTECTION FROM MECHANICAL INJURY: During the curing period, protect concrete from damaging mechanical disturbances including load stresses, heavy shock, excessive vibration, and from damage caused by rain or flowing water. Protect all finished concrete surfaces from damage by subsequent construction operations.

11. MISCELLANEOUS CONCRETE ITEMS:

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

11.02 CURBS: Provide monolithic finish to interior curbs by stripping forms while concrete is still green and steel-troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.

11.03 EQUIPMENT BASES AND FOUNDATIONS: Provide machine and equipment base and foundations, as shown on the Drawings. Set anchor bolts for machines and equipment to template at correct elevations, complying with certified diagrams or templates of the manufacturer furnishing the machines and equipment.

12. CONCRETE EVALUATIONS:

12.01 EVALUATION OF QUALITY CONTROL TESTS: The concrete quality control testing as herein before specified will be evaluated by the following criteria:

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Do not use concrete delivered to the final point of placement which has a slump or total air content outside the values specified.

If the compressive strength tests fail to meet the minimum requirements specified, the concrete represented by such tests will be considered deficient in strength and subject to additional testing as herein specified.

- 12.02 FORMED CONCRETE DIMENSIONAL TOLERANCES: Formed concrete having any dimension smaller than required, and outside the specified tolerance limits, will be considered deficient in strength and subject to additional testing as herein specified.

Formed concrete having any dimension greater than required will be rejected if the appearance or function of the structure is adversely affected, or if the larger dimensions interfere with other construction. Repair, or remove and replace rejected concrete as required to meet the construction conditions. When permitted, accomplish the removal of excessive material in a manner to maintain the strength of the section without affecting function and appearance.

- 12.03 STRENGTH OF CONCRETE STRUCTURES: The strength of the concrete structure in-place will be considered potentially deficient if it fails to comply with any of the requirements which control the strength of structure, including the following conditions.

Failure to meet compressive strength test requirements.

Concrete which differs from the required dimensions or location in such a manner to reduce strength.

Concrete subjected to damaging mechanical disturbances; particularly load stresses, heavy shock, and excessive vibration.

Poor workmanship and quality control likely to result in deficient strength.

13. CONCRETE SURFACE REPAIRS:

- 13.01 GENERAL: Repair and patch defective areas with cement mortar immediately after removal of forms, but only when directed by the Engineer.
- 13.02 Cut out honeycomb, rock pockets, voids over ½" diameter, 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. Before placing the cement mortar, thoroughly clean, dampen with water, and brush coat the area to be patched with neat cement grout. Proprietary patching compounds may be used when acceptable the Engineer.

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- 13.03 REPAIR OF UNFORMED SURFACES: Test unformed surfaces, such as monolithic slabs, for smoothness and to verify surface plane to the tolerance 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 the required slope. Correct high and low areas as herein specified.

- 13.04 Repair finished unformed surfaces that contain defects which adversely affect the durability of the concrete. Surface defects, as such, include crazing, cracks in excess of 0.01" wide or which penetrate to the reinforcement or completely through non-reinforced sections regardless of width, spalling, popouts, honeycomb, rock pockets, and other objectionable conditions.
- 13.05 Correct high areas in unformed surfaced by grinding, after the concrete has cured at least 14 days.
- 13.06 Correct low area in unformed surfaces during, or immediately after, completion of surface finishing operations by cutting out the low areas and replacing with fresh concrete. Finish repaired areas to blend into adjacent concrete. Proprietary patching compounds may be used when acceptable to the Engineer.
- 13.07 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 ¾" clearance all around. Dampen all concrete surfaces in contact with patching concrete, and brush with a neat cement grout coating or concrete bonding agent. Place patching concrete before grout takes its initial set. Mix patching concrete of the same materials to provide concrete of the same type or as the original adjacent concrete. Place, compact and finish as required to blend with adjacent finished concrete. Cure in the same manner as adjacent concrete.
- 13.08 Repair isolated random cracks and single holes not over 1" in diameter by a dry pack method. Groove the top of cracks and cut out holes to sound concrete and clean of dust, dirt and loose particles. Dampen all cleaned concrete surfaces and brush with a neat cement grout coating. Place dry-pack before the cement grout takes its initial set. Mix dry-pack, consisting of one part Portland Cement to 2-½ parts of fine aggregate passing a No.16 mesh sieve, using only enough water as required for handling and placing. Compact dry-pack mixture in place and finish to match adjacent concrete. Keep patched areas continuously moist for not less than 72 hours.

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13.09 Repair methods not specified above may be used, subject to the acceptance of the Engineer. Under no circumstances will "dusting" of wet concrete during finishing operations be allowed.

14. VAPOR BARRIER:

14.01 GENERAL:

- A. Provide vapor barrier cover over subgrade material under all beams and slabs cast against grade.

14.02 PRODUCTS:

- A. Use a clear polyethylene sheeting, 0.006" (6 mil) thick, complying with CS 238.
- B. Products offered by manufacturers to comply with the requirements include the following:

Zendel: Union Carbide
Visqueen

14.03 EXECUTION:

- A. Install over subgrade material.
- B. Lap sides and ends 6".
- C. Protect vapor barrier from punctures until floor slab has been properly placed.

END OF SECTION