

CASE Guide to Special Inspections and Quality Assurance

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Part Two

Commentary on the IBC Chapter 17

The *International Building Code* (IBC) was first published in 2000. The code merged provisions from the three model building codes that preceded it, the *BOCA National Building Code* (BOCA), the *ICBO Uniform Building Code* (UBC) and the *SBCCI Standard Building Code* (SBC). The BOCA and UBC codes each contained chapters on Special Inspections and Structural Testing, but their philosophy and focus was slightly different. The SBC did not contain any requirements for Special Inspections. The BOCA and UBC provisions for Special Inspections and Structural Testing were merged into Chapter 17 of the IBC. The second edition of the IBC was published in 2003 and contained very minor revisions to Chapter 17. The comments contained in this article apply to both the IBC 2000 and the IBC 2003.

Periodic vs. Continuous Inspection

The IBC specifies the frequency of each inspection task as either periodic or continuous. The BOCA and UBC codes left the determination of the frequency of testing up to the Registered Design Professional that specified the Special Inspection program.

When continuous inspection is required, 100% of the work must be inspected and it must be inspected as the work is being performed.

When periodic inspection is indicated, inspection of less than 100% of the work may be acceptable. The Registered Design Professional, when preparing the *Statement of Special Inspections*, should indicate the frequency of inspection that is required. The frequency of inspection varies depending on the size and complexity of the project.

Special Inspections Exemptions

Special Inspections are required for most engineered building projects. Special Inspections are required unless one of the following three exceptions apply to the project:

1. The Building Official may waive the requirements for Special Inspections if he or she deems that the work is of a minor nature or if the local Building Department has the resources to provide comparable inspections with its own staff.
2. If the size and use of the building is such that local state statutes and regulations do not require a Registered Design Professional for the project, the project is exempt from the Special Inspection requirements.
3. Special Inspections are not required for one and two family residences (Use Group R-3) or utility buildings such as garages or barns that are accessory to a residence.

Shop Inspections

Where structural elements or assemblies are fabricated off site, such as structural steel, pre-engineered metal buildings, precast concrete or prefabricated wood trusses, inspections must be performed in the fabricator's shop. The code requires that the Special Inspector review the fabricator's quality control procedures. There is no mention of inspecting the structural elements being fabricated.

While there is no question that a fabricator should have a quality control program, review of the program by the Special Inspector seldom results in a benefit to the project. If an inspector finds that a particular fabricator does not have an acceptable quality control program, he cannot reject the fabricator's work unless the work itself is found to be defective. The emphasis of shop inspections should be on inspecting the quality of the fabricator's work rather than his means and methods of operation.

A fabricator may be exempt from shop inspections when approved by the Building Official. The basis for such approval varies across the country. In the Northeast, it is customary to exempt fabricators that are certified by industry organizations such as the American Institute of Steel Construction (AISC) or the Precast Concrete Institute (PCI). On the West coast, it is more common for local Building Officials to maintain a list of local fabricators that they have approved. The approval is sometimes based on an ICC or ICBO Evaluation Service Report on the fabricator.

When a fabricator has been approved, it is common practice for no inspections to be performed in the shop. In some areas, an approved fabricator is deemed to be exempt only from having the Special Inspector review the quality control procedures. The actual work being fabricated is still inspected.

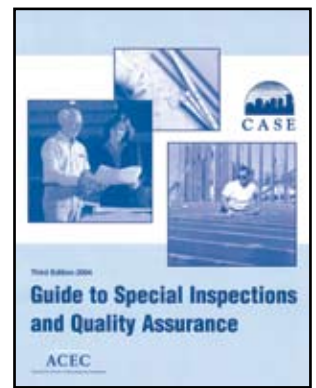
Approved fabricators are required to submit a *Fabricator's Certificate of Compliance* at the completion of fabrication.

Structural Steel Inspection

The requirements for Special Inspection of steel construction focus on structural steel. Inspection of light-gage metal framing is only required when members are connected by welding.

Welding inspection is emphasized. The code is very specific about what types of welds require continuous visual inspection (such as groove welds and multi-pass fillet welds). While there is no specific mention of non-destructive weld testing in the code, it is customary to ultrasonic test full penetration groove welds in moment connections and column splices.

When composite construction is used, welding of shear connectors must be inspected. Ring testing is commonly used to check shear connector welding. There is no ASTM standard for ring testing. Each shear connector is struck with a 3 pound hammer. If the hammer makes a ringing sound, the weld is deemed to be sound. If there is a dull thud rather than a ring, or if the shear connector breaks off when struck by the hammer, the shear connector is rejected.



Inspection is required of high-strength bolt installation and tightening. Continuous inspection is required of slip-critical connections, or where bolts are tightened by the calibrated wrench method or by the turn-of-nut method without matchmarking.

The Special Inspector is required to review mill certificates for rolled shapes, welding electrodes, high-strength bolts, nuts and washers. Material markings must also be inspected. While bolts and welding electrodes have clearly visible markings, rolled shapes often do not. Rolling mills will paint identification markings on steel shapes, but they are often cut off or obliterated prior to or during fabrication.

After structural steel erection has been completed, the details of the steel frame must be inspected for compliance with the construction documents. This inspection is usually best performed by the SER



Concrete Inspection

The requirements for Special Inspection of concrete construction cover both cast-in-place and precast concrete. Most foundation concrete for low rise buildings, including footings, frost walls and slabs on grade are exempt from Special Inspections. Inspection and testing is required for all other concrete, including slabs on metal deck.

Reinforcing steel must be inspected prior to concrete placement. Not only should the size, spacing and position of reinforcing be verified, but the inspector should also confirm that the surface of the reinforcing steel is free of form release oil or other deleterious substances.

The inspector is required to verify that the concrete proportioning is consistent with the approved mix design. This is best accomplished by reviewing the batch tickets for each truck.

Anchor rod installation must be inspected to verify the correct size and embedment. The inspector is not expected to verify the precise location of anchor rods, but he should verify that the contractor has taken appropriate steps to correctly position them, such as engaging a surveyor or setting up a system of string lines and batter boards.

Field testing of concrete is required, including casting compression test cylinders and testing slump, air-content and temperature. Cylinders must be properly handled and stored on site until transported to the testing laboratory. In cold weather a heated curing box is often needed to store test cylinders. Continuous testing is required during concrete placement. This means that the testing technician must remain at the site for the duration of concrete placement. It is common practice for a testing technician to remain at the site only long enough to cast a set of cylinders and perform a set of tests. This does not constitute continuous testing.

Continuous inspection is required during concrete placement to verify that proper procedures are being followed for transporting, placing, consolidating and finishing of concrete. It is common practice for placement inspections to be performed by the same technician that is performing the field testing. It is often not possible to perform a proper placement inspection from the location where testing is performed (usually near the concrete trucks and pump). The inspector needs to be near where the concrete is being placed rather than near where concrete trucks are discharging their loads. When the finish on a floor slab is critical, the inspector needs to be present while the slab is being floated and power troweled. This is often several hours after the actual placement is completed.

Concrete curing and protection procedures must be inspected. This is particularly important during extreme cold or hot weather.

There are no requirements in the IBC for concrete formwork inspection or concrete batching plant inspection. The BOCA National Building Code had previously required Special Inspection of these items.

Masonry Inspection

The code defines two levels of inspection for masonry. Level 2 inspections are required for "engineered masonry" (not empirically designed) in essential facilities (hospitals, police stations, firehouses, etc.). All other masonry is subject to Level 1 inspections. The inspection tasks are similar for Level 1 and Level 2 inspections. For Level 2 inspections, more items are identified as continuous rather than periodic inspections.

Inspections are required during the installation of masonry units to verify proper mixing of mortar and proper technique for laying of masonry units. Mortar joints need to properly filled and tooled. Cold weather and hot weather protection procedures must also be inspected.

Inspection of reinforcing steel placement, masonry anchors and ties is crucial. Continuous inspection is required of grouting operations.

The emphasis of the masonry Special Inspection requirements is on structural details. Equally important, although not required by the code, is inspection of the non-structural masonry details such as flashings, cavity wall construction and control joints.

Wood Framing Inspection

The Special Inspection requirements for wood frame construction are very brief.

Shop inspection is required of fabricated wood elements such as wood trusses, but there are no requirements for inspection of the installation of those same trusses in the field. Most construction quality problems occur during handling, erection, bracing and modification of wood trusses in the field.

Inspections are required of high-load diaphragms such as plywood shearwalls and floor diaphragms needed to resist wind or seismic loads.

Soils and Foundations

Special Inspections are required of controlled fill installation. The subgrade must be inspected to verify that all unsuitable material has been removed prior to placement of controlled fill. Each lift of fill must be inspected and tested for proper density.

There are no requirements for the inspection of the soil below footings, even though this is often the most important inspection of foundation construction.

Deep foundations such as driven piles and drilled piers require inspection during installation.

Spray Fireproofing Inspection

The inspector must be present during the application of sprayed fire-resistant materials to structural steel construction. The inspector must verify that surfaces have been properly prepared to receive fireproofing. Structural steel shapes must be free of paint or other materials that could impair bond. If steel has been painted, a bond coat must be applied over the paint or wire lath secured to the steel. Metal deck surfaces

continued on next page



need to be solvent cleaned to remove oil left on the surface after galvanizing operations.

The inspector must verify that the fireproofing is properly applied and that the flutes of the metal deck are completely filled over beams. During cold weather, precautions must be taken to allow proper curing conditions and to prevent the material from freezing. Adequate ventilation is required during curing, to allow moisture to be removed from the air and to prevent mold growth in the fireproofing.

The thickness of the fireproofing material must be tested. Since the required fireproofing thickness varies depending on the size of a steel beam or column, the inspector needs to have a copy of the approved thickness schedule in order to perform the testing. The code requires that not less than one thickness test be performed for every 1,000 square-feet of floor or roof assemblies and on not less than 25% of

the beams and columns that require a fire rating. Each test is actually the average of several thickness measurements taken on a specific pattern. This frequency of testing is considerably more intense than the frequency of testing that is customary.

Quality Assurance for Seismic and Wind

The most confusing provisions in Chapter 17 are those pertaining to Quality Assurance for seismic resistance and wind requirements.

If a project is located on a site with a high predicted wind speed or a high seismic design category, a Quality Assurance Plan is required.

Each contractor and sub-contractor that is responsible for constructing a building element or assembly included in the Quality Assurance Plan must submit a Contractor's Statement of Responsibility.

The provisions for Quality Assurance do not actually require any additional inspection or testing. They merely require additional paperwork on the part of the RDP and contractor.

Special Inspections and Testing for Seismic Resistance

There are considerable specific inspections and tests required for projects with a high seismic design category. Many of the building elements requiring inspection are non-structural such as storage racks, emergency power conduits, etc... Non-structural systems requiring inspection are referred to as "designated seismic systems" while structural systems are referred to as "seismic force resisting systems."

Structural Observation

The code has provisions for mandatory structural observation on large projects. It is customary for the SER to perform structural observation as part of basic services on most projects. Since on certain occasions these services are not performed, the code has made them mandatory for large projects. It is strongly recommended that structural observation services be performed on all projects, whether or not required by the Building Code.■

This article is a condensed and abridged version of the *CASE Guide to Special Inspections and Quality Assurance*. The full text including standard forms for conducting a Special Inspections program can be downloaded from the CASE website www.acec.org/case

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