STRUCTURAL CONCRETE PLANT INSPECTION

GENERAL

Refer to IM 527 (General, Safety).

The following instruction is to be used when inspecting the operation of a ready mix concrete plant typically used for structural concrete, patching, and other concrete items.

EQUIPMENT

1. ELEVATED, LOW PROFILE, AND GROUND-LEVEL BINS

   Refer to IM 527 (Equipment Bins) and the following:

   Permanent structural concrete plants often have facilities for storing sizable quantities of a number of different aggregates. There is a tendency for the stockpiles to become too large for the available area and for the bins to be filled beyond their normal capacity. Aggregates thus tend to become intermingled. Aggregates may also become contaminated with foreign material from a number of sources, including the material, which underlies some stockpiles, if proper care is not taken. Materials, which have been intermingled or otherwise contaminated, must not be incorporated into the work.

2. PROPORTIONING EQUIPMENT

   Requirements for scales or meters for proportioning aggregates, cement, fly ash, water or air entraining agents or other admixtures are found in Article 2001.20 of the Standard Specifications, as modified by Supplemental Specifications. These requirements are in addition to Section 1 above for elevated bins.

   It is the duty of the District Materials Engineer to examine and evaluate all proportioning and plant equipment annually, and maintain a current list of approved structural concrete plants. The Calibration Report, Form #820917, with any appropriate restrictions, conditions, comments, etc., will be posted at the plant site. (See IM 527, Appendix C for a sample copy and Appendix D for calibration checklist.) Before concrete work begins on a project, the Project Engineer must communicate with the District Office and determine that the plant to be used has received annual approval.

   The plant inspector must be familiar with all features of the plant operation before work begins. While the inspector must not personally make any of the manipulations or adjustments, an understanding of the basic machinery operation and the ability to recognize the significance of a malfunction is important.

   The proportioning equipment must be examined at regular intervals during a placement for correctness of the amount being delivered and for possible damage or malfunction. Special attention must be given to the empty balance and the position of the poise weights for beam and dial scales.

The normal plant operation causes vibration, which tends to change these adjustments. Accumulation of material clinging to the inside of the hoppers can also cause these adjustments to drift. Small amounts of material accumulation clinging to the inside of a hopper are not considered objectionable. If the amount exceeds one percent of the material batch, however, it must be removed and readjusted to indicate a zero load within 0.5% (Article 2001.20).

The scale sensitivity shall be checked at least at the beginning of a placement if operations are intermittent, and at the beginning of each day if the operations are continuous in the following manner:

> Place a mass equal to 1/10 percent of the batch on the fully-loaded scales while observing the movement of the indicator.

A properly sensitive scale will exhibit a visible indicator movement when tested in this manner. If no indicator movement is visible and immediate corrective action by the owner does not yield successful results, the District Materials Engineer must be informed.

Periodic observation of the measuring operation must be made to determine that the proper amounts of materials are being delivered to the concrete batch. The plant inspector must be able to recognize when the hopper is overloaded or underloaded by one percent of the batch. For a dial scale, these limits are readily recognizable on the graduated dial chart. For scales with a balance indicator, the location of the indicator hand when a one percent over and underload is applied and removed can be noted before work begins.

If an examination reveals that the scales are not properly sensitized or the proper amounts of material are not being furnished to the concrete batch, refer to IM 527, General, for the necessary action.

Document all routine scale sensitivity, delivery tolerance checks and any necessary corrective action taken, in the plant inspection diary.

The following procedure is required for setting or adjusting the various items of proportioning equipment so that they will deliver the proper amount of material to the batch:

- The plant superintendent or other authorized operator representative must make all necessary scale and equipment setting and/or adjustments. The plant inspector is specifically directed not to participate in this activity.

- Before the plant operation begins or resumes, the plant inspector will independently determine for himself/herself that the settings and/or adjustments are correct and that the amounts of material being delivered to the batch are correct. Errors must be corrected immediately. Strict adherence to the above procedure is necessary to maintain a proper division of authority and responsibility between the contractor and the contracting authority, and to minimize the possibility of operating with erroneous proportions.

Suitable wind protection on all sides of the scales is required by the specification. This protection, if not provided by the plant design, can be fabricated from burlap, masonite, plywood or other suitable material and should provide adequate room for the scale operator to work unobstructed.

An air-entraining admixture is required for all structural concrete, except Class X, and can be proportioned either manually or automatically. Mechanical dispensers must have a transparent measuring chamber so that each batch can be observed as it is measured and dispensed. Mechanical dispensers must be cleaned daily to minimize the possibility of deposits accumulating and causing a malfunction.

The amount of air entraining admixture required is determined by the results of the pressure meter air tests run on the plastic concrete, as described in IM 318. The contractor must decide the quantity to be used and the adjustments necessary, if any, after the pressure meter testing has been completed. Provision shall be made for agitation of the air-entraining agent. (See Article 4103.01A)

An admixture for set retardation may be required. The list of approved retarding admixtures, and recommended dosages, is found in IM 403. An admixture for water reduction may be used at the contractor's option in mixes so designated in IM 529. (See Article 2301.04D.)

See IM 527 (Materials, Admixtures), regarding dosage, handling and storage of admixtures.

Most air entraining and retarding admixtures, when intermingled with each other tend to neutralize each other and negate the effects of each. Care must therefore, be taken to introduce each admixture into the mixer separately and allow the first to become intermingled into the batch before the second is introduced. A procedure, which has been used successfully, is to introduce the air-entraining agent first along with most of the mixing water and other ingredients, and after these have become intermingled then introduce the balance of the mixing water and the retardant admixture.

3. MIXING EQUIPMENT

Mixing equipment for structural projects will be one of the following types:

Truck-mounted transit mixers
Stationary central mixers with in-transit agitation
Stationary mixers located at the project site
Concrete-Mobiles

The truck-mounted transit mixers are the most popular with stationary, central mixers increasing in popularity. Stationary site mixers are seldom used.

Refer to IM 527 (Mixing Equipment) for inspection instructions relating to stationary central mixers and truck-mounted transit mixers, and Concrete-Mobiles.

Transit mixers must carry a current certification signed by a responsible company representative stating that the mixer condition has been examined during the previous 30 days, is free of hardened concrete, and is in proper working condition. Mixers not carrying the required certification must not be used.

MATERIAL

Refer to IM 527 (Material) for the necessary inspection instructions relating to material identification, handling and storage.

SAMPLING & TESTING

1. AGGREGATES

Refer to IM 527 (Sampling & Testing) for related inspection instructions.

The minimum frequencies for testing aggregates for structural concrete vary slightly from those for pavement and are as follows:

Specific Gravity - One sample per week for both coarse and fine aggregate for the first two weeks of concrete placement, and one sample for both coarse and fine every other week thereafter, unless the first two tests indicate variations greater than 0.02 from the tabular value T203, Aggregate Source Information, or from one test to the next. If the above variations are greater than 0.02, inform the Project Engineer and the District Materials Engineer immediately. The District Materials Engineer may adjust the specific gravity used to determine batch weights.

Moisture - One sample for each aggregate per lot. If a system with instantaneous moisture content measurement equipment is used to automatically adjust individual batch weights, see section titled Sampling & Testing/Moisture in IM 527 for instructions on approval, use, and monitoring of the system.

Gradation – One sample for each aggregate per lot.

Lots are based on amount concrete produced from the plant and may include more than one project. For structural concrete operations, a lot should consist of one day's run or approximately 250 cubic yards (190 m³) whichever is greater. If less than 250 cubic yards (190 m³) are produced in one calendar week that week's work shall be considered as one lot. A bridge deck is considered a lot, unless a bridge deck has over a single day's run, then each day's run shall be considered a lot.

For projects requiring certified plant inspection, the certified inspector will obtain and test one gradation sample per lot, unless operations are prematurely shut down.

The engineer will perform sampling and testing at the frequency described in IM 204. IM 205 describes the agency responsibility to randomly select sample location and time, and witness sampling with the contractor providing assistance in obtaining the samples. When

production is less than 25 cubic yards (25 cubic meters) per week, the engineer may group the sampling with the previous week.

A lot is accepted when a verification test result by the contacting authority is determined to be in compliance. Since the contracting authority tests are verification, correlation with IM 216 is not required, but may be performed as a check of sampling and testing procedures.

2. WATER/CEMENT RATIO

Whenever the water demand, to achieve the desired workability, exceeds the design water/cement ratio and approaches the maximum water allowed the Project Engineer and the District Materials Engineer Office should be notified. At the same time, aggregate moisture contents, batch amounts, cement scales, water meter, etc., should all be immediately checked. In no circumstance should the maximum water/cement ratio be knowingly exceeded.

If, after the District Materials Engineer investigation and evaluation, additional workability above that which is attainable within the maximum permissible water content is desired, the cement content may be increased in accordance with Article 2403.03A. This should be done only with the approval of the District Materials Engineer or the engineer representative. The District Materials Engineer will provide the revised and adjusted mix proportions for these situations.

Also, in accordance with Article 2403.03C, the engineer may authorize the use of a water-reducing admixture to improve workability. When authorized, only the water-reducing admixtures and dosage rates, as shown in IM 403 should be used.

When calcium chloride solution is added for patching M mix, water included in the calcium chloride solution should not be included in calculation of water-to-cement ratio.

3. STRENGTH TESTS

The test for Modulus of Rupture is the only strength test determined in the field. Test specimens are required for each section placed.

A section is defined as a day's placement of structural concrete. IM 204 lists minimum testing requirements.

Abutment backwalls, pier footings, bridge end posts, and culvert curtain walls are not considered critical structural units and therefore, test specimens are not required from these units, unless directed by the engineer.

Test the flexural specimens as prescribed in IM 316, Flexural Strength of Concrete. Testing shall be done by contract authority personnel.

PROPORTIONS

Refer to IM 527 (Proportions)

REPORTS & REPORTING

1. PCC PLANT PAGE – FORM #240

   The same form is to be used for PCC Paving and PCC Structures. Refer to IM 527 for instructions on completing the form and an example form.

   Structural Reports are to be recorded in the computer program or on hand-completed forms both provided by the Iowa Department of Transportation. A copy of the completed PCC Plant Page shall be faxed or delivered to the District Materials Engineer within four hours on the next working day after the end of the lot. The Certified Plant Inspector shall keep a copy of the PCC Plant Page and send the original to the Project Engineer. Copies of the files containing the project information will be available to the engineer upon request until the project is final.

   A separate report is to be made for each lot of concrete. These reports are to be consecutively numbered for each project.

   When computer forms are used, refer to IM 527 for the necessary equipment.

2. READY MIXED CONCRETE, TRUCK TICKET FORM – FORM #830212

   Each truckload of concrete must be identified by Form #830212 or an acceptable computer-generated plant ticket. See IM 527.