

INFRASTRUCTURE DESIGN STANDARDS

**INSTRUCTIONS
to
ARCHITECT/ENGINEER
for
SPECIFICATIONS for CONCRETE**

January 10, 1992



**THE CITY OF NEW YORK
BUREAU OF WATER AND SEWER OPERATIONS
DEPARTMENT OF ENVIRONMENTAL OPERATIONS**

[A] **INSTRUCTIONS TO ARCHITECT/ENGINEER PREFACE TO PREPARATION OF DETAILED SPECIFICATION BY THE ARCHITECT/ENGINEER**

(These instructions are for explanatory purposes only and do not form a part of the Specification)

I1 The form of this specification is similar to, but is no way dependent upon ACI, standard 301 "Specifications for Structural Concrete for Buildings." That specification has been modified to reflect the local conditions in New York City and the particular requirements of the department. These are not "guide" specifications. Individual chapters of the "General Specifications - Concrete" (Chapter 1 to 20) or sections thereof should not be copied into detailed specifications or changed in any way since there is danger that taking them out of context may change their meanings. The "Detailed Specification" shall contain a brief scope and shall designate or specify individual project supplemental requirements.

I2 The "General Specification - Concrete (latest version - 1991)", similar to ACI standard 301 may be used as a reference standard which is to be made applicable to any project by being cited in the Detailed Specification. A reference type Specification, by its very nature, is extremely flexible. The detailed specification may be a very short document (one page) or a lengthy one. The Consultant Architect/Engineer shall check with the Department and obtain acknowledgment in writing as to whether the "General Specification - Concrete" shall be incorporated by reference or included in total in the final contract specification.

I3 The consultant Architect/Engineer shall also check with the Department and obtain acknowledgment in writing as to the assignment of the Supervising Engineer for Concrete Construction (Engineer designated for controlled inspection) and the designation of a testing laboratory. Administrative action may be provided through allowances in the Contract documents in which case carefully written language must be incorporated in the contract Detailed Specification. Many possibilities exist some of which are listed below:

I3.1 The department may assign one of its Engineers as the Supervising Engineer for concrete Construction. It may make arrangements with a Construction Manager, with the Architect/Engineer, with another consultant, with a testing laboratory, etc.

I3.2 The best arrangement with the Testing Laboratory is for it to be hired directly by the City or through the Construction Manager. This does not relieve the Contractor of his responsibilities for payment for services by a testing laboratory (which may be other than that used by the City or the Construction Manager), as outlined in 16.1.2.2, 16.3.1.1 and 16.3.1.2.

I3.3 The Supervising Engineer for Concrete Construction may be responsible for controlled inspection only, or designated for Semi-controlled inspection as well. In any case, the responsibility of the contractor must be carefully spelled out.

I3.4 Payment for testing laboratory may be from an allowance in the contract documents. This may also be so for the Supervising Engineer for Concrete Construction (and his staff) although this is not considered desirable.

I3.5 The relationship between the Supervising Engineer of Concrete Construction and the Resident Engineer must be carefully delineated. Will the Resident Engineers Inspection staff divorce itself completely from the Concrete work or will it assist in the work of the Supervising Engineer for Concrete Construction?

I4 The Consultant Architect/Engineer shall assist in the preparation of any documents, contracts etc. required for the proper assignment of a Supervising Engineer for Concrete Construction and a testing laboratory.

I5 There is no conflict between Chapter 19 "Slabs on Earth, Curbs and Drainage Structures and the standard specifications of the Department of Highways or of the Bureau of Water Pollution Control, Division of Sewer Design.

I6 Supplemental requirements

The list of supplemental Requirements in the Detailed Specifications must always cover the mandatory requirements below and, in addition, should include relevant items from the list of requirements to be designated where applicable. Items not listed will be assumed to be inapplicable to the project or to be subject to the option of the contractor. (The lists are keyed to section numbers of this Specification). For structures of unusual complexity, the individual Architect/Engineer may incorporate still more stringent provisions in the Detailed Specification.

I7 Concrete with 28 day strength above 5000 psi, while not excluded from these specifications, is not adequately treated. If used, then extensive material must be added to the detailed specifications. Use the New York City Building Code and ACI 318 as a guide.

I8 The following General Specifications of the DEP, Bureau of Heavy Construction, Division of Plant Construction (Water Pollution Control) have been incorporated in General specification 11 and should no longer be included in the Contract Documents:

- No. 13 Cinder Concrete & Cinder Fill.
- 13A Light Weight Concrete Fill.
- 14 Rubbed Finish.
- 15A Cement Floor and Stair Finish.
- 15B Granolithic Floor Finish.
- 20 Steel Reinforcement.
- 29 Copper Water Stops.
- 29A Water Stops.
- 37 Expansion Joint Filler.
- 201 Concrete Pavement, Walks and Curbs.

I9 Reference Specifications (See 1.4.2, 3.2.1, 16.2 & 19.2)

Note that the New York City building Code (NYCBC) and the Rules, Regulations or Standard Specifications of other Agencies (RRSSOA) are incorporated in this specification by reference. The requirements of this project must be clarified in a schedule (for example, See Appendix, table 3.3).

I10 In reference to Section 1.4.2 - Note (Table 10-1) that only structural concrete is controlled concrete although some structural concrete may not be subject to controlled inspection. Non-structural concrete (mud slabs, fills, toppings, overlays, pipe and conduit encasement etc...) are clearly not subject to controlled inspection. Work required to comply to requirements of other Regulatory Agencies (sewers, sewers cradles, roads, curbs, concrete base of pavement etc.; See chapter 19) is also not subject to controlled inspection. Non-structural concrete does not require laboratory inspection either in the mix plant or at the job-site. As Semi-controlled concrete, the inspections required are much more limited (See 1.4.3(b) and 3.9.2.5). All these items should be clearly defined and listed in schedule table 3.3.

I11 In reference to 3.9.2.3 NYCBC Method I

Note that "in lieu of making preliminary tests, previously accepted mixes in accordance with NYCBC (See 27-65 (a) (4)) are acceptable. Accepted means accepted by the NYC Building Department or other Regulatory Agency. Note that acceptance must be within the last year. Accepted does not mean used.

I12 In reference to 3.9.2.4 NYCBC Method II

Note that method II does not require mix plant inspection but does require attestations by the mix plant. Proportioning in accordance with method II must be requested by the Contractor (the producer) and be supported by statistical data. Method II may be accepted (i.e., by the Regulatory Agency) subject to the approval of the Architect or Engineer designated for Controlled Inspection.

I13 In reference to Section 3.9.2.5 NYCBC Method III

Method III (Average Concrete) has limited use as structural concrete. However, if used as non-structural concrete it has definite advantages. There is no mix plant or job site inspection required and a minimum of involvement with Regulatory Agencies. At the fixed cement factors and maximum water permitted (See table 10-3A, NYCBC 27-605(C)), the slump will be high, obviating the need for water reducing agents. Air entrainment may or may not be needed.

From Table 10-3A

F'c	Cement lbs/cu.yd.	Max. Gals/H ₂ O	W/C Ratio
2000	520	40	0.64
2500	560	41	0.61
3000	610	42	0.57

Non-structural concrete, especially fills, mud slabs etc... sometimes involves large quantities. By clearly defining such concrete (See table 3.3, Appendix), aside from the economies achieved, the administrative involvement with Regulatory Agencies is greatly reduced.

If used, some level of field inspection should be specified (See table 3.3, Appendix).

Experience with average concrete (Method III) by the Department of Public Works years ago showed it to be a reliable and economical product.

[B] **"FORMAT OF DETAILED SPECIFICATION - CONCRETE"**

Scope: Add brief statement as to nature of concrete work on this project.

Reference Specification:

If the General Specification - Concrete is to be referred to by reference only (not included in the body of the spec.), add the following statement, otherwise omit.

The "GENERAL SPECIFICATION 11 - CONCRETE" of the Department is declared to be part of this specification, the same as if fully set forth elsewhere herein. Copies of this specification may be obtained from the Department. Concrete work shall conform to all requirements of that specification except as modified by this Detailed Specification.

Detailed Requirements:

Reference numbers are keyed to section numbers of the "General Specification - Concrete". (See Appendix for Examples)

MANDATORY SUPPLEMENTAL REQUIREMENTS TO BE STATED FOR ALL PROJECTS.

1.4.1.6 Supervising Engineer for Concrete Construction (Engineer designated for controlled inspection). State who will be assigned (Construction manager, Resident Engineer etc.). If through allowance in the contract, give all the details (including staffing) and scheduled of payment. State whether the Supervising Engineer for concrete construction will also be responsible for Semi-Controlled Inspection. In general, this is Department policy. If Semi-Controlled Inspection (1.4.2(b)) is to be by the "person superintending the use of the material or its incorporation into the work" (i.e. the Contractor), the detailed specification should clearly say so.

2.1 Specify that Coarse and Fine Aggregates for Concrete shall be well graded in accordance with 2.6.1.1. Maximum size of Coarse Aggregate shall be 3/4". All sieve sizes (1½" to No. 200) shall be used in determining grading of both Coarse and Fine Aggregates.

2.3 Specify that an approved mineral Admixture Type F (Fly Ash) shall be substituted for cement in the ratio of 20% by weight.

2.3 Maximum cementitious material factor shall be 660 lbs/cu.yd of concrete for 4000 p.s.i concrete.

3.1 Specify the following tolerances that will be permitted during production of the concrete:

Slump + 1" (See also 3.6.1, 3.6.1.1, 3.6.1.2, 3.6.1.3, 3.6.2)

Air ± 1½% (See also 3.5.1)

Unit Weight ± 2%

Fineness modulus ± 0.1 (See also 2.6.1.1 of detailed spec.)
(Combined &
Individual ingredients)

% Mortar Not to exceed 57% for general use (See also 2.6.1.4)

Water/cement ratio 0.44 max. (See also 3.5.3)

Specify that when the above tolerances are exceeded, the condition shall be immediately investigated and corrective action taken. Corrective action may include modification of the mix for gradation as required by the N.Y.C. Building Code. A report of the condition and the remedial action taken shall be filed with the Engineer designated for Controlled Inspection within 48 hours.

3.3 Schedule of Mixes (Table 3.3)

For each portion of the structure, specify the strength of concrete, the Agency having jurisdiction, the specified strength, the slumps, mix proportioning data and the required inspection, all in a schedule showing full details. See Appendix, table 3.3 for example. For strengths above 5000 psi see instructions to the A/E (I7).

It is recognized that method III is limited by the NYC Building Code to situations where "... the total yardage placed does not exceed 50 cu. yds. and the level of calculated stress does not exceed 70 percent of the basic allowable stresses" (See 3.9.2.5). However, the recommendation for use of method III in the Table 3.3 are either for non-structural concrete or other agency concrete; i.e.-not under the jurisdiction of the NYC Building Code.

5.3 Reinforcing Steel - specify types and grades of reinforcing steel, designated by ASTM specification number and, where necessary, by yield strength. See appendix for example.

16.1.2.1 Testing Agency - Designate testing agency for services of Sections 16.3, 16.4, and 16.5; and method of selecting testing agency for services of Section 16.7.1. It is recommended that the testing agency be required to provide evidence of recent inspection of its facilities by the Cement and Concrete Reference Laboratory of the National Bureau of Standards and be required to show that any deficiencies mentioned in the report of that inspection have been corrected. Designate location of laboratory to which cylinders are to be delivered. See Appendix for example.

16.6 Lab Payment - Designate Methods of Payment for Concrete Testing laboratory. It is recommended that testing agency be paid by owner. If by allowance in contract, give details. See Appendix for example.

20.1.1 Payment - Designated Method of payment for concrete and for Reinforcing Steel if other than in 20.2.2.1 or 20.3.2.1.

[C] SUPPLEMENTARY REQUIREMENTS TO BE DESIGNATED IF APPLICABLE

2.3.2 Specify special cement requirements if any.

2.4 Specify Admixture types specifically required or prohibited.

Note: Air Entrainment is already designated in Section 3.5 - Durability.
Mineral Admixture (Type F-Fly Ash) is covered in Mandatory Detailed Spec. 2.3.
Water Reducing Agents are included in section 2.4.1.2.
Calcium Chloride as a separate Admixture is not permitted (3.8.1).

3.1 Specify Portions of the structure for which concrete must be watertight.

3.4 Specify weight and strength of light weight concrete and lightweight concrete fill. See Appendix for example.

3.6 Specify Slump if other than as specified.

3.7 Specify Size and location where size greater than 1" is acceptable. See also 14.3.2 (both General Spec and Detailed Spec. herein).

3.10 Grout and Mortar - Designate if high strength grout or mortar ($F'_c > 4000$ psi) requiring trial mixes will be required.

3.11 Heavy duty paving concrete (high density concrete overlays or latex modified Concrete overlays are not part of this specification. If required, refer to N.Y. State Department of Transportation Specification Section 584 - Specialized Concrete Overlays for Structural Slabs. These are recommended in parking garages etc.

3.11.2 Classes of floors - Specify required compressive strength of topping if greater than 4000 psi.

4.1.2. Earth cuts as forms - Specify where or when earth cuts may be used as forms. See Appendix for example.

4.3.3 Specify beveling of interior corners and the edges of formed joints of permanently exposed surfaces.

4.3.7 Form accessories - Specify special form accessories to be or not to be used. See Appendix for example.

4.4.1 Tolerances other than those listed in Table 4.4.1. Specify for Sewage Treatment Plants, special attention should be directed to General Specification 48 where very rigid requirements are spelled out for Settling tanks.

4.4.4 Specify permissible variations from plumb and designated buildings more than 100 ft. above ground.

4.5.2 Specify special form coating procedures.

- 4.7.5 Specify minimum strengths of concrete to be reached before weight-supporting formwork and shoring may be removed. See Appendix for example.
- 4.8 Removal of shoring - Specify age or strength at which shoring may be removed if other than as noted.
- 5.3.2 When coated reinforcing bars are required. Specify whether the coated bars are to be zinc-coated (galvanized) or epoxy-coated.
- 5.3.2.1 For zinc-coated (galvanized) reinforcing bars per ASTM A 767, specify class of coating, Specify whether galvanization is to be performed before or after fabrication, and if supplementary requirement S3 applies. If the bars are to be galvanized after fabrication, indicate which bars sizes require special finished bend diameters, usually smaller bar sizes used for stirrups and ties.
- 5.3.3 Specify if bar mats are to be galvanized or epoxy coated.
- 5.3.4.1 Specify if wire is to be smooth or deformed.
- 5.3.5 Welded wire fabric - Designate which fabric is load carrying reinforcement.
- 5.3.5 Specify wire size and wire spacing of welded wire fabric; and whether fabric is to be smooth or deformed wire.
- 5.4 Specify class of protection for wire bar supports if other than Class 1 or Class 2.
- 5.7 When welding is required or permitted, specify any desired or more stringent requirements for preparation or welding such as removal of zinc or epoxy coating than those contained in AWS D1.4. Also specify any desired more stringent requirements for chemical composition of reinforcing bars than those contained in the referenced ASTM Specifications. Specify special heat treatment of welded assemblies if required. Specify supplementary requirements for welding of wire to wire, and welding of wire or welded wire to reinforcing bars or structural steels.
- 5.10.1 Specify if cover for reinforcement is other than as noted. see Appendix for example.
- 5.10.3.2 Specify side form spacers including material, type, spacing and location where required.
- 5.10.3.3 Specify minimum clear distance from galvanized reinforcing bars to other reinforcement and embedded steel items if other than 2".
- 5.11 Fully encased structural steel members - Designate whether such members have been designed for composite action.
- 6.3.1 Construction joints - Specify special requirements. See Appendix for example.
- 6.3.4 Bonding of joints - Designate locations and bonding method to be used. Specify the adhesive and/or retarder.
- 6.4.3 Premolded expansion joint filler - Specify location, size and details of fillers. Designate type of filler to be used if other than as specified.

- 6.4.4 Sealing compounds - Specify other joint sealing compounds. See Appendix for example.
- 6.5.1 Water stops - Specify material, design and location of water-stops. See Appendix for example.
- 6.6 Other embedded items - Designate any special embedded items. See Appendix for example.
- 6.7.1 Specify special precast items. See Appendix for examples.
- 6.7.9.3 Finishing of miscellaneous precast items or ornaments - Specify special finishes or variance from Sections 10.3, 11.9.2, or 13.10.1.
- 6.11 Fills - Lightweight Concrete etc. Specify as required. Specify method of payment for fills.
- 8.5.1 Depositing - Specify special requirements.
- 8.7 Connecting new to existing concrete - Specify special instructions - See Appendix for examples.
- 8.8 Concreting under water - Designate method of placing concrete under water and elaborate as necessary.
- 8.10 Specify any special non-shrink grout - See Appendix for example.
- 8.10.5.1 Premixed Grouts - Designate whether manufacturer's representative will be required.
- 8.11 Specify any concrete sealer - See Appendix for example.
- 8.11.3 Dry packing or grouting machine bases-Designate if at variance with specification as noted.
- 9.3 Defective areas - Specify other methods of repairing and patching if applicable.
- 10.1 Specify if samples (approximately 100 sq. ft. each) in an inconspicuous location designated by the Supervising Engineer for Concrete Construction are to be prepared for acceptance before proceeding with the finish in a specified location.
- 10.1.1 Specify required finishes for formed surfaces. Specify locations at variance with 10.1.1, if any.
- 10.3.3 Other special finishes - Specify.
- 10.4 Finishing of formed surfaces - Specify any special finishes required, or designate any selections of finishes or of their locations at variance with Section 10.4. See Appendix for example.
- 10.5 Specify finish if other than as in General Specification.
- 11.7 Jointing - Specify special requirements. Detail joints in slabs on grade if other than as noted.
- 11.9.2 Specify types of slab finishes if other than as in 11.9.2.
- 11.9.2.5 "Dry-shake" finish-Specify proprietary "aggregate" for "dry-shake" finish.
- 11.9.2.6 and 11.9.2.7 Heavy duty topping - Specify additional requirements for the aggregate.

- 11.9.2.8 Nonslip finish - Specify nonslip abrasive particles.
- 11.9.2.9 Exposed aggregate finish-Specify chemical retarder if desired in connection with any exposed aggregate floor finish.
- 11.9.2.10 Special treatments - Specify (painting, hardeners, dustproofing, etc.). See Appendix for example.
- 11.9.3 Finishing of flatwork - Specify any special finishes required, or designate any selection of finishes or of their locations at variance with Section 11.2. See Appendix for examples.
 - 11.9.3.2 Specify if a method other than the F method of ASTM E1155 is required for measuring floor.
- 11.9.6 Make special reference to General Spec. 48 when applicable.
- 12.1 Curing and Protection - Specify methods and material if other than as listed in the General Spec.
- 13.1.1 Architectural concrete - Designate areas to be treated as architectural concrete.
 - 13.1.1 Specify special color requirements for architectural concrete.
 - 13.1.1 Specify if white portland cement, colored aggregate-Designate areas where white portland cement and/or colored aggregates will be required.
 - 13.1.3 Preplaced aggregate - Specify results to be obtained and limitations and restrictions on methods of aggregate preplacement and grouting process.
 - 13.1.4 Specify special textures and patterns if any.
- 13.2.1 Test bent or mock-up - Specify whether test bent or mock-up will be required and give details.
- 13.3.1 Specify where concrete technical specialists will be required.
- 13.8.1 Specify special form deflection limits for architectural concrete if other than as noted in the General Spec.
- 13.10 Specify types of special architectural finishes and materials required for forming them.
 - 13.10.1.1 Textured form liners - Specify textured form linear material.
 - 13.10.1.2 Aggregate transfer finishes - Specify color and size of surface aggregates, type of adhesive cement, and details of joining panels.
 - 13.10.1.3 Specify type of sandblast finish if other than light.
 - 13.10.1.3 Specify depth of penetration for sandblast or tooled finish.
- 14.1 Specify portions of structure to be treated as massive concrete. The provisions of Chapter 14 will be applicable whenever the mass of the concrete is large enough to produce cracks or other problems caused by excessive differential temperatures resulting from the heat of hydration. The critical size

depends on many factors such as: weather conditions, the volume - surface ratio, rate of hydration, temperature and mass of surrounding materials, functional and aesthetic effect of surface cracking, and other factors. In general, the critical size may be more than 2½ ft in the least dimension, but the requirements of each project should be evaluated on their own merits.

Note that by definition (Section 14.1.1), Sections 4 feet or more in the least dimension are termed mass concrete.

14.1.2 Section larger than 6 ft. - Specify requirements for heating, cooling, curing and protecting sections more than 6 ft. in the least dimension.

15.1 List prestressed members and variations from General Specification if any.

15.5.1 Specify types and strengths of prestressing steel required.

16.1.2.1 Specify when submission of mill test reports for steel and cement is required.

19.2 Other City Agencies - Designate information required by Standard Specs. of other agencies. Attention is directed particularly to the Rules and Regulations of the Department of Highways Section 3.05 4.04 to 4.14 and 6.08 to 6.16; Standard Specifications of Bureau of Water Pollution Control, Division of Sewer Design, Sections 2.11 and Division V.

19.3.1 Specify concrete strength in table 3.3 detailed spec. if other than as noted. Highways and Sewers give approximate volumetric equations and require Constructor to submit formula he intends to use. For same class (strength) of concrete, each Agency has a different formula; i.e., class 25 Highways is a 5 bag mix; class 25 Sewers is a 6 bag mix. The fixed cement requirements of these Agencies will be met by the formulas in 19.3.1.

19.4.1 Drainage fill - Specify (including material and gradation) if required and not otherwise shown.

19.4.1 Preparation of foundations - Specify if other than as noted.

19.5.1 Slab on earth, reinforcement - Specify if required and not otherwise shown.

19.5.1 Slab on earth, thickness - Specify if other than as noted or shown.

19.5.2 Slab on earth, control joints - Specify if other than as noted or shown. Specify joint sealer.

19.5.3 Slab on earth, scoring - Specify special patterns, etc.

19.5.4 Slab on earth, expansion joints - Specify details (spacing, width, sealers etc.) if other than as noted.

19.6.4.11 Concrete curbs, headers, steel-faced curbs etc. - Specify details if other than as noted.

19.6.4.13 Granite and Bluestone curbs - Specify if concrete cradle is required.

19.8 Special pavement and/or sidewalks - Specify.

20.1 Specify if payment is other than as noted in the General Specification.

EXAMPLES OF ITEMS UNDER "DETAILED SPECIFICATION-CONCRETE"

These illustrations are intended only as guides. Most of the examples (or modifications thereof) have been used by the Department in previous concrete specifications.

1.4.1.6 The Supervising Engineer for concrete construction will be assigned by the Department (Construction Manager).

1.4.2 The SECC will be responsible for both controlled and semi-controlled inspection. (He will only be responsible for controlled inspection. Semi-controlled inspection remains the responsibility of the Contractor).

3.3 Schedule of mixes - See attached table 3.3, page A19.

3.4 Lightweight concrete shall be an air entrained concrete properly proportioned so as to produce the strength indicated on the drawings (or as herein specified) and shall weigh not more than 120 pounds per cubic foot at the job site.

3.4 Lightweight concrete fill shall be an air entrained concrete proportioned so as to have a minimum strength of 1500 pounds per square inch; shall weigh not more than 100 pounds per cubic foot wet weight at site and shall be composed of a mixture of Portland Cement, fine and coarse graded lightweight aggregates and mixing water to specified weight and strength.

4.1.2 Stepped footings - Where different levels are indicated for wall footings, the footings shall be stepped. Unless otherwise indicated on the drawings, steps in wall footings shall not be of greater height than the thickness of the footings and the steps shall lap not less than 6 inches. No form shall be set at the back of such steps and where earth has slumped off in such locations it shall be cut back to a vertical plane just before the concrete is placed.

4.3.7 Forms for columns, beams and girders - Beam and girder soffits shall be erected with a camber of 3/4-inch in 20 feet and they shall be sufficiently braced, shored and wedged to prevent deflection. Column sides shall be clamped with Symons metal columns clamps, or equal, spaced according to manufacturer's direction. Exposed external angles of columns, beams, girders and walls, except where specifically excluded shall be provided with 3/4-inch bevel strips, securely nailed on all concrete work including fireproofing of structural steel shapes.

4.7.5 Removal of forms and ties - Forms shall not be removed without permission. In general, forms shall not be removed until the concrete has hardened sufficiently to safely support its own load plus any superimposed loads that might be placed thereon. In any event, forms shall be left in place the minimum lengths of time specified below, from the date of the placing concrete:

Column	2 days
Side forms for girders and beams	2 days
Bottom forms of slab	4 days
Bottom forms of beams and girders.....	5 days
Walls.....	2 days
Monolithic concrete pipe	2 days

The removable portion of form ties shall be removed from the concrete immediately after removing the form. Care shall be taken in removing forms, walers, shoring, supports and form ties to avoid spalling or marring the concrete.

5.3 Deformed billet steel bars complying with the requirements of ASTM designation A 615, grade 40 (or 60).

5.3 Rail steel deformed bars complying with the requirements of ASTM designation A 616, grade 50 (or 60).

5.10.1 The protective coating around reinforcing bars shall be as follows, unless otherwise indicated on the drawings or required:

SLABS -

- 1 inch in general.
- 1½ inches at surfaces trowelled as floor finish, walkway or driveway.
- 2 inches at surfaces contacting water or sewage.
- 3 inches in bottom of slab resting on earth.

FOOTINGS -

- 2½ inches in top of tank wall footings.
- 3 inches in bottom of tank wall footings and at sides and ends of footings.
- 4 inches at bottoms and 2½ inches at tops of building footings.
- 2 inches at bottoms where sealing concrete is used.

WALLS -

- 1½ inches in walls less than 12 inches thick.
- 2 inches in walls 12 inches or more in thickness.
- Add ½ inch for wall surfaces contacting earth or sewage.

BEAMS AND GIRDERS -

- 1½ inches min. for stirrup steel.
- 2 inches min. for main longitudinal reinforcement.
- Add ½ inch for beams and girders contacting water or sewage.

COLUMNS -

- 2 inches in general.
- Add ½ inch for column surfaces contacting water or sewage.

POURED IN PLACE SEWER SECTION -

- 2 inches at exterior surfaces, except 3 inches at bottom of floor slabs.
- 2½ inches at interior surfaces, except that at the invert it shall be 3½ inches.
- 2½ inches at bottom of roof slabs.
- 3 inches for circular sections.

6.3.1 Keys for footings - Where walls retaining earth are constructed on the top of footings, the top of such footings shall be provided with a recess of design and dimensions indicated on drawings or a minimum recess of 2" depth and 4" width cast with the footings. The walls shall be anchored to the footings, unless other reinforcing details are shown, with ½ inch round rods, 3 feet long, spaced 12 inches on centers in two rows and projecting 1'-6" into the wall above. The ends of rods imbedded in footings

shall have hooks.

Retaining walls shall be cast in full height sections in one operation, keying into recess of footings. Weep holes shall be installed at indicated centers.

Column Footings shall be placed as a single unit or if so indicated on drawings as a combination. Anchor bolts shall be set in place using templates furnished under the Section on "STRUCTURAL STEEL", before the construction of the footings.

6.3.1 Areaways, Pipe Trenches and Pits - In the construction of concrete areaways, pipe trenches, boiler pits, elevator pits, sump pits, etc., all walls shall be placed monolithically. Keys shall be formed with floor slabs for the keying of walls to slabs. Water stops shall be installed as shown on the plans or required. Inside surfaces shall be troweled smooth, except where cement coat waterproofing is indicated.

6.4.4 "Joint Compound, Poured Type"

Thiokol Rubber Joint material shall conform to N.Y. State Department of Public Works Specifications Group No. 36 Spec. No. 15026.

Thiokol Rubber joint material shall under no circumstances be placed in contact with materials containing asphaltic or bituminous substances.

Dimensions and details of the joint, including bond breakers shall be as shown on the drawings or recommended by the manufacturer.

Rubber joint material shall be installed in strict conformity with the manufacturer's directions but in no case shall preparation and installation include less than the following:

- Step 1. Preparation of slot - The slots shall be thoroughly cleaned of all scale, loose concrete, dirt, rust or other foreign matters. Projections of concrete into the slot space shall be removed. The slots shall be cleaned by means of sand blasting and air pressure at no less than 50 pounds per square inch. The surface adjacent to the slot shall also be blown free of all loose dust by means of compressed air.
- Step 2. The slot and adjacent surfaces shall be thoroughly dry before sealant is placed. Drying may be accomplished by the application of heat.
- Step 3. The slot shall be primed on all faces with a consistent primer and thiokol joint material shall then be flowed into the slot or if joint is vertical a non-sagging mixture shall be pressed into slot.
- Step 4. Cover joint with cement coat waterproofing, if used, or mortar if indicated.

6.5.1 Water Stops - Water stops shall be of such sizes, forms and shapes as indicated on the drawings or required to fit the allotted space. Bends in metal water stops shall have a minimum radius of one half (1/2) inch. Full size samples, including samples of bends, crimps and joints shall be submitted for approval. Construction joint water stops shall be provided where shown and at all construction joints and intersections of floor slabs and walls below elevation.

Where water stops are indicated on drawings, the contractor shall have the option of furnishing and installing either one of the following:

(a) COPPER WATER STOP

- (1) Sheet copper shall be hot rolled and shall be free from bad chemical edges and corners and all surface defects. It shall be clean, of uniform color and quality, true to gauge and patent leveled. It shall be free from sulphur and other detrimental impurities and shall contain a minimum of 99.5 percent of pure copper. Unless otherwise indicated on the drawings, 20 ounce copper shall be used.
- (2) Where no lengths are indicated in the Drawings, sheet copper water stops shall be furnished in the maximum standard lengths available. Joints shall be lapped 2 inches, riveted, pretinned and soldered at the site.
- (3) Solder shall be non-corrosive and shall be composed of 50% pig lead and 50% block tin. All soldering shall be done with resin and heavy irons, and the joints shall be well locked and sweated full of solder.
- (4) All bolts, screws, rivets, rods and other fastenings, fittings and appurtenances where required for reinforcing, connecting and securing copper work shall be copper or bronze.

(b) MONEL WATER STOPS

- (1) Monel metal shall conform to the requirements of the A.S.T.M. Des. B127. Metal thickness shall be 24 gauge, U.S. Std. (0.025") unless otherwise indicated on the drawings.
- (2) Monel metal nails shall have large heads and shall be of sizes and types required for the proper execution of the work. Monel metal rivets shall conform to ASTM B164 Class A.
- (3) Joints in Monel water stops may be either welded or soldered as for copper water stops.

(c) PLASTIC WATER STOP

The water stops shall be manufactured from virgin polyvinyl chloride plastic compound and shall not contain any scrap or reclaimed material or pigment whatsoever. The properties of the polyvinyl chloride compound used, as well as the physical properties of the water stops, shall exceed the requirements of the U.S. Army Corps. of Engineers water stop specification (CRD-C572-74).

The required minimum physical characteristics for this material are:

- Tensile strength - 1,750 psi.
- Ultimate elongation - not less than 280%.

No reclaimed PVC shall be used for the manufacturing of the water stops. The Contractor shall furnish certification that his proposed water stops meet the above requirements.

Water stops for construction joints shall be flat ribbed type, 6 inches wide with a minimum thickness at any point of 3/8 inches.

Water stops for expansion joints shall be ribbed with a center bulb. They shall be 9 inches wide with a minimum thickness at any point of 3/8 inch unless shown or specified otherwise.

Water stops shall be carefully positioned so that they are embedded to an equal depth in concrete on both sides of the joint. They shall be kept free from oil, grease, mortar or other foreign matter. To ensure proper placement, all water stops shall be fastened every 12 inches, both sides, prior to placing concrete. Such method of support shall be submitted for review and approval.

Splices in PVC water stops shall be made with a thermostatically controlled heating element. Splices shall be made in strict accordance with the manufacturer's recommended instructions and procedures. At least three satisfactory sample splices shall be made on the site. The Engineer may require tests on these splices by an approved laboratory. The splices shall exhibit not less than 80% of the strength of the unspliced material.

6.6 (a) TEE INSERTS for hung ceiling construction shall be installed after concrete reinforcement is in place.

(b) ANCHOR BOLTS AND HANGERS for steel pan stairs shall be built into the concrete.

(c) FLOOR HINGES - Depressions for floor hinges shall be made oversize and after hinges are set, shall be grouted in place and the surface of concrete finished to match adjoining areas.

(d) METAL ANCHOR SLOTS - Where concrete walls are to be faced with stone or brick masonry, anchor slots shall be installed in the form work, spaced on 20-inch centers.

(e) METAL ANCHOR TIES - Where concrete walls, piers, columns or column fireproofing are veneered with brick, or structural facing tile, metal anchor ties shall be built into the concrete, unless otherwise shown.

(f) WEEP HOLES SLEEVES shall be of indicated diameter, made of standard weight galvanized steel pipe in accord with ASTM A-120, latest edition. Where diameter is not indicated it shall be 2 inches.

(g) ANCHOR SLOTS for the reception of anchor inserts for stonework or masonry work anchored to concrete shall be of No.24 gauge galvanized metal, dovetail shape of approved standard manufacture.

(h) FLOOR CLIPS for anchoring wood floor sleepers shall be standard manufactured as approved. Clips shall embody a pair of anchor members of not less than 20 gauge, permitting at least 2-inch embedment in concrete, and a pair of wings with 2 nail holes in each wing, for attachment to the sleepers.

(i) METAL DIVIDING STRIPS shall be installed at the junction of cement finish with resilient and other floor covering to be set in a recess in the floor. Dividing strips shall be of (WHITE ALLOY ZINC- BRONZE- ALUMINUM) with proper provision for effective anchoring. Strips shall have a (1/8") top and a shoulder at correct depth to enable resilient or other flooring materials to finish flush with top

of strip. The bottom flange of strip may be in 18 gauge B & S and shall be 1¼" high overall. Strips shall be set indicated and required locations, true to line and level, flush with the cement finish that remains exposed and have tight metal-to-metal joints at intersections.

6.6.2 The Contractor shall coordinate and/or provide for the installation of anchor bolts, pipes, sleeves, inserts, chases, recesses, etc. required in the work.

6.7.1 PRECAST CONCRETE BENCHES

(a) **PROPORTIONING OF AGGREGATE** - Cast stone standards shall be air entrained concrete simulating limestone; the aggregate, consisting of crushed hard white marble of mixed sizes, shall be mixed with white and light gray Portland cement, ½ part light gray portland cement, ½ part light gray cement and 2 parts aggregate with enough water to make a workable mix.

(b) **MIXING** - Aggregate, including cement, shall be thoroughly mixed in an approved type mechanical batch mixer before and after the addition of mixing water.

(c) **COMPACTING** - The wet mix immediately after placing in non-leakable forms shall be carefully compacted by rodding, tapping and vibrating so as to completely fill all corners and around reinforcing steel and inserts to produce a finished standard which will be dense, uniform in color and texture, and free from honeycomb.

(d) **REINFORCING** steel shall be carefully formed and placed in accordance with detail drawing.

(e) **CURING** - Standards after removal from forms shall be kept moist, and cured by continuous dampening for a period of at least two weeks.

(f) Standards shall be installed in place with hot dip galvanized steel screw anchors and 3/8" diameter hot dipped galvanized steel bolts with side slot, truss-type, vandal proof heads. Bolts and anchors shall be of indicated design and length as manufactured by "Richmond Screw Anchor Co." of Brooklyn, N.Y. or approved equal. Furnish a surplus of 2% of bolts, and one tool for drawing up bolts to anchors, to the Resident Engineer.

(1) All bolts, excepting the 2% surplus shall be shipped with their threads, heavily greased.

(2) Bolts shall be inserted to the normal depth in the standards.

(g) **FINISH** - the exposed surfaces of all standards shall be smooth, dense, free from cement film, patching and all other defects. Sharp corners and unseen edges shall be rubbed with a carborundum brick.

(h) **WOOD SLATS** - shall be of "B or better" grade, dense vertical grained Douglas Fir. Slats shall be worked accurately and smoothly to indicated profiles and have no torn grain or rough spots on any surface. Slats shall be primed on all surfaces with lead and oil paint as approved.

6.7.1 PRECAST PARKING AREA BUMPERS

Parking area bumpers shall be precast, air entrained concrete 6"x8"x6'0" long reinforced with 2 No.4 and 1 No.3 reinforcing bars. They shall have chamfered top edges and two holes for anchoring. Furnish and install the 3/4" diameter steel spike anchors. Bumpers shall be similar to type G as manufactured by Bedford Hills Products Corp., Bedford Hills, N.Y., or approved equal.

6.7.1 TRENCH COVERS AND REMOVABLE SLABS

(1) REMOVABLE COVER of concrete shall be cast in metal frames as shown on the drawings, and finished the same as the adjacent floor surfaces. Unless otherwise shown on the drawings, trench covers shall be cast in approximately 4-foot long sections and shall be provided with lifting arrangements as indicated or required.

(2) FIXED COVERS of concrete shall be either precast or cast-in-place to the thickness shown on the drawings and in approximately 4-foot lengths, unless otherwise shown. The covers shall fit into a rabbet in the trench wall and shall be separated therefrom by a double thickness of waterproof sheathing paper on the bottom and by a mastic strip or other material as approved along edges. Cement floor finish or other floor covering shall extend over the trench covers to provide a continuous floor finish.

(3) REMOVABLE SLABS of concrete shall be either precast or cast-in-place of size indicated on the drawings. The openings for removable slabs shall have a shoulder all around to receive the slabs. If cast-in-place, the slab shall be separated from the shoulder by waterproof sheathing paper to prevent bond. Lifting rings as specified under the Section on "MISCELLANEOUS METAL WORK:" or as required, shall be built in.

6.11 FILL BETWEEN SLEEPERS

(1) SLABS ON EARTH-FILL between sleepers for wood floor construction over concrete slabs on earth, shall be composed of not less than 40 nor more than 50 gallons of tar to each cubic yard of sand. The sand shall be heated sufficiently before adding tar, to make it thoroughly dry. Before mixing with the sand, the tar shall be heated to such a temperature that when the mixing takes place, the temperature will not exceed 225 degrees F. A coat of the tar-concrete mixture ½" thick shall be placed on the slab and after sleepers have been set, leveled and bedded, the filling between the sleepers of the tar-concrete mixture shall be deposited and tamped to within ½" of the top of the sleepers.

(2) SLABS ABOVE GRADE - FILL between sleepers for wood floor construction over reinforced concrete slabs above grade shall be concrete fill, composed of one part Portland cement, 2½ parts sand, and not over 4 parts pea gravel or crushed stone passing a ½" screen. The Water-cement ratio shall be the minimum necessary to produce a workable mix. After the sleepers have been properly set, they shall be solidly bedded by depositing the concrete and spading it under the sleepers and the spaces between the sleepers. The concrete fill shall be screened or roughly floated to a uniform surface.

6.11 FILLS

(a) PLATFORM FOR LOCKERS, ETC - Raised platforms for lockers, electric cabinets, kitchen equipment, metal cabinet work, radiators, for steps at doors to roof and other items noted on drawings shall be constructed to fit the items which are to be placed upon same. Except as may be otherwise shown on drawings, the top of platforms shall be finished with one (1) inch of cement finish mixed and applied as specified for separate cement finish on floors. Where cement base occurs it shall be carried around these platforms.

(b) NAILING CONCRETE FILL shall be used for the construction of cants and wherever else indicated on the drawings. The nailfill shall be mixed with Portland cement, sand and water, applied and cured in accord with the directions of the manufacturer of the nailfill. Just before application, clean all surfaces, remove all dust and loose materials, moisten surfaces and sprinkle with dry cement. The nailing concrete fill shall be applied in such a manner that it will firmly bond with the work below. It shall be

worked and troweled smooth, even and true to the exact lines and levels required.

(c) FILL FOR TREADS AND PLATFORMS OF STEEL STAIR PANS shall be composed of 1 part Portland cement, 2 parts of sand and ½ parts of crushed stone or gravel passing a ¼" and being retained on a 1/8" mesh sieve, measured by volume and with only sufficient water added thereto to produce a mixture of the direct consistency for proper finishing. (WHEN NO ABRASIVE NOSING IS SPECIFIED OR INDICATED, ADD THE FOLLOWING SENTENCE.) (After striking off the fill to the proper levels it shall be covered with abrasive aggregate spread at the rate of not less than 40 pounds per 100 square feet of surface and well worked in.) The fill shall then be thoroughly compacted and finished by hand floating. After the fill has hardened sufficiently to prevent excess fine material from working to the surface, the treads and platforms shall be brought to a smooth finish, free from defects and blemishes, by additional finishing with a steel trowel.

(1) The fill for the pans shall be reinforced with a wire fabric woven in 2"x2" square mesh of No.14 gauge steel wire and weighing 21 pounds per 100 sq. ft. of fabric. The fabric shall extend over the entire area of each tread and platform and be properly supported ½" above the bottom of the pans.

8.7 CUTTING AND PATCHING OPENING FOR PIPE, ETC. IN EXISTING CONCRETE

(a) The Contractor shall cut the existing concrete within the limits required, expose the existing reinforcement, and perform the work in such manner to prevent damage to existing adjacent concrete and/or equipment. Unless otherwise permitted, line drilling is required. The exposed reinforcement shall be thoroughly cleaned, then cut and bent to permit installation. When reinforcing is required to be welded to structural members, the work shall be done by licensed welders.

(b) Where watertightness is required, openings shall be provided with keyed joints meeting the Engineer's approval prior to coating and patching.

(c) Where such work will be visible in the completed work, the adjacent surfaces shall be made to match as closely as possible.

8.7 BONDING COMPOUND

For bonding new concrete or grout to existing concrete surfaces, an epoxy resin concrete adhesive shall be used. The adhesive shall be as manufactured by Permagile Corp. of America, Sika Chemical Corp., or equal.

CONNECTING NEW TO EXISTING CONCRETE WORK

(a) Where new concrete work is to be made integral with existing concrete work, the Contractor shall.

- (1) Roughen surface of existing concrete.
- (2) Cut existing concrete as directed by the Supervising Engineer for concrete Construction.
- (3) Where necessary to expose existing reinforcement, they shall be thoroughly cleaned by wire brushing and new reinforcement lapped or welded as directed with existing reinforcement.

- (4) Where expansion anchors are shown, holes shall be drilled in the existing concrete for three unit anchors to the minimum depths as follows:

Diameter of Bolt Inches	Minimum Depth of Hole Inches
1/2	3
5/8	4
3/4	5
1	7

- (5) Where water stops are required to be set into existing concrete, reglets shall be cut as shown on the Contract Drawings.
- (6) Thoroughly wash all surfaces and install metal water stops and reinforcing steel as required.
- (7) Apply bonding compound in strict conformance with the manufacturer's instructions.
- (8) Apply new concrete in strict conformance with bonding compound manufacturer's recommendations.

(b) Where portions of existing concrete structures of masonry bulkheads are to be removed and where the remaining concrete is to be finished smooth, the Contractor shall:

- (1) Remove concrete or masonry to the depths shown or required.
- (2) Cut off projecting reinforcement to provide at least 1" cover. Where shown, reinforcement shall be bent across cut face and covered with new concrete.
- (3) Thoroughly coat the roughened concrete surfaces by applying bonding compound in strict conformance with the manufacturer's instructions.
- (4) Cement mortar shall be placed to a thickness slightly in excess of the finished surface and shall be steel-trowel-finished, flush with the adjacent surfaces.
- (5) The color of new concrete in the exposed surfaces shall match the color of the existing adjoining concrete as closely as possible.
- (6) Cement mortar shall consist of one part Portland cement and two parts of sand by volume.

Wherever new concrete is connected to existing concrete, the existing concrete shall be coated with bonding compound. Surface preparation, application and curing shall be done in strict accordance with the manufacturer's directions.

8.10 NON-SHRINK GROUT

Non-shrink, non-staining grout shall be "Euco N-S" by the Euclid Chemical Company, or "Masterflow 713" by Master Builders, or equal. Non-shrink grout shall be mixed and placed in strict accordance with the directions of the manufacturer.

Non-shrink grout shall be used for setting of structural items such as base plates for columns and beams and equipment.

8.11 CONCRETE SEALER

Concrete sealer shall be a one (1) part polyurethane sealer and dustproofers, "Eucothane" as manufactured by the Euclid Chemical Company, or equal.

Concrete sealer shall be applied on all equipment pads to prevent oil from seeping into the concrete.

10.4 SURFACES TO RECEIVE CEMENT COAT WATERPROOFING - All vertical surfaces that are to receive CEMENT COAT WATERPROOFING applied directly to the concrete, shall be treated as specified herein for such finish. The surface shall be removed to a depth of not less than 1/16-inch exposing the aggregate and leaving a clean, firm, rough, granular surface. The surface shall be removed by chipping with an air-hammer operated chisel or other methods as approved. Treatment shall be such as to not affect the strength of the concrete below a depth of 1/8-inch. Care shall be taken to leave no untreated surfaces.

11.9.2 FLOOR FINISHES

Concrete floors shall receive the following finishes where indicated in the schedule of floor finishes in the Contract Drawings or as specified herein.

- (1) Non-Slip, Steel Trowel Finish - All concrete floors so indicated in the schedule of floor finishes shall receive a non-slip, steel trowel finish as specified herein. The floors shall be floated, given a non-slip dry shake finish in accordance with the specifications for Structural Concrete for Buildings - ACI 301 Chapter 11, Section 11.7.6 and 11.7.7. After the ceramically bonded, aluminum oxide abrasive particles have been embedded by two floating as specified in ACI Section 11.7.6, the floors shall be given a steel trowel finish.
- (2) Wood Float with Broom Finish - All exterior walkways and platforms shall be wood floated to produce dense, smooth surfaces and given a light broom finish.

11.9.3 CONCRETE STAIRS AND PLATFORMS shall be constructed to the details indicated on the drawings, but with such modifications thereto as may be necessitated by field conditions.

(1) Step fills shall be cast monolithic with the supporting slab and shall be accurately laid out so that each run of stairs will have risers of uniform height and treads of equal width throughout.

(2) When wearing surfaces have sufficiently hardened to prevent excess fine materials from working to the surface, the treads and platforms shall be brought to a smooth finish free from defects and blemishes, by additional steel troweling. No dry cement or mixture of cement and sand shall be sprinkled on surfaces to absorb moisture or stiffen the mix.

(3) After striking off treads and platforms at proper levels, cover with an approved properly graded abrasive aggregate, spread at the rate of not less than 40 pounds per 100 sq. ft. of surface, well worked in, surface, finished by hand troweling.

(NOTE TO SPEC. WATER: WHERE SAFETY TREADS ARE TO BE APPLIED TO CONCRETE TREADS AND PLATFORMS, ADD THE FOLLOWING PARAGRAPH.)

(4) Safety treads furnished under the Section on "MISCELLANEOUS METAL WORK" shall be imbedded at the front edge of concrete treads and platforms secured by means of countersunk flat head bronze bolts.

11.9.3 CONDITIONING OF FLOOR SLABS FOR SURFACE FINISHES

(a) **MEMBRANE WATERPROOFING** - Surfaces to receive membrane waterproofing and/or lead lining shall be given a monolithic screed finish. Such surfaces shall be lightly steel troweled if necessary to accomplish this result.

(1) **CEMENT PROTECTION COATS** consisting of one part Portland cement and three parts sand, shall be of indicated thickness or ½" minimum if not otherwise shown, applied as soon as practicable after the membrane waterproofing has been installed, be screeded smooth and left in proper condition to receive the work which will be applied over the same.

(b) **TERRAZZO, QUARRY TILE AND CERAMIC TILE** - The top surface of ceramic tile shall, after the concrete has been compacted, be screeded to accurate lines and levels as may be required to properly receive these finishes. Where required, concrete slabs shall be depressed so that terrazzo, quarry tile and ceramic tile surfaces will finish flush with adjacent finishes.

(c) **WOOD BLOCK FLOORING** - The top surface of concrete slabs under wood block flooring shall be screeded to a true grade and finished with a wood float, producing a true and even finish with no float marks showing.

(d) **WHERE RESILIENT** flooring occurs, the elevation of the top of the cement topping under these materials shall be such that the resilient materials will finish flush with the adjoining floor levels.

11.9.3 GRANOLITHIC FLOOR FINISH

(a) General - Concrete floor slabs which are to receive a granolithic finish shall receive an integral or non-integral finish as specified in the Detailed Specifications and describe herein.

All granolithic finishes applied to air-entrained concrete slabs shall be air-entrained granolithic finishes. Granolithic finishes in other areas shall be air-entrained granolithic finishes only when specifically shown or specified.

Where granolithic finish is required to be placed upon cinder concrete fill, it shall be as describe herein for non-integral finish.

(b) Materials for granolithic finish - Materials for granolithic finish shall conform to the requirements stated herein and the following specifications:

General Specification - Concrete (for portland cement, Sand, air-entraining agents and water) - New York Specification 24 A-20 Coarse Aggregate (Type 1, Grade A, Size No.4).

(c) Samples - The Contractor shall make a satisfactory sample of granolithic floor finish at least 3 feet square and 2 inches thick, before proceeding with the work. All granolithic floor finish shall be equal to the approved sample.

(d) Integral granolithic finish - Integral granolithic finish shall be one-inch minimum thickness applied monolithically to the concrete slab before final set has taken place therein.

(e) Non-integral granolithic finish - Non-integral granolithic finish shall be 1½ inches minimum thickness when applied to concrete slabs after final set has taken place therein.

(f) Slope for drainage - Granolithic finishes shall be pitched towards drains 1/8 inch per foot, unless otherwise shown or specified.

(g) Mixture - The mixture shall be 1 part of Portland cement, 1 part of fine aggregate and 2 parts of coarse aggregate by volume. Not more than 5 gallons of water, including the moisture in the aggregates, shall be used for each sack of portland cement in the mixture.

Air-entrained granolithic finish shall be made by adding an approved air-entrained agent to the mixture in conformity with the requirements specified for air-entrained concrete in General Specification - Concrete.

(h) Mixing - Mixers shall be of the rotary batch type. Each batch shall be mixed until there is a uniform distribution of materials. Each batch shall be mixed at least 1½ minutes after insertion of all materials. Each shall be entirely discharged from the drum before recharging.

(i) Placing - Before non-integral granolithic finish is applied, all loose particles, paint, grease, dust, dirt and other foreign matter shall be removed from the concrete slab or cinder concrete fill. Where necessary, the slab shall be roughened by approved means. The concrete slab or cinder concrete fill shall then be thoroughly wetted and a thin coat of cement grout shall be broomed into the surface. Grout shall be one part portland cement and one part sand. The non-integral granolithic finish shall be applied before the grout has started to set and shall be brought to the required grade in one operation.

Non-integral granolithic finish shall be screeded to the required grades with a straight edge, compacted by rolling or tamping and then floated with a wood float or power floating machine and brought to a uniform, dense surface, free from defects and blemishes. The resulting surface shall be tested with a straight edge to detect high and low spots which shall be corrected.

Integral granolithic finish shall be applied monolithically before final set has taken place in the concrete slab and then shall be screeded, tamped and floated as hereinbefore specified for non-integral finish.

For garage floors, driveways and trucking areas, wood floating shall be the final finish. For other areas, floating shall be followed by steel troweling after the topping has hardened sufficiently to prevent excess fine material from working to the surface. The troweled finish shall be brought to a uniform, dense, smooth surface, free from defects and blemishes. Sprinkling the surface with cement or wetting the surface with water to obtain the required surface finish not be permitted.

(j) Curing and Protection - Granolithic finish floors shall be covered with sisalkraft paper or approved equal, within 24 hours. All seams of such paper shall be overlapped at least 2 inches and sealed with tape. Paper shall be adequately fastened to prevent displacement.

Where required, planking of sufficient size shall be placed for further protection.

Except as required for application of dustproofing treatment, the floor protection shall not be removed until just prior to final cleaning.

(k) Hardening and Dustproofing Treatment - All granolithic finished floors shall be treated with at least three applications of magnesium zinc fluosilicate floor hardener.

The full strength floor hardener, as produced by the manufacturer, shall be a colorless liquid containing not less than two pounds of magnesium zinc fluosilicate (80% magnesium silicate, 20% zinc fluosilicate) and a wetting agent in each gallon of liquid. The hardener shall be Lapidolith by L. Sonneborn Sons, Inc., Hornolith by A.C. Horn Co., Flintox by Tosh Bros., Inc., or approved equal.

Hardener shall be delivered to the site of the work in the manufacturer's original labeled and sealed containers.

Samples of the hardener proposed to be used shall be submitted to the Engineer for approval.

Surfaces to be treated shall have been thoroughly cured and shall be dry, clean and free from all dust, oil, grease, paint and other foreign materials.

The full strength floor hardener liquid shall be diluted for each application as follows:

- First application - 1 part hardener to 2 parts water.
- Second application - 1 part hardener to 1 part water.
- Third application - 2 parts hardener to 1 part water.

A total of not less than one gallon of the full strength floor hardener shall be used in the three applications to treat 100 square feet of surface.

Each application shall be applied evenly and freely with long handled brushes, brooms or squeegees and allowed to dry at least 24 hours between applications. Before the third application is completely dry, and whitening on the surfaces treated shall be removed by flushing and scrubbing with water.

(l) Payment - When the contract does not provide an item for granolithic floor finish, the cost thereof shall be included in the prices bid for the contract item under which Granolithic floor finish is required or in the Lump Sum bid for the Contract.

11.9.3 CEMENT FLOOR AND STAIR FINISHES

(a) General - Concrete floor slabs for which no separate floor finishes are shown or specified shall be finished as specified in 11.9.2.10.

Concrete floor slabs which are to receive a separate cement finish shall receive an integral or non-integral finish as described herein.

(b) Materials for Cement Finishes - Materials for cement finish shall conform to the requirements specified herein.

(c) Proportions - Floors and Stairs - Proportions shall be as follows:

For the top one inch.....One part cement, two parts sand.

For the remainder in excess of one inchOne part cement, two parts sand,
three parts gravel.

The minimum quantity of water which will produce a stiff trowelable mixture shall be used. Cement, sand and gravel shall be measured by volume and mixed dry. The water shall then be added and each batch shall be thoroughly mixed to obtain uniform color and consistency. Mortar which has attained initial set shall not be used.

(d) Integral Cement Finishes - Integral cement finish shall be 1" minimum thickness applied to the concrete slab after final set has taken place therein.

(e) Non-integral Cement Finishes - Non-integral cement finish shall be of 1½ inches minimum thickness when applied to the concrete slab after final set has taken place therein.

(f) Sloped Floors - The pitch of floors sloped for drainage shall be approximately 1/8" per foot unless otherwise, shown specified or required.

(g) Workmanship - Before non-integral cement finish is applied, all loose particles, paint, grease, dust, dirt and other foreign matter shall be removed and the slab or cinder concrete thoroughly cleaned. Where necessary, the slab shall be roughened by approved means. The slab fill shall then be saturated with water and a thin coat of neat cement grout shall be broomed into the surface just prior to placing the finish. Cement finish shall be laid to the required depth in one operation.

Cement finish shall be brought to the required grades with straight edges, then compacted and floated to produce a smooth even surface.

After the cement finish has attained initial set, it shall be steel troweled until all trowel marks and irregularities are removed and the surfaces are smooth, even and at the required levels. The final troweling shall produce a burnished glossy surface over the entire area. Surfaces shall be neatly finished at the edges. Sprinkling with dry cement will not be permitted.

On pan-type stairs, the finish shall be flush with the nosing.

(h) Elastic Cement Joints - Approved ½" elastic cement joints shall be provided between cement finish and sanitary fixtures.

(i) Cove Bases - Cove bases shall be placed in two operations. The undercoat shall consist of one part cement and three parts sand. The finish coat shall consist of one part cement and two parts sand, and shall be at least ¼" thick. The base shall be run by templates on substantial grounds true to assure uniform distribution of color. The quantity of pigment shall be sufficient to produce a permanent color of the required shade but shall not exceed 5% by weight of the cement.

(j) Scoring - Unless otherwise indicated or specified, cement finishes shall be scored to a symmetrical approved pattern with grooves having a minimum depth and width of ¼".

(k) Stair Finishes - All interior and exterior stair treads and landings shall be provided with metal anti-slip treads as required by the Detailed Specifications or Contract Drawings.

(l) Abrasives - Where abrasive finish is shown, specified or required, one abrasive aggregate shall be Alundum, Carborundum, Aloxite or Paralum having a purity of 90% to 95%. The abrasive aggregate shall be mixed with dry portland cement in the proportion of one part of cement to two parts of abrasive by weight. This abrasive mixture shall be uniformly sprinkled-on after the initial trowelling. For rough or float finished surfaces, the abrasive shall be graded in size #6:12 (coarse); and for fine or smooth

trowelled surfaces, the abrasive shall be graded in size #12:30 (fine). Each square foot of surfacing shall receive a minimum of ½ pound of abrasive. Samples of abrasive shall be submitted for approval.

(m) Curing and Protection - Twenty-four hours after the finish has been applied, it shall be covered with Sisalkraft paper, or approved equal, fastened adequately against displacement.

Further protection shall be provided by placing planking whenever required.

Except as required for application of dustproofing treatment, the floor protection shall not be removed until just prior to final cleaning.

(n) Hardening and dustproofing treatment - All concrete floors, cement finished floors and cement cove bases, except those to be covered with linoleum, asphalt, cork or other material, shall be treated with at least three applications of magnesium zinc fluosilicate floor hardener.

The full strength floor hardener, as produced by the manufacturer, shall be a colorless liquid containing not less than two pounds of magnesium zinc fluosilicate (80% magnesium fluosilicate, 20% zinc fluosilicate) and a wetting agent in each gallon of liquid. The hardener shall be Lapidolith by L. Sonneborn Sons, Inc., Hornolith by A.C. Horn Co., Flintox by Toch Bros., Inc., or approved equal.

Hardener shall be delivered to the site of the work in the manufacturer's original labeled and sealed containers.

Samples of the hardener proposed to be used shall be submitted to the Engineer for approval.

Surfaces to be treated shall have been thoroughly cured and shall be dry, clean and free from all dust, oil, grease, paint and other foreign materials.

The full strength floor hardener liquid shall be diluted for each application as follows:

- First application - 1 part hardener to 2 parts water.
- Second application - 1 part hardener to 1 part water.
- Third application - 2 parts hardener to 1 part water.

A total of not less than one gallon of the full strength floor hardener shall be used in the three applications to treat 100 square feet of surface.

Each application shall be applied evenly and freely with long handled brushes, brooms or squeegees and allowed to dry at least 24 hours between applications. Before the third application is completely dry, any whitening on the surfaces treated shall be removed by flushing and scrubbing with water.

(o) Cleaning - The finished surfaces shall be given a final cleaning. Linseed oil soap shall be used to remove stains, dust and dirt.

(p) Pavement - When the contract does not provide an item for cement floor and for stair finishes the cost thereof shall be included in the price bid for the Contract item under which cement floor and stair finishes is required or in the lump sum bid for the contracts.

11.11 CEMENT BASE

(a) Finished cement base shall be installed where so indicated on the drawings or "FINISH SCHEDULE." Finished base shall be of indicated height and design (FLUSH-PROJECTING), with cove to floor and bullnoses as indicated. Base shall be applied in at least two coats. The finish coat shall be at least ¼" thick, applied as integral with undercoat as possible. Mix shall be 1 part portland cement to 2 parts fine aggregate. Surface shall be troweled to a smooth even surface (and colored and hardened where required). Base shall be installed with joints spaced not over 10 feet apart and extending entirely through the base.

(b) Base shall be run by templates on approved grounds with true level lines and surfaces and right angle corners, neatly finished against screeds, be carried around all columns, walls, breaks permanent fittings and other locations as needed to make the installation complete in each space. Where two or more vertical pipes or conduits pass through floors and are exposed on the face of walls, partitions etc. and are not concealed by equipment etc., same shall be solidly enclosed in cement for full height of room or space base, following contours, and finish materials to match similar work in every respect.

16.1.2.1 Testing Agency: All testing of concrete of the mix plant and/or at the job site will be performed by a licensed testing laboratory hired directly by the Department (or by the Construction Manager). This does not relieve the Contractor of his responsibilities as outlined in section 16.8 of the General Specification.

The laboratory used by the contractor for work specified in sections 16.1.2.2, 16.3.1.1, 16.3.1.2, 16.5.1, or 16.5.2 need not be the same laboratory hired by the City (or the C.M.).

16.1.2.1 Testing Agency: The Contractor shall include in his bid the sum of (check amount with Department) to be used in payment for the services of an approved Testing Laboratory. The laboratory will assign qualified technicians to be stationed at the mixing plant and at the job site as required. Payment will be made in accordance with an approved schedule for actual services performed (inspector's time, cylinder testing, etc.). This payment schedule shall include overhead and profit of the Testing Laboratory, but no overhead or profit shall be allowed to the contractor on this item. Time sheets of all field inspectors and records of number of cylinders made shall be verified by the Supervising Engineer for Concrete Construction. Responsibility for having inspectors at the mix plant and job site as required lies with the contractor. The Supervising Engineer for Concrete Construction will not recognize inspectors time if the General Contractor cancels the concrete work for any reasons.

16.6 Vouchers for payment to the testing lab shall be included with the contractor's periodic partial payments. Invoicing for cylinders shall be made only for acceptance cylinders broken and reported. The contractor shall make payment to the testing labs or agency within 10 days of receiving payment from the City. The unexpended balance of the sum included for Concrete Testing shall be credited to the Department. No payment will be made for work performed as specified in sections 16.1.2.2, 16.3.1.1, 16.3.1.2, 16.5.1 or 16.5.2.

20.1.1 All costs of the concrete shall be included by the contractor in the Lump Sum BID for the contract work. This lump sum will also include the costs of all steel reinforcement used.

TABLE 3.3 SCHEDULE OF MIXES - PROPORTIONING AND TESTING

ELEMENT	Applicable Code or Agency	Structural Under Code	Specified Strength f _c (psi)	Method of Proportioning	Inspection Required by Testing Agency				
					Controlled Inspection	On Site Method of Construction*	Batch Plant		
							Method I	Method II	Method III
Underpiping	Bldg.	Yes	4000	I or II	Yes	Yes	Yes	No	
Foundation Plans	Bldg.	Yes	4000	I or II	Yes	Yes	Yes	No	
Foundation Walls	Bldg.	Yes	4000	I or II	Yes	Yes	Yes	No	
Columns	Bldg.	Yes	4000	I or II	Yes	Yes	Yes	No	
Girders	Bldg.	Yes	4000	I or II	Yes	Yes	Yes	No	
Floor Slab on Grade	Bldg.	No	4000	I or II	Yes	Yes	Yes	No	
Floor Arch Slabs	Bldg.	Yes	4000	I or II	Yes	Yes	Yes	No	
Short Span Floor & Roof C27 610		Yes	2000	I or II	No	Yes	No	No	
Fireproofing Steel Beams	Bldg.	No	4000	I or II	No	Yes, if placed with Arches, Otherwise No	No	No	
Retaining Wall	Bldg.	Yes	4000	I or II	Yes	Yes	Yes	No	
Machine Bases	None	No	3500	I or II	No	No, for bases under 10 cubic yds., Otherwise Yes	No	No	
On - Site [Curbs] [Sidewalks]	None	No	3500	I or II	No	Yes	No	No	
On - Site Roadways	None	No	4000	I or II	No	Yes	Yes	No	
City [Curbs] [Sidewalks]	Dept. of Highways		3200	I or II	No	No (Cores)	No	No	
City Road Pavement	Dept. of Highways		4000	I or II	No	No (Cores)	Yes	No	
On - Site [Pipe - Encasement] [Pipe - Cradles]	None	No	3500	I or II	No	Yes, if Pile Support, Otherwise No	No	No	
City Road Base for Pavement	Dept. of Highways		1800	III	No	No (Cores)			No
Mudslabs	None	No	2500	III	No	No			No
Fills	None	No	2500	III	No	No			No
Slab Overlays (Toppings)	None	No	4000	I or II	No	No	Yes	No	
Fuel Tank Encasement	Fire Department	No	4000	I or II	No	No	Yes	No	
Conduit & Pipe Encasements	None	No	2500	III	No	No			No

* If Yes, than test cylinders, etc. are required. If No, then contractor shall perform Swiss Hammer or Windsor Probe Tests at the locations designated by and in the presence of the supervising engineer for concrete construction. NO TEST CYLINDERS REQUIRED.

APPENDIX