

**ADDENDUM NO. 4
TO
SPECIFICATIONS AND DRAWINGS
FOR THE
CITY OF HOWELL
WATER TREATMENT PLANT IMPROVEMENTS**

ISSUED: March 27, 2020

HRC Job No. 20190539

BID OPENING: 10 am, April 2, 2020 (online/phone only)

This Addendum is issued prior to receipt of bids to provide for certain changes and clarifications to the specifications and/or the plans, as herein specified, and is hereby made a part of the Contract Documents and shall be taken into consideration in preparing the Proposal. All other conditions remain the same.

GENERAL

1. Bids shall be delivered physically by mail or in the City Hall drop box on the first floor.
2. The Public Bid Opening will be accessible **only online or by phone**. To access, follow these instructions:

Join from a PC, Mac, iPad, iPhone or Android device:

Please click this URL to join. <https://zoom.us/j/828755278>

Or join by phone:

Dial(for higher quality, dial a number based on your current location):

US: +1 312 626 6799 or +1 646 558 8656 or +1 346 248 7799 or +1 669 900 9128 or +1 253 215 8782 or +1 301 715 8592

Webinar ID: 828 755 278

International numbers available: <https://zoom.us/u/acmuTDOT4i>

3. Requests for Clarifications:
 - a. **Question:** Can both Well Houses be worked on simultaneously?
Response: Well Houses 4 and 5 can be worked on simultaneously but only one well house can be offline at one time. The plant does not have redundant capacity for both well houses to be offline.
 - b. **Question:** As per Addendum #3, Pg#13, Schedule of Proposed Major Equipment and Subcontractors. WTP SCADA work to be performed by CCI and Well houses SCADA work by Kennedy Industries. Do we include it in our base Bid, or are they quoting it directly to the City?
Response: The WTP and Well Scada work is to be included in the base bid per Section 00300 Bid Form Paragraph 5.03B Pay Item schedule.
 - c. **Question:** As per drawing E-2, please confirm Lime Slaker control panel, CO2 Gas sensor and CO2 feed system panel to be installed by contractor?
Response: The Lime Slaker Control Panel, CO2 gas sensor, and CO2 feed system panel are to be installed by the contractor and provided by the manufacturers. See Sections 11402 Carbon Dioxide Feed System and 11726 Lime Slaking Equipment.

SPECIFICATION CHANGES

1. **Page 00030:** Replace the first sentence with the following:

“Sealed proposals for the construction of the WATER TREATMENT PLANT IMPROVEMENTS will be received by the City of Howell City Clerk’s Office, 611 East Grand River Avenue by mail or in the drop box on the first floor, Howell, Michigan 48843, until **10 a.m., Local Time on Thursday April 2, 2020.**”

2. **Page 00300/1:** Bidders must acknowledge this Addendum on the Bid Form.
3. **After Section 03300:** **Insert** the attached Section 03310 “Concrete Work” attached with this Addendum after this section.
4. **Page 00500/Page 1 Paragraph 4.02A:** **Replace** the paragraph in its entirety with:

“A. The Work will be substantially completed on or before (425 days from issuance of Notice to Proceed), and completed and ready for final payment in accordance with Paragraph 14.07 of the General Conditions on or before (455 days from issuance of Notice to Proceed).”

DRAWING CHANGES

1. **Sheet C-3: Add** “(MDOT CLASS 2)” after the callout “Compacted Granular Structural Fill”

This addendum consists of the following:

2 Pages of text

Enclosure No. 1: Revised Section 03310 Concrete Work, consisting of 16 pages

SECTION 03310
CONCRETE WORK

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. This Section includes the furnishing and mixing of all materials required for concrete, the furnishing, erection, care and removal of forms; the furnishing placement, finishing, curing and protection of all concrete, and the furnishing and placing of steel reinforcement for all concrete.
- B. Concrete shall be composed of a mixture of Portland Cement, fine aggregate, coarse aggregate and water. The materials and methods used shall produce a dense, homogeneous, impervious, durable and workable concrete of the highest quality and without defects of any kind.
- C. The Contractor shall provide portland cement concrete mixtures that are resistant to excessive expansion caused by alkali-silica reactivity (ASR). The evaluation as to the resistance of submitted concrete mixtures to excessive expansion caused by ASR shall be by the Owner as described herein.

1.2 RELATED SECTIONS

- A. Materials Concrete
 - 1. Notes: Should any conflict occur between this section and related sections, the provisions of this section shall apply.

1.3 SUBMITTALS

- A. The following approval requests shall be submitted to the Owner for review. No such items or the materials therefore shall be ordered fabricated, delivered, or incorporated in the work until the proper approvals for the same have been received from the Owner.

Approval Requests	Shop Drawings
Testing Laboratory	
Concrete Design Mix	Steel Reinforcement
Concrete Mix Materials	
Waterstop	
Measures for Cold Weather Protection	
Measures for Hot Weather Protection	

PART 2 MATERIALS

2.1 CEMENT

- A. Cement shall be "Portland Cement" conforming to current ASTM Specification C-150, Type I or Type II. When authorized for use in the work by the Owner, High Early Strength Cement shall conform to current ASTM Specification C-150, Type III.

- B. Only one type of cement shall be used in the same portion or element of the work. All cement shall be of the same brand and shall be produced by a single mill unless otherwise authorized. Cement salvaged by cleaning sacks or from discarded sacks of cement, shall not be used in the work. Any cement which for any reason has become partially set, contaminated or which contains lumps will be rejected and shall be immediately removed from the site.

2.2 FLY ASH

- A. Fly ash shall conform to the requirements of ASTM C-618 Class F.

2.3 GROUND GRANULATED BLAST FURNACE SLAG

- A. Ground Granulated Blast Furnace Slag (GGBFS) shall conform to the requirements of Grade 100 or 120 (ASTM C 989).

2.4 AGGREGATES

- A. Fine Aggregate shall be natural sand, 2NS.
- B. Coarse aggregate shall conform to ASTM C-33, Class 4S and be graded in accordance with the following Michigan Department of Transportation Specifications for Construction Classifications:

Element	MDOT Class
Walls, Slabs & Other Concrete less than 8" thick	26A
All other concrete	6AA

2.5 WATER

- A. Tap water of potable quality shall be used for mixing concrete and at the time of use shall be clean and free from oil, alkalis, or organic matter.

2.6 ADMIXTURES

- A. An air entraining admixture conforming to the requirements of current ASTM Specification C-260 shall be used for all concrete.
- B. All concrete shall contain a water reducing admixture, complying with current ASTM Specification C-494, Type A. The admixture shall, be free of significant amounts of chloride, and shall be used in accordance with the manufacturer's recommendation for the type of cement to be used, except that only volumetric dispensing will be allowed.
- C. The manufacturer shall certify, in writing, that the materials supplied for use under this Contract are identical in all respects, including concentration and chloride content, to the material tested in accordance with current ASTM Specification C-494. When requested by the Owner, the Contractor shall make available the services of a manufacturer's qualified field representative, to assure proper use of the admixture.

2.7 REINFORCING STEEL

- A. Unless otherwise indicated, reinforcing steel shall be deformed steel bars conforming to the requirements of current ASTM Specification A-615, Grade 60. Reinforcing steel for ties and stirrups shall be new billet steel intermediate grade conforming to the requirements of the current edition of ASTM Spec. A-615 Grade 40.
- B. All reinforcing steel shall be free from defects, kinks, and bends not shown on the drawings.
- C. Wire mesh for reinforcement shall conform to the current requirements of ASTM Specification A-185.
- D. All bars shall be of the shape, size, class, and grade of steel specified and shown on the drawings, and each bar shall have at all points a net section not less than that of a plain round bar of corresponding size.
- E. The Contractor shall furnish the manufacturer's written certification to the Owner that all reinforcing steel of each shipment meets the pertinent requirements of ASTM Specifications.
- F. Samples for the inspection and testing of the reinforcing steel shall be chosen by the Owner, and sampling and testing methods shall conform to the requirements of the General Conditions.

2.8 FORMS

- A. Forms for structural concrete shall be of metal, plywood, first class dressed lumber, or other material approved by the Owner. The forms shall be true in every respect to the required shape, size, grade, and alignment of the finished structure and shall be of sufficient strength and rigidity to maintain their position and shape under the loads and operations incident to placing and curing the concrete. The forms shall be mortar-tight at the time concrete is placed in them and shall be so constructed that the surface of the finished concrete will be reasonably free from ridges, fins, offsets or similar defects. Suitable molding or beveled strips shall be placed in the forms to chamfer or bevel all exterior corners of the concrete to prevent breaking and spalling at the edges when the forms are removed. Adequate and suitable means for removing the forms without injury to the surface of the finished concrete shall be provided.
- B. The Contractor shall locate and provide adequate shoring to safely support the work at all times. Shoring shall be spaced to insure that no member will be excessively loaded or will be subjected to adverse stresses during construction operations.
- C. Shores shall be continuous between supports and shall be aligned vertically with respect to each other. No adjustable or spliced wooden shores shall be used, unless specifically approved by the Engineer.
- D. When requested by the Owner, drawings showing details of the forms and shoring proposed by the Contractor shall be submitted to the Owner for approval.
- E. The forms shall be maintained at all times in good condition as to shape, strength, rigidity, water-tightness and smoothness of surface. Before each use, forms shall be thoroughly cleaned of all debris and water before concrete is placed, and shall be coated with a

non-staining type mineral oil which shall not discolor or otherwise injuriously affect the concrete. The coating shall be applied before reinforcing steel is placed. Temporary openings shall be provided at the bottom of wall forms and at other points where necessary to facilitate cleaning and inspection.

- F. Sectional form panels may be used throughout where practicable. When requested, designs of sectional forms shall be submitted to the Owner for approval before using in the work.
- G. The Owner may at any time condemn any section or sections of forms found deficient in any respect and such forms shall be promptly corrected or removed and replaced. Form alignment tolerances shall conform to current requirements of ACI 347, latest edition.
- H. Wire ties shall not be used as form ties.
- I. Metal inserts for anchorage of materials or equipment to concrete construction shall be provided as required in the work.
- J. The type and kind of form ties and spreaders used shall be subject to the Owner's approval. Form ties shall not project through the finished concrete, but shall be of such type that, upon removal of the forms, the ends of the ties or spreader will remain one inch or more within the face of the concrete.

2.9 WATERSTOPS

- A. Waterstops shall be manufactured from a plastic compound, the basic resin of which shall be polyvinyl chloride (PVC), and shall not contain any scrap or reclaimed material. In all construction joints where required, the water stop shall be Sealtight, Type No. 6380 as manufactured by W. R. Meadows, Inc. or Serviced Durajoint, Type No. 5, as manufactured by W. R. Grace Co., Vulco Type VP-8073 as manufactured by Vulcan Metal Products, Inc. or Owner approved equal
- B. Plastic waterstops shall have the following physical properties:

Specific Gravity	1.33 Max.
Durometer Hardness	65-80
Tensile Strength	2000 psi min.
Elongation	300% min.
Temperature Range	from +176 deg. F. to -35 deg. F.
- C. Waterstops shall be chemically resistant to chlorinated water, salt water, acids, alkalis, sewage wastes and oil.
- D. Splices in the continuity of waterstops shall be performed by heat sealing or other methods but always in strict accordance with the manufacturer's recommendations. Corners, tees, and other intersections shall be prefabricated in the shop.

2.10 NON-SHRINK GROUT

- A. Non-shrink grout shall meet C.O.E. specification CRD-C621 and be equivalent to the following:
 - 1. Crystex (L & M)

2. Sure-Grip
3. High Performance (Dayton Superior)
4. Masterflow 713 (Master Builders)

PART 3 EXECUTION

3.1 PROPORTIONING AND STRENGTH OF CONCRETE

- A. The mixing proportions and water cement ratio shall be such as to produce a dense, homogeneous, workable and durable air-entrained concrete having a minimum compressive strength of 4000 psi @ 28 days for all concrete work.
- B. The Contractor shall provide portland cement concrete mixtures for the project that are resistant to excessive expansion caused by alkali-silica reactivity (ASR).
- C. The evaluation as to the resistance of submitted concrete mixtures to excessive expansion caused by ASR shall be by the Owner as described herein.

3.2 RELATED SECTIONS

- A. This provision is supplemental to all other sections within the specifications of the Contract related to the construction of concrete items for the project.

3.3 SUBMITTALS

- A. One week after the Owner awards this project the Contractor shall submit to the Owner all proposed concrete mix designs. These shall include the following:
 1. Sources for all fine and coarse aggregates proposed to be used identified by their MDOT A.S.I # as listed in the Qualified Products List from the current MDOT Materials Source Guide if applicable or by an identifiable name if not applicable.
 2. Sources and recent mill test reports for all cementitious materials and supplementary cementitious materials proposed to be used.
- B. The Contractor also may submit for consideration the following:
 1. Recent ASTM C 1260 (Potential Alkali Reactivity of Aggregates (Mortar-Bar Method)) test results for the fine and /or coarse aggregates indicated on the proposed concrete mix designs.
 2. Recent ASTM C 1567 (Determining the Potential Alkali Reactivity of Combinations of Cementitious Materials and Aggregate (Accelerated Mortar-Bar Method)) test results for the specific proportionate combinations of cementitious, supplementary cementitious, fine, and coarse aggregate materials indicated on the proposed concrete mix designs.
 3. Recent ASTM C 1293 (Determination of Length Change of Concrete Due to Alkali-Silica Reaction) test results for the fine and /or coarse aggregates indicated on the proposed concrete mix designs.

3.4 REFERENCES

- A. Portland Cement ASTM C 150

- B. Fine Aggregate ASTM C 33
- C. Coarse Aggregate ASTM C 33
- D. Ground Granulated Blast Furnace Slag, Grade 100, 120 ASTM C 989

3.5 QUALITY ASSURANCE

- A. The Engineer shall review the submitted information and testing data submitted with the proposed concrete mixtures and any information and/or any test results with respect to ASR the Engineer has on record for the proposed aggregates and/or proportionate combinations of cementitious materials and aggregates.
 - 1. The criteria for approval of a proposed concrete mixture for resistance to excessive expansion caused by ASR shall be as follows:
 - a. If a proposed concrete mixture contains cement with an alkali level of less than 0.60% expressed as equivalent sodium oxide (percent $\text{Na}_2\text{O} + 0.658 \times$ percent K_2O) the mixture shall be considered to be resistant to the potential for excessive expansion caused by ASR.
 - 1) The determination of the alkali level of the proposed cement shall be made from the mill test reports submitted per Section 1.03.
 - b. If a proposed concrete mixture contains both fine and coarse aggregates for which there is testing per ASTM C 1260 that shows that both the fine and coarse aggregates produce expansions of less than 0.10%, the fine or coarse aggregate used to construct the mortar bar shall be considered to be “innocuous” (per Appendix X1 of ASTM C-33). Concrete mixtures that include both fine and coarse aggregates considered to be innocuous shall be considered to be resistant to excessive expansion caused by ASR.
 - c. If a proposed concrete mixture for which there is previous testing per ASTM C 1567, shows the proposed combination of cementitious materials and aggregates produce expansions of less than 0.10% the mixture shall be considered to be resistant to excessive expansion caused by ASR.
 - d. If a proposed concrete mixture for which there is previous testing per ASTM C 1293 shows that both the fine and coarse aggregates meets the criteria of Appendix XI of ASTM C 1293 with respect to the non-reactivity of the aggregate, the mixtures shall be considered to be resistant to excessive expansion caused by ASR.
 - e. If, based on the Engineer’s evaluation, additional testing of the fine and / or coarse aggregates is needed to make the evaluations as discussed herein; the Owner shall perform such testing.
 - 1) The Owner shall have access to all materials, including aggregate pits, in order to obtain samples for such additional testing.
 - 2) The Owner shall perform the following test using the fine and/or coarse aggregates proposed for each concrete mixture: ASTM C 1260 – Standard Test Method for Potential Alkali Reactivity of Aggregates (Mortar – Bar Method).
 - 3) All samples submitted for testing per ASTM C 1260 shall first be tested to establish conformance to the required material specification for gradation.
 - 4) All samples submitted shall meet the required material specification for gradation prior to being submitted for testing per ASTM C1260.

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2. If, based on the Engineer's evaluation, the submitted concrete mixture does not meet any one of the criteria of 1.05A.1. the mixture shall be rejected or be mitigated by Methods 1. or 2. as follows:
- a. Method 1. Use of a cement with an alkali level of less than 0.60% expressed as equivalent sodium oxide (percent Na₂O + 0.658 x percent K₂O).
 - 1) The determination of the alkali level of the proposed cement shall be made from the mill test reports submitted per Section 1.03.
 - b. Method 2. Substitution of a portion of the cement with Ground Granulated Blast Furnace Slag (GGBFS) Grade 100 or 120 (ASTM C 689).
 - 1) For Method 2, the maximum substitution of cement with the GGBFS permitted shall be 35% by weight of total cementitious material (cement plus GGBFS).
 - 2) For Method 2, the effectiveness of the proposed cement-GGBFS combination to resist the potential for excessive expansion caused by ASR for each aggregate that is considered to be potentially reactive shall be demonstrated.
 - 3) The effectiveness of the proposed cement-GGBFS combination shall be based on test mortar bars per ASTM C 1260 using each fine or coarse aggregate that has been considered to be potentially reactive and the proposed cement-GGBFS combination for the concrete mixture.
 - 4) The criteria for evaluating the mitigation of a proposed concrete mixture with respect to ASR by Method 2. shall be as follows:
 - a) If a mortar bar constructed of an aggregate that is considered to be potentially reactive and the proposed cement-GGBFS combination produces an expansion of less than 0.10%, the aggregate and proposed cement-GGBFS combination shall be considered to be resistant to excessive expansion caused by ASR.
 - b) Concrete mixtures that include both fine and coarse aggregates considered to be resistant to excessive expansion caused by ASR by mitigation Method 2. as described herein shall be considered to have been adequately mitigated with respect to and resistant to excessive expansion caused by ASR.
 - c) If a mortar bar constructed of an aggregate that is considered to be potentially reactive and the proposed cement-GGBFS combination produces an expansion of 0.10% or greater, concrete mixtures containing these materials shall not be considered resistant to the potential for excessive expansion caused by ASR and the concrete mixture shall be rejected.
 - c. The contractor shall be responsible for all costs associated with the mitigation of a concrete mixture for ASR and any delay costs incurred from the Owner if, due to the mitigation method selected by the Contractor, it takes the Contractor beyond their completion dates.
- B. If the Contractor intends to change suppliers or if the supplier intends to change concrete mixtures after the evaluation and/or Mortar-Bar tests are performed, the Contractor shall inform the Owner immediately, but not less than forty-five (45) days prior to concrete batching.

1. Upon notification, all concrete work will be postponed, without any additional costs or extension of time allowed by the Owner, until evaluation of the new mixtures and testing of the new materials, if needed, have been completed.
- C. The Owner will be testing the concrete that is delivered to the project site so as to ensure that the approved mix design is being followed.
 1. To assist the Owner in establishing that the approved mix design is being followed, the supplier shall include on the delivery ticket for each batch of concrete delivered to the job, the identification and proportions of each material batched.
- D. The cost associated with the testing of the aggregates, or aggregates with the proposed cement–GGBFS combinations as described herein shall be borne by the Owner. The price for assisting the Owner in such testing is included in the item (s) of the concrete being supplied. If, during the testing process, it is determined that alkali-silica reaction (ASR) is not a condition that requires mitigation, the Contractor will not be entitled to any compensation whatsoever, for assisting the Owner in addressing the ASR issue.
- E. Prior to the commencement of concreting operations, the Contractor shall design and submit to the Engineer the concrete mix he proposes to use to obtain the specified minimum strength concrete at 28 days, when sampled in accordance with the requirements of current ASTM Specification C-31, and tested in accordance with the requirements of current ASTM specification C-39, together with a statement of the sources of the materials upon which such concrete design mix is based, and recent certified tests of all components including gradation and physical properties of fine and coarse aggregates. Submittal shall be based upon compliance with ACI 318 Sections 5.2, 5.3, and 5.4.
- F. The design mix shall be proportioned by weight and shall designate: the weight in pounds of fine and coarse aggregates, in saturated surface dry condition, per sack (94 pounds) of cement; the cement content in sacks per cubic yard; the gallons of water per sack of cement; and the volume of admixtures per hundredweight of cement which will be required for the concrete design mix; gross weight and yield per cubic yard and slump of trial mixes; compressive strength developed at 7 days and 28 days from not less than three test cylinders cast for each 7 day and 28 day test and each design mix.
- G. The Concrete mix design to produce concrete of the required minimum strength shall be the sole responsibility of the Contractor, except that not less than 5 1/2 sacks of cement per cubic yard shall be used for 4000 psi concrete and the water cement ratio shall not exceed 0.45. The maximum allowable slump shall be that consistent with the proper placement of the mix and as specified herein, but in no case shall the water content exceed that specified. Air entrainment shall equal 5% ± 1%.
- H. The Contractor may, at his option, substitute up to 20% of fly ash or 35% of GGBFS' by weight of cement for the specified cement content, provided that the resulting concrete meets specified requirements for strength, workability, and appearance.
- I. Recent certified copies of test results of the fine and coarse aggregates proposed by the Contractor shall be provided with the mix design. Test results shall indicate aggregate grading, physical and chemical properties.

3.6 READY MIXED CONCRETE

- A. Ready mixed concrete shall be batched, mixed and transported in accordance with "Specifications for Ready-Mixed Concrete," ASTM C-94. Full batch ticket information including all items of C-94 Section 16.2 shall be furnished. Plant equipment and facilities shall conform to the "Check List for Certification of Ready Mixed Concrete Production Facilities" of the national Ready Mixed Concrete Association.

3.7 CONSTRUCTION JOINTS

- A. General
Construction joints shall be provided in the locations indicated on the Drawings, or at such locations as designated or approved by the Engineer. They shall be so designed and located as to least impair the strength, water-tightness and appearance of the structure. The distance between construction joints shall in no case be greater than 25 feet, unless otherwise indicated on the Drawings.
Keyways shall be provided in all construction joints. Unless otherwise indicated, the width of keyways shall be approximately one-third of the width of the section at that point and their depth one-third their width, except that the width of keyway shall not exceed 12 inches.
- B. Location
Construction joints in the base slab, walls, and upper slab of structures shall be located in the same vertical plane.
Joints in slabs on grade shall be located at a maximum 16' spacing and shall be perpendicular to the horizontal surfaces. All joints shall be truly vertical or horizontal unless otherwise shown on the Drawings or as ordered by the Owner. The surfaces of horizontal joints shall be screeded level.
- C. Treatment of Hardened Concrete
Before depositing fresh concrete on or against hardened concrete, the surface of the hardened concrete shall be roughened, as required by the Owner, in a manner that will not leave loosened particles of aggregate or concrete at the surface. Such roughening of the surfaces may be accomplished by bush-hammering as required, or by the use of Sika Chemical Corporation Rugasol S or B, ChemMasters H, or equal, applied in accordance with the manufacturer's directions in order to produce a naturally roughened surface. Such hardened surfaces shall be thoroughly cleaned of foreign matter and laitance. Just before the fresh concrete is deposited, the cleaned surface shall be thoroughly wetted, the excess water removed, and the wetted surfaces slushed with a mortar of the same proportions as the mortar in the concrete mix. The coat of mortar on horizontal joints shall not be less than two inches in thickness. The fresh concrete shall be deposited before the mortar has attained its initial set.

3.8 INSTALLING WATERSTOPS

- A. Waterstops shall be provided as shown on drawings including all connecting construction joints. Waterstops shall be held rigidly in place and shall extend through slots in the forms. In no case shall waterstops be bent over inside the forms.
- B. The waterstops shall be adequately protected from oil, dirt and damage and shall be maintained and left clean, ready to receive future concrete placement. Damaged waterstops shall be repaired to the satisfaction of the Engineer

- C. Care shall be taken in placing and maintaining waterstops in their correct position during the placing of concrete.

3.9 PLACING CONCRETE

- A. Concrete shall not be placed in water other than by tremie method and/or unless authorized by the Engineer nor shall water be allowed to rise or flow over concrete which has not attained its initial set. Concrete shall not be placed in contact with frozen earth.
- B. Concrete shall be placed in the forms only after the forms, bracing, and reinforcing steel have been checked and the space within the forms has been cleaned of all debris and water. This check shall be made by the Owner's designated representative and no concrete shall be placed except with his approval.
- C. When concrete is deposited directly on ground, care shall be taken to prevent loss of moisture from the concrete either by means of sprinkling the ground or by placing a waterproof membrane over the ground prior to placing the concrete.
- D. Concrete shall be promptly placed with a minimum of handling so as to avoid segregation or loss of any ingredients. Each placement shall be completed in a continuous operation and the concrete shall be placed as nearly as possible in its final position to avoid rehandling.
- E. Concrete shall be placed in layers not to exceed 24 inches deep and shall be compacted by mechanical internal vibrating equipment supplemented by hand spading, rodding, and tamping. Vibrators shall not be used to transport concrete inside the forms. Under no circumstances shall concrete that has partly hardened be deposited in the work.
- F. During freezing weather Contractor shall take whatever steps are necessary to prevent the freezing of ground against which concrete has to be placed. This protection will not be considered provided by a mud mat or other thin membrane but shall be provided by insulation, covering and heating, or other Owner approved means.
- G. Sufficient and suitable equipment and labor shall be provided so that, regardless of the method of transporting, handling, and placing the concrete when deposited in the forms shall have the quality and consistency specified. Concrete shall not be pumped through aluminum pipe.
- H. Mixing, handling and transporting equipment and tools shall be kept clean and free from lumps and incrustations of hardened concrete. Buggies, buckets, chutes, conveyors, and other devices used for the transportation of concrete shall be watertight, and their design and the method of transporting the concrete shall be subject to the approval of the Owner. Overloading of vehicles or chutes so that spillage or leakage occurs will not be permitted.
- I. The Contractor shall use the least slump possible consistent with workability for proper placing of concrete. Unless otherwise specified, maximum slumps permitted are:
 - 1. 4" slump For sections with side forms
 - 2. 3" slump For foundation slabs poured with curb forms only
- J. Slump will be determined by the Owner's designated representative by means of the slump cone test as outlined in current ASTM Designation: C-143.

3.10 BUILT IN WORK

- A. All necessary ties, anchors, bolts, inserts, dowels, waterstops, sleeves for pipe of every kind, and all other work to be anchored or set in the concrete shall be accurately set and securely held in place in accordance with details shown on the Contract Drawings or in accordance with standard practice, including such anchor bolts as may be necessary for equipment furnished by the Owner, or under other contracts.
- B. Sleeves of a suitable size and type shall be set in the concrete where all pipes, conduits, ducts, plumbing and other work are to pass through the concrete work, except where pipe wall castings or other devices are shown to be cast in place on the Contract Drawings.

3.11 PROTECTION AND CURING

- A. General
 - 1. Fresh concrete shall be protected from rain, and other adverse conditions by means of tarpaulins or other suitable equipment or methods. After placing and finishing operations have been completed, concrete shall not be subjected to loading or otherwise disturbed until it has attained its specified design strength.
- B. Initial Curing
 - 1. One of the following methods shall be used to initially cure freshly placed concrete. This curing shall be employed for a period not less than 24 hours.
 - a. Ponding or continuous sprinkling
 - b. Fogging
 - c. Absorbent mat or fabric kept continuously wet
 - d. Sand or other covering kept continuously wet
 - e. Continuous steam (not exceeding 150 degrees F within the enclosure)
 - f. Exposed surface of concrete shall be protected against premature drying by curing in a manner subject to approval by the Owner.
- C. Final Curing
 - 1. Immediately following the initial curing, for a period of not less than six days before concrete has dried, additional curing shall be accomplished by one of the following materials or methods.
 - a. Continuing the method used in initial curing
 - b. Waterproof paper conforming to current Specifications for Waterproof Paper for Curing concrete ASTM C-171
 - c. Other moisture retaining coverings as approved by the Owner.

3.12 MEASURES FOR COLD WEATHER PROTECTION

- A. When the mean daily temperature is less than 40°F the Contractor shall provide the necessary temporary heat, protection and enclosures so that newly placed concrete is kept at a temperature of not less than 50 degrees F for 7 days in accordance with ACI 306R recommendations. At the end of the curing period, artificial heating shall be discontinued and protections and enclosures removed in such a manner that the fall in temperature at any point in the concrete will not exceed 50°F in any 24 hours. Excessive heating shall be avoided to assure no undue loss of moisture from the concrete during the curing period. Fire prevention facilities shall be provided. Admixture of calcium chloride will not be allowed.

- B. Concrete placed when the ambient temperature is lower than 40°F shall have a temperature of not less than 55°F and not greater than 90°F.

3.13 MEASURES FOR HOT WEATHER PROTECTION

- A. When a combination of high air temperature, lower humidity and higher wind velocity tend to impair concrete quality, the Contractor shall provide the windbreaks, shading, sprinkling or other means and methods necessary to protect the concrete in accordance with ACI 305 recommendations.
- B. The maximum temperature of concrete at placement shall not exceed 90°F in hot weather. Steps shall be taken to control concrete temperature and water evaporation by proper attention to ingredients mixing, placing, handling, protection and curing.

3.14 TESTING CONCRETE

- A. All finished concrete testing shall be at the expense of the Contractor using an approved testing laboratory.
- B. Field cured cylinder test results will be used by the Engineer to verify the specified curing and protection, and to evaluate time intervals for removal of forms and shoring, and imposition of service loads.
- C. When test results are such that there is reasonable doubt that the specified concrete strength and other characteristics have been attained in the structure, the Owner may require the Contractor to take cores from the questionable areas and conduct tests to determine the strength and other characteristics of the in-place concrete. Such tests will be paid for by the Contractor.
- D. Concrete failing to meet specified requirements will be rejected, and may be required to be removed and replaced; or, additional approved construction may be required to compensate for rejected concrete; all without additional cost to the Owner, and as required to meet Owner's approval.
- E. Sampling shall be done in accordance with the methods specified in the current edition of ASTM Specification C-172.

3.15 FINISHING

- A. General
 - 1. Immediately following the removal of forms all fins, rough spots and hardened mortar shall be removed from all surfaces except those to be covered by backfill.
 - 2. On all surfaces including those to be covered by backfill, the cavities caused by form tie cones shall be repaired with Portland Cement and sand grout. All other holes, honeycomb spots, broken corners or edges shall be thoroughly cleaned to solid concrete but of not less than a minimum depth of one inch with edges cut perpendicular to the surface. After the cuts and surrounding areas have been saturated with water for a period of not less than three hours and the surface to be repaired has been brushed with a grout of equal parts of Portland Cement and sand, they shall be carefully pointed and trued with a mortar of cement and fine aggregate mixed in the

same proportion used in the concrete being repaired. Fine aggregate for mortar shall pass a No. 14 screen. The quantity of water used shall be no more than necessary for handling and placing.

3. The repair mortar shall be thoroughly mixed before using until it has reached the stiffest consistency that will permit placing.
4. Repair areas shall be kept moist for seven (7) days by a method meeting the approval of the Engineer.
5. Rough spots, stains, and hardened mortar on surfaces which will be exposed to view shall be removed by rubbing lightly with a fine abrasive stone or hone. Water shall be used freely and rubbing shall be sufficient only to remove the stains without working up a mortar lather or changing the texture of the concrete.
6. Stains caused by excessive use of form oil shall be removed by scrubbing with a 5 to 10 percent solution of muriatic acid, using a stiff bristle brush. The acid solution shall be applied to a thoroughly wetted surface and shall be rinsed off the surface with an abundance of water.

B. Floated Surface Finish

1. A fine floated surface finish shall be given to all slabs. The concrete surface shall be struck off with a straight edge which shall move on suitable guides set to the required elevation for the finished surface. After striking, the surface shall be finished without excessive working to a smooth even surface without any unevenness of more than 1/8 inch in any 10 ft. length in any direction.

3.16 REMOVAL OF LAITANCE

- A. All laitance and concrete which in the opinion of the Owner is of questionable quality shall be removed completely from the top surface of all concrete walls.

3.17 SHOP FABRICATION OF REINFORCING STEEL

- A. Bars shall be bent cold to the shapes and dimensions shown on the Drawings or as specified herein. Bends shall be made in accordance with the requirements of the current "Manual of Standard Practice" of the Concrete Reinforcing Steel Institute and/or current ACI 315 "Manual of Standard Practice for Detailing Reinforced Concrete Structures".
- B. Steel shall not be bent or straightened in a manner injurious to the material. Bending of reinforcing steel by heating will not be permitted. Bent up bars in beams and slabs shall be bent at an angle of 45 degrees unless otherwise shown on the drawings.

3.18 SHIPPING AND STORAGE OF REINFORCING

- A. Reinforcing bars shall be shipped to the site of the work in standard bundles, tagged and marked in accordance with the current Code of Standard Practice of the Concrete Reinforcing Steel Institute.
- B. Reinforcing steel shall be stored above the ground on platforms, skids or other supports, and shall be protected from the weather at all times with suitable covering. It shall be stored in an orderly manner and plainly marked to facilitate inspection and checking. Labor and other assistance shall be furnished to the Owner by the Contractor as may be required to check the steel as it is being stored or after storage on the site.

3.19 PLACING REINFORCING STEEL

A. General

1. All reinforcing steel shall be accurately placed in the position shown on the drawings, or as otherwise specified, and it shall be securely held in place before and during the placing of concrete. When placed in the forms the steel shall be free from dirt, rust, millscale, paint, oil, or other foreign material. In case there is a delay in pouring concrete after the steel has been placed, the steel shall be reinspected, and when necessary, recleaned prior to placing the concrete. Bases shall be wire tied or clipped at intersections, such fastenings being not more than 18 inches apart in either direction, unless otherwise approved by the Owner. Supports for reinforcement which are to remain in the finished work shall be precast concrete or plastic tipped metal.
2. The minimum clear distance between parallel bars shall be not less than the nominal diameter of the bars. In no case shall be clear spacing between bars be less than one inch, nor less than 1 1/3 times the maximum size of the coarse aggregate.
3. The minimum concrete cover for reinforcing steel shall be as called for in the current edition of ACI 318, where not specified otherwise on the drawings.
4. The clear distance between reinforcing steel and the face of the concrete shall be maintained at all points in order that the designed strength of the structure shall not be reduced. No reinforcing steel shall be bent or welded in the field without specific permission of the Owner.
5. Tolerances for location of reinforcing steel shall be as called for in current edition of ACI 318.

B. Splicing Reinforcing Steel

1. No splicing of reinforcing bars shall be made at points of maximum stress, except with prior approval of the Owner. Splices in adjacent bars shall be staggered. Lapped splices shall not be used for bars larger than Size No. 11. For bars size No. 11 and smaller in tension or compression lap splicing shall be used.
2. Lapped ends of bars shall be placed in contact and securely wired. Bars shall have a minimum lap of 40 bar diameters.

C. Dowels

1. All dowels shall be in position before the concrete is placed. Dowels shall not be inserted after the concrete has been placed.

D. Reinforcing Steel Schedules

1. Reinforcing bar schedules and detail shop drawings, showing complete details as to size, length, weight, arrangement, and bending of all reinforcing steel shall be submitted by the Contractor to the Owner. A complete schedule of reinforcement chairs, supports, saddles, spacers, and other accessories shall be included. No reinforcement shall be cut, bent, or fabricated before these schedules and/or drawings are reviewed by the Owner.

3.20 REMOVAL OF FORMS AND SHORES

- A. Forms shall not be disturbed until the concrete has adequately hardened. Shoring shall not be removed until the supported member has acquired sufficient strength to support its weight and any superimposed load upon it without exceeding the normal amount of deflection. Members

subject to additional loads during construction shall be adequately shored to support both the member and the construction loads in such a manner as will protect the member from damage.

3.21 ACCEPTANCE OF STRUCTURE

A. General

1. Completed concrete work which meets all applicable requirements will be accepted without qualification.
2. Completed concrete work which fails to meet one or more requirements but which has been repaired to bring it into compliance will be accepted.
3. Completed concrete work which fails to meet one or more requirements and which cannot be brought into compliance may be accepted or rejected as provided in these specifications. In this event, modifications may be required to assure that remaining work complies with the requirements.

B. Dimensional Tolerances

1. Formed surfaces resulting in concrete outlines smaller than permitted by the tolerance shall be considered potentially deficient in strength.
2. Formed surfaces resulting in concrete outlines larger than permitted by the tolerance may be rejected and the excess material shall be subject to removal. If removal of the excess material is approved, it shall be accomplished in such a manner as to maintain the strength of the section and to meet all other applicable requirements of function and appearance.
3. Concrete members cast in the wrong location may be rejected if the strength, appearance, or function of the structure is adversely affected or misplaced items interfere with other construction.
4. Inaccurately formed concrete surfaces exceeding the tolerances and which are exposed to view, may be rejected and shall be repaired or removed and replaced if required.
5. Finished slabs exceeding the tolerances may be repaired provided that strength or appearance is not adversely affected. High spots may be removed with terrazzo grinder, or other remedial measures performed as approved.

C. Appearance

1. Concrete exposed to view with defects which adversely affect the appearance of the specified finish may be repaired only by approved methods.
2. Concrete not exposed to view is not subject to rejection for defective appearance.

D. Strength of Structure

1. The strength of the structure in place will be considered potentially deficient if it fails to comply with any requirements which control the strength of the structure, including but not necessarily limited to the following conditions:
 - a. Low concrete strength.
 - b. Reinforcing steel size, quantity, strength, position, or arrangement at variance with the requirements.
 - c. Concrete which differs from the required dimensions or location in such a manner as to reduce the strength.
 - d. Curing less than that specified.
 - e. Inadequate protection of concrete from extremes of temperature during early stages of hardening and strength development.

- f. Mechanical injury, construction fires, accidents or premature removal of formwork likely to result in deficient strength.
- g. Poor workmanship likely to result in deficient strength.
- 2. Structural analysis and/or additional testing may be required when the strength of the structure is considered potentially deficient.
- 3. Core tests may be required when the strength of the concrete in place is considered potentially deficient.
- 4. If core tests are inconclusive or impractical to obtain or if structural analysis does not confirm the safety of the structure, load tests may be required and their results evaluated in accordance with Chapter 20 of "Building Code Requirements for Reinforced Concrete" (ACI 318).
- 5. Concrete work judged inadequate by structural analysis or by results of a load test shall be reinforced with additional construction if so approved by the Engineer, or shall be replaced, at the contractor's expense.
- 6. The contractor shall pay all costs incurred in providing the additional testing and/or structural analysis required by this section.

END OF SECTION