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Controlling Quality Construction - Part 1

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In my previous article entitled "Construction Defects Can Be Avoided!", I illustrated various aspects of how the construction process can and should incorporate Due Diligence and Quality Control systems and methods.

This article is intended to give the reader a thumbnail sketch of how Quality Control relates to the project Superintendent on the job site.

Supervision

It is the duty of the contractor to complete the work covered by his or her contract, in accordance with the approved plans and specifications. The contractor must carefully study the approved plans and specifications and should plan their schedule of operations well ahead of time. If at any time it is discovered that the work which is being done is not in accordance with the approved plans and specifications, the contractor should immediately correct the work.

In order to assure that the work being done is in accordance with the approved plans and specifications, the contractor must provide for and furnish adequate, experienced, competent supervision, and coordination of all of the work he or she is contracted to perform.

Inspection of the Work

Inspection is a crucial function that does not start with the Building Inspector, or the Special Inspector. Inspection must begin with the Superintendent. It is critically important that the Superintendent be thoroughly knowledgeable of each and every trade that he is supervising.

This doesn't necessarily mean that he has to be an expert in all trades, but it does mean that the superintendent must be aware of the resources available to him to gather sufficient information to assure that the work is being performed in accordance with the approved plans and specifications, and the manufacturer's recommendations for the use and installation of the material products being used, and that the work is in conformance with the requirements of the Codes.

Good grief ... that's a lot of responsibility! That's right, the job of a construction superintendent is a heck of a lot of responsibility, and must not be taken lightly!

Let's see if we can take some of the mystery out of what the superintendent can do to ensure that the work will conform to the approved plans, specifications, Building Codes, and industry standards of quality as well.

To begin with, in Part 1, we'll start with CONCRETE INSPECTIONS. The following, is a recommended check list that should be followed by the Project Superintendent:

1. PLAN READING
General Project Requirements:
Review the general notes and/or specifications and typical details for general project requirements for concrete strengths, reinforcing steel grade(s), clearances, and Special Inspection requirements.
- 1.2 Foundations and below-grade Walls:
Review the approved plans for reinforcement and concrete construction requirements for foundations, below-grade walls, and grade beams.
- 1.3 Beams, Girders and Joists:
Review the approved plans for reinforced concrete construction requirements for beams, girders and joists.
- 1.4 Columns:
Review the approved plans for reinforced concrete column construction requirements.
- 1.5 Slabs:
Review the approved plans for reinforced concrete slab requirements.
- 1.6 Miscellaneous Details:
Review the approved plans for reinforced concrete construction requirements for stairs, above grade walls and other special details.
- 1.7 Revised Details:
Review the revised details for the changes from the approved plans. Verify that the revised detail(s) are approved by the Structural Engineer, and the Building Official.
2. CONCRETE MIX VERIFICATION
 - 2.1 Mix Design:
Verify that concrete is batched based upon the approved laboratory mix design (specific for each project), that cement type is as specified, that aggregate type, weight and size are as specified and admixtures are correct and in accordance with the Mix Design, approved by the Structural Engineer of Record.
 - 2.2 Trip Ticket:
Determine that mixer truck trip tickets specifies that the mix in the truck is the mix required.
 - 2.3 Batch Plant Inspection:
Verify Batch Plant Inspection (if required), and review Batch Plant Inspection tickets.
 - 2.4 Mixing Water:
Verify that total water added to mix does not exceed that allowed by the concrete mix design and is of acceptable quality (drinkable water).
 - 2.5 Adequate Equipment:
Verify that concrete mixing and placing equipment at the site is adequate for the intended use, and that a vibrator is on hand.
 - 2.6 Quality of Concrete:
Verify that the quality of the concrete is indicative of adequate mixing time, consistency and relevant time limits (90 minute rule).
3. CONCRETE REINFORCEMENT
 - 3.1 Rebar Grade:
Verify the grade and visual conformity of the rebar with acceptable quality standards and the approved plans and specifications.

- 3.2 Rebar Condition:
Verify that rebar is free of oil, dirt, mud, excessive rust and free from damage in shipment to the job site, or on the job site.
- 3.3 Rebar Tying and Bracing:
Verify that rebar is adequately tied, chaired, and supported to prevent displacement during concrete placement.
- 3.4 Reinforcing Steel Ties and Supports:
Verify that reinforcing steel ties and supports are adequately tied, and supported to prevent displacement during concrete placement, and are adequate for the intended stresses.
- 3.5 Rebar Clearance:
Verify the minimum and maximum clear distances between bars and minimum structural distance to the outside of concrete. The structural drawings should provide a list of required clearances.
- 3.6 Concrete Cover over Rebar:
Verify minimum concrete cover is maintained between rebar and the surface of the concrete and the clearance of the rebar to dirt or forms.
- 3.7 Rebar Placement:
Verify the size and placement of the rebar is as detailed in the approved plans and specifications.
- 3.8 Rebar Laps and Bends:
Verify bar laps for proper length, stagger and bar bends for minimum diameter, slope and length.
- 3.9 Rebar Welding:
Verify that the welding of rebar is approved by the Building Official, and is properly inspected.
- 3.10 Reinforcing Steel Anchorage:
Verify location, size and placement of reinforcing steel anchorage as detailed in the approved plans and specifications.
- 4. CONCRETE FORMWORK AND EMBEDDED ITEMS
- 4.1 Concrete Construction Joints:
Verify proper preparation of construction joint surfaces, spacing and type(s) as specified in the approved plans and specifications.
- 4.2 Formwork Construction:
Verify that the formwork is tight to prevent leakage and that it will result in a final structure with correct shape and member size. Verify that the formwork is adequately braced, tied and supported to prevent collapse.
- 4.3 Embedded Items:
Verify that embedded items are properly sized and placed as detailed in the approved plans and specifications.
- 5. CONCRETE PREPARATION AND PLACEMENT
- 5.1 Concrete Base Preparation:
Verify the acceptable general condition of the concrete base prior to placement. Is it free from dirt, sawdust and debris?
- 5.2 Prepour Base Moisture:
Verify that the base is properly wetted and standing water is removed before concrete is placed.
- 5.3 Concrete Placement:
Verify that conveyance and depositing avoids segregation due to excessive falling, rehandling or flowing, and maintain proper joint construction.

- 5.4 Concrete Consolidation:
Verify that concrete is properly consolidated with a mechanical vibrator. Too little vibration will produce rock pockets, or voids, too much will produce excessive settlement of the aggregates and produce a mass that is not homogenous.
- 5.5 Concrete Curing:
Verify the specified methods and procedures for the proper curing of the concrete.
6. SAMPLES AND TESTS
When specified on the drawings, and as required by the Building Code, Continuous Special Inspection may be required. When required, the Special Inspector will conduct all of the above, and provide for concrete specimen testing, as follows:
- 6.1 Test Type:
Determine the type and number of concrete, and reinforcing steel tests that are required.
- 6.2 Test Samples:
Take the proper number of samples of fresh concrete, and reinforcing steel in accordance with the requirements of the specifications, the UBC and ASTM Standards applicable for the tests.
- 6.3 Slump Tests:
Perform the consistency (slump) tests in accordance with the requirements of the specifications, the UBC and ASTM Standards applicable for the tests.
- 6.4 Specimens' Preparation:
Prepare the test specimens (cylinders, flex beams or shrinkage bars), in accordance with the requirements of the specifications, the UBC and ASTM Standards applicable for the tests.
- 6.5 Hardened Concrete Test Samples:
Witness the removal of test samples and perform other test procedures on hardened concrete.
- 6.6 Air Tests:
Perform air content tests for air-entrained concrete, in accordance with the requirements of the specifications, the UBC and ASTM Standards applicable for the tests.
- 6.7 Specimen Handling and Protection:
 - Using a permanent broad tip marker pen, mark all specimen lids with the following:
 - Name and Address of Project.
 - Date of sampling.
 - Mix design number.
 - 28 day ultimate design strength.
 - Set or load number (if needed).
Properly handle and place the specimens in an insulated storage box (usually furnished by the General Contractor), after preparation. Arrange for transportation of the specimens by the testing laboratory.
- 6.8 Document Tests:
Report tests performed by accurately completing the "Field Data Sheet for Test Specimens". Log the air and concrete temperatures on the data sheet. Attach the original to the specimens within a plastic packing slip envelope for the testing laboratory record. Copy the Project Superintendent.
7. CONCRETE PROTECTION
- 7.1 Protection:
Verify that appropriate hot-weather and cold-weather measures are taken for the protection of the concrete, and that proper curing of the concrete will be provided for.

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