SECTION II
PLAIN AND REINFORCED CONCRETE

A. STATEMENT OF WORK

1. Scope

The work covered by this Specification consists in furnishing all plant, labor, equipment, appliances and materials, and in performing all operations in connection with the furnishing and placing of all concrete.

B. MATERIALS

1. Standard Specifications and Quality

Wherever the Specifications, tests, standards, or recommendation of a nationally recognized testing laboratory, professional society, or industrial association are referred to, the latest applicable specification, test, standard or recommendation shall be met. For brevity, the words "conforming to", "specification", "description", and "latest" are omitted hereafter, and society or association names are abbreviated by use of initials only. Thus, the phrase "Portland Cement", ASTM C-150, Type I shall be read as "Portland Cement shall comply with the Standard Specifications for Portland Cement, ASTM designation C-150, latest revision, and shall be Type I".

Where no specification is given, materials shall be of the best grade and quality and shall be subject to the approval of the Township Engineer. "Approved equal" shall mean as approved for use on this work by the Township Engineer.

2. Portland Cement

Portland Cement, ASTM C-150, Type I. Other types may be used where specifically authorized by the Township Engineer.

3. Concrete Aggregates

(a) Concrete Aggregates, AST, C33

Lightweight aggregates for concrete, ASTM C130. Where aggregates conforming to these Specifications are not obtainable, aggregates that have been shown by test and actual service to produce concrete of the required strength, durability, water-tightness and wearing qualities may be used.

(b) Maximum Size

Maximum size of the aggregate shall be not larger than one-fifth of the narrowest dimension between forms of the member for which the concrete is to be used not larger than three-fourths of the minimum clear spacing between reinforcing bars.

4. Water

Water used in mixing concrete shall be clean, and free from deleterious amounts of acids, alkalis, or organic materials.

5. Metal Reinforcement

(a) Reinforcing Bars, ASTM A305, and ASTM A15. (Alternate ASTM A16 of ASTM A160).

(b) Welded Wire Fabrics, ASTM A185 or cold-drawn steel wire, ASTM A82.

(c) Structural Steel, ASTM A7.

(d) Cast Iron, ASTM A44.

6. Storage of Materials

Cement and aggregates shall be stored at the work in such a manner as to prevent deterioration or intrusion of foreign matter. Any material which has deteriorated or which has been damaged shall not be used for concrete. Material rejected by the Township Engineer shall be promptly removed from the site by the Contractor.

C. QUALITY

1. Strength

The mix shall be designed to secure concrete having a compressive strength at the end of 28 days of 3000 psi, which is the minimum strength for any one cylinder.

2. Mix Design

The determination of the proportions of cement, aggregate and water to attain the required strength shall be made by one of the following methods:

(a) Concrete from average materials, which are not to be preliminarily tested, shall contain not more than 6.5 U.S. gallons of water per 94-pound bag of cement and shall contain no less than six (6) bags of cement per cubic yard of concrete. (Surface water contained in the aggregate must be included as part of the mixing water in computing the water.)

(b) Controlled concrete shall be produced in accordance with the predetermined design of a recognized laboratory and approved by the Township Engineer. The strength and quality of the concrete proposed for use in the work shall be established by tests of the design mix (ASTM C192, of ASTM C39) made in advance of the beginning of operations. A curve representing the relation between the water content and the average 7-day and 28-day compressive strength hereinbefore specified. The curve shall be established by at least three points, each point representing average values from at least four (4) test specimens. The amount of water used in the concrete for the work, as determined from the curve, shall correspond to a strength, which is 15% greater than that required by the specifications. The laboratory report shall include slumps (ASTM C143) for each of the mixes reported. No substitutions shall be made in the materials used on the work without additional tests in accordance herewith to show that the quality of the concrete is satisfactory.

(c) Additional cement may be required by the Township Engineer, without additional compensation to the Contractor, if the mix adopted does not produce the required strength.

3. Proportions and Consistency

(a) Proportions of aggregate to cement for any concrete shall be such as to produce a mixture, which will work readily into the corners and angles of the forms and around reinforcement with the method of placement employed on the work, but without permitting the materials to segregate or excess free water to collect on the surface. The combined aggregates shall be of such composition of sizes that when separated on the No. 4 Standard Sieve, the weight passing the sieve shall not be less than 30% more greater than 50% of the total (not necessarily applicable to lightweight aggregate).

(b) Methods of measuring concrete materials shall be such that the proportions can be accurately controlled and easily checked at any time during the work. All materials shall be mechanically batched and measured by weight (1 bag cement = 94 pounds, and 1 gallon water = 8.33 pounds). Measurement of materials for ready-mixed concrete shall conform to ASTM C94.

(c) Consistency

The slump test (ASTM C143) on concrete being placed in the work shall fall within the following tabulation of limits, except that nothing contained herein shall be construed as a release from the provisions of C-1, and that the water content shall not be increased from the amount required by the design mix unless cement at required water-cement ratio is added:

Slump of Concrete

Type of Structure	Slump in inches Max.	Min.
Reinforced foundation walls and footing	5	2
Plain footings and substructure walls	4	1
Slab, beams, columns, and reinforced walls	6	3
Pavement and mass concrete	3	1

4. Tests

(a) Compression

Tests of compression specimens shall be made during the progress of the work (ASTM C31 and ASTM C39). Not less than three (3) specimens shall be made for each test, nor less than (1) test for each 250 cubic yards (or one day's pour, whichever is the least). Specimens shall be cured under laboratory conditions, except that the Township Engineer may require additional specimens to be cured under job conditions. One 7-day and two 28-day breaks per test will be required, except that the Township Engineer may authorize a second 7-day break when the first would indicate that the concrete is falling below the compressive strength specified.

(b) Failures

Failures of tests to comply with the requirements of C-1 for any portion of the work shall give the Township Engineer the right to order a change in the proportions or the water content for the remaining portion of the work. As a result of the failure of the test specimens to meet the requirements of C-1, the Township Engineer may order the testing of the hardened concrete (ASTM C42) or order load tests to be made on the work affected.

(c) Removal and Replacement

Removal and replacement of concrete work, which has been determined by the Township Engineer to be unsuitable, either from the standpoint of strength or water-tightness, shall be promptly accomplished by the Contractor at no additional cost to the Owner.

D. MIXING AND PLACING

1. Preparation

(a) Before placing concrete, all equipment for mixing and transporting the concrete shall be cleaned, all debris and ice shall be removed from the places to be occupied by the concrete, forms shall be thoroughly wetted (except in freezing

weather) or oiled, and masonry filler units that will be in contact with concrete shall be well drenched (except in freezing weather), and the reinforcement shall be thoroughly cleaned of ice or other coatings. Form oil shall be a non-staining mineral oil and shall be applied before reinforcement is placed. Foundations to be placed on dry or pervious material shall be covered with waterproof sheathing paper before concrete is deposited.

(b) Water shall be removed from place of deposit before concrete is placed unless otherwise permitted by the Township Engineer.

2. Mixing

(a) The concrete shall be mixed until there is a uniform distribution of the materials and shall be discharged completely before the mixer is recharged.

(b) For job-mixed concrete, the mixer shall be rotated at a speed recommended by the manufacturer and mixing shall be continued for at least one (1) minute after all materials are in the mixer.

(c) Ready-mixed concrete, ASTM C94.

3. Conveying

(a) Concrete shall be conveyed from the mixer to the place of final deposit by methods, which will prevent the separation or loss of the materials.

(b) Equipment for chuting, pumping and pneumatically conveying concrete shall be of such size and design as to insure a practically continuous flow of concrete at the delivery end without separation of the materials.

4. Depositing

(a) Concrete shall be deposited as nearly as practicable in its final position to avoid segregation due to rehandling or flowing. The concreting shall be carried on at such a rate that the concrete is at all times plastic and flow readily into the space between bars. No concrete that has partially hardened or been contaminated by foreign material shall be deposited on the work, nor shall retempered concrete be used. Concrete shall be so deposited in wall pours that the maximum distance between points of depositing does not exceed fifteen (15) feet.

(b) When concreting is once started, it shall be carried on as a continuous operation until the placing of the panel or section is completed. The top surface shall be generally level. When construction joints are necessary, they shall be made in accordance with Paragraph E-7.

(c) All concrete shall be thoroughly compacted by suitable means during the operation of placing, and shall be thoroughly worked around reinforcement and embedded fixtures and into the corners of the forms. Concrete shall be spaded and vibrated with approved mechanical vibrators. Vibrators shall not be used to transport concrete inside the forms. Internal vibrators (form or surface types shall not be used) shall maintain a speed of not less than 6000 impulses per minute when in operation submerged in the concrete.

(d) Where conditions made compacting difficult, or where the reinforcement is congested, batches of mortar containing the same proportion of cement to sand as used in the concrete shall first be deposited in the forms. Concrete shall not be allowed to drop freely more than five (5) feet and where greater drops are required, a tremic or other means approved by the Township Engineer shall be employed.

5. Curing

Provisions shall be made for maintaining concrete in a moist condition for at least five (5) days after the placement of the concrete, except that for high-early-strength concretes, moist curing shall be provided for at least the first two (2) days.

6. Cold Weather Requirements

The following limitation shall apply when the mean daily temperature is below 50° F.

a. No concrete pours shall be permitted from December 1st to March 1st unless prior approval is received from East Manchester Township.

b. No concrete pours shall be allowed when the mean daily temperature will fall below 32° F within five (5) days of the pour. All concrete materials and all reinforcement, forms, fillers, and ground with which the concrete is to come in contact with, shall be free from frost.

c. When the mean daily temperature is between 32° F and 50° F, all concrete place in the forms shall have a temperature of between 70° F and 80° F, and adequate means shall be provided for maintaining a temperature of not less than 70° F for two (2) days or 50° F for three (3) days or for as much more time as is necessary to insure proper curing of the concrete. The housing, covering or other protection used in connection with curing shall remain in place in intact at least 24 hours after the artificial heating is discontinued. No dependence shall be placed on salt or other chemicals for the prevention of freezing.

d. Adequate equipment shall be provided for heating the concrete materials and protecting the concrete during freezing or near-freezing weather. No frozen materials or materials containing ice shall be used.

E. FORMS AND DETAILS OF CONSTRUCTION

1. Design of Forms

Forms shall conform to the shape, lines and dimensions of the members as called for on the plans, and shall be substantial and sufficiently tight to prevent leakage of mortar. They shall be properly braced or tied together so as to maintain position and shape.

2. Removal of Forms

Forms shall be removed in such a manner as to insure the complete safety of the structure. Where the structure as a whole is supported on shores, the removable floor forms, beams and girder sides, column and similar vertical forms may be removed after 24 hours, providing the concrete is sufficiently hard not to be injured thereby. In no case shall the supporting forms or shoring be removed until the members have acquired sufficient strength to support safely their weight and the load thereon.

3. Cleaning and Bending Reinforcement

Metal reinforcement, at the time concrete is placed, shall free from rust, scale or other coatings that will destroy or reduce the bond. Bends for stirrups and ties shall be made around a pin having a diameter not less than two (2) times the minimum thickness of the bar. Bends for other bars shall be made around a pin having a diameter not less than six (6) times the minimum thickness of the bar, except that for bars larger than one (1) inch the pins shall be not less than eight (8) times the minimum thickness of the bar. All bars shall be bent cold.

4. Placing Reinforcement

Metal reinforcement shall be accurately placed in accordance with the plans and shall be adequately secured in position by concrete or metal chairs and spacers.

5. Splices and Offsets in Reinforcements

(a) In slabs, beams and girders, splices of reinforcement at point of maximum stress shall generally be avoided. Splices shall provide sufficient lap to transfer the stress between bars by bond and shear.

(b) Where changes in the cross-section of a column occur, the longitudinal bars shall be offset in a region where lateral support is afforded. Where offset, the slope of the inclined portion shall not be more than 1 in 6, and in the case of tied columns, the ties shall be spaced not more than three (3) inches on centers for a distance of one (1) foot below the actual point of offset.

6. Concrete Protection for Reinforcement

(a) The metal reinforcement shall be protected by the thickness of concrete indicated in the plans. Where not otherwise shown, the thickness of concrete over the reinforcement shall be as follows:

Where concrete is deposited against ground without the use of forms, not less than three (3) inches.

Where concrete is exposed to the weather, or exposed to the ground but place in forms, not less than two (2) inches for bars more than 5/8-inch diameter and 1-1/2 inches for bars 5/8 inch of less diameter.

In slabs and walls not exposed to the ground or to the weather, not less than ¾ inch.

In beams, girders and columns not exposed to the ground or to the weather, not less than 1-1/2 inches.

In all cases, the thickness of concrete over the reinforcement shall be at least equal to the diameter of round bars and 1-1/2 times the side dimension of square bars.

7. Construction Joints

(a) Joints not indicated on the plans shall be so made and located as to impair the strength of the structure. Where a joint is to be made, the surface of the concrete shall be thoroughly cleaned and all laitance removed. In addition, vertical joints shall be thoroughly wetted and slushed with a coat of neat cement grout immediately before the placing of new concrete.

(b) At least two (2) hours must elapse after depositing concrete in the columns or walls before depositing in beams, girders, or slabs supported thereon. Beams, girders, brackets, column capitals and haunches shall be considered as part of the floor system and shall be placed integrally therewith.

(c) Construction joints in floors shall be located near the middle of the spans of slabs, beams or girders, unless a beam intersects a girder at this point, in which case the joint in the girders shall be offset a distance equal to twice the width of the beam.

In this last case, provision shall be made for shear by use of inclined reinforcement.

F. FINISHING

1. Finishing

Immediately after removal of forms, all unsightly ridges or lips shall be removed and undesirable local bulging on the surfaces shall be remedied. Excessive rubbing of formed surfaces shall not be permitted. All voids and holes left by the removal of tie rods shall be reamed and neatly filled with dry-patching mortar (pre-shrunk) mixed in proportions directed by the Township Engineer. The cement used in the mortar shall be a blend of Portland Cement and White Portland Cement properly proportioned so that the final color of the cured mortar will be same as the color of the surrounding concrete. Defective concrete shall be repaired by cutting out the unsatisfactory material and placing new concrete, which shall be formed with keys, dovetails or anchors to attach it securely in place. Concrete for patching shall be drier than the usual mixture and shall be thoroughly tamped in place. All finishing, filling or voids and tie rod holes, and patching of exposed surfaces shall be perfumed immediately after form is removed, unless otherwise authorized or directed by the Township Engineer. All unformed surfaces of concrete that are not to be covered by additional concrete or backfill shall have a wood float finish without additional mortar and shall be true to elevation as shown on the drawings. Care shall be taken to see that all excess water is removed before making any finish. Other surfaces shall be brought to the specified finished elevation and left true and regular. Where indicated on the drawings, joints shall be carefully made with a jointing tool. Every precaution shall be taken by the Contractor to protect finished surfaces from stains and abrasions. Surfaces or edges likely to be injured during the construction period shall be properly protected.