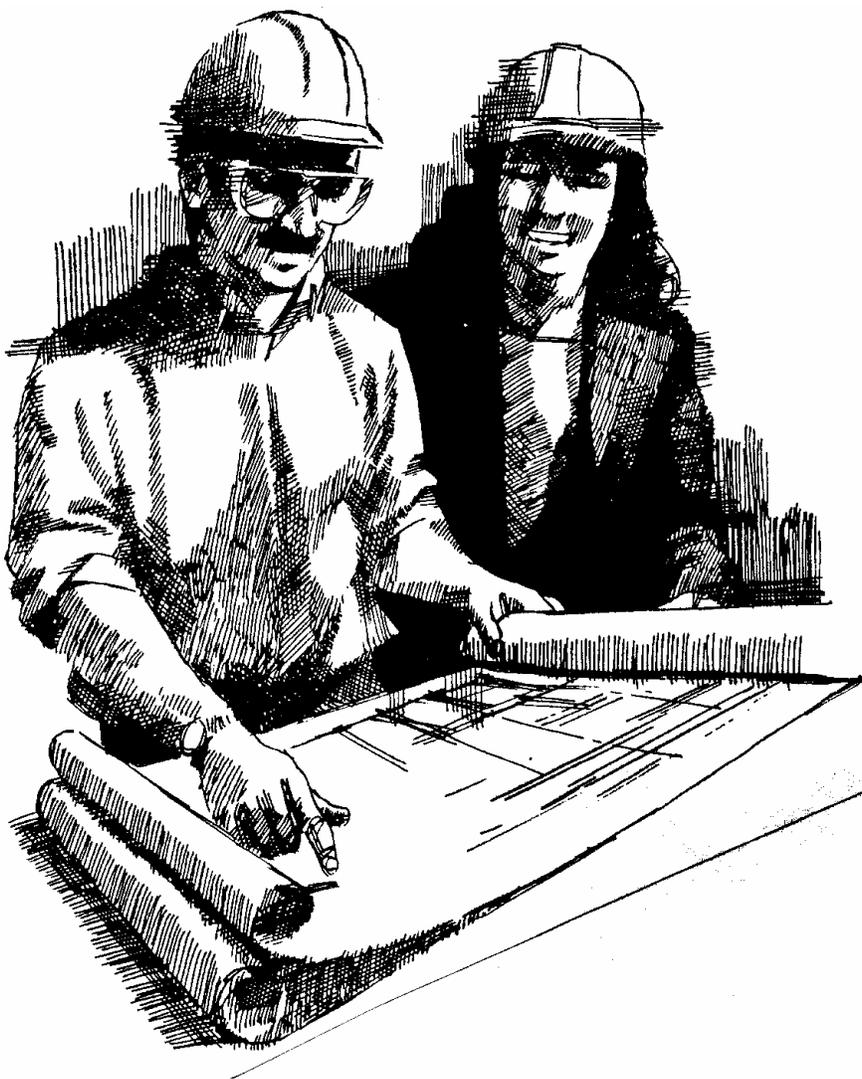


Guide to Special Inspections and Quality Assurance

Third Edition 2004



Position Statement

The interests of the public, clients, and the AE community are best served when materials and workmanship critical to the structural integrity of structures are monitored through the Special Inspections process by the Structural Engineer of Record (SER). The extensive on-site presence of the SER through the Special Inspections process is the best means to protect the public, control claims and losses, and improve quality of the completed project.

The SER is the only member of the design team with the expertise and intimate knowledge of a particular building's Structural System and, therefore, is the best qualified to recognize and respond to site conditions that require the application of structural engineering judgment.

As the Special Inspector, the SER is able to communicate required corrections or Owner-directed changes before they are built into the structure, provide prompt responses to contractor's field questions, expedite corrective measures to address contractor errors, help build and maintain team communication and working relationships with the contractor, and minimize misinterpretation of the structural design intent.

The SER should serve as the Special Inspector wherever possible and practical.

(Adopted by the CASE Executive Committee at its meeting February 4, 1995).

Guide to Special Inspections and Quality Assurance

Third Edition 2004

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Preface to the Third Edition

The First Edition, titled *National Practice Guideline for Special Inspections*, was produced by the *CASE National Practice Guidelines Committee* in 1996. This document was one in a family of National Practice Guidelines covering various aspects of structural engineering services. The intent of the guidelines was to facilitate a more uniform practice within the profession.

The Second Edition, published in 2001 was an update of the First Edition in response to changes in Building Code requirements for Special Inspections.

The Third Edition is re-titled *Guide to Special Inspections and Quality Assurance* to address provisions of the *2003 International Building Code (IBC)*. Although some of the terminology differs in the *NFPA 5000 Code*, the concepts expressed in this guideline generally apply.

Acknowledgement

This edition has been produced by the CASE Special Inspections Committee with assistance from the Connecticut Structural Engineers Coalition– Special Inspections Committee and CASE-Minnesota. CASE acknowledges the contribution of the following individuals involved with the Connecticut Structural Engineers Coalition – Special Inspections Committee to the preparation of this document:

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Background

Following the 1981 collapse of the Hyatt Regency walkway in Kansas City, the U.S. House of Representatives Subcommittee on Investigations and Oversight, chaired by Albert Gore, Jr., held investigative hearings to examine the causes of structural failures. The Committee on Science and Technology's report titled *Structural Failures in Public Facilities, House Report 98-621*, was presented to the 98th Congress.



The central issue addressed by the Subcommittee was: *"Are there common problems associated with structural failures, the elimination of which would decrease the number of failures?"* The Subcommittee identified over twenty contributing factors, with two of the most critical being:

- The need for improved organization on construction projects and better communication between participants.
- The need for construction inspection by the Structural Engineer of Record (SER) during the construction of principal structural components.

The Subcommittee found that *"For a variety of reasons, the structural engineer of record or his designee is often not present on the job site during the construction of principal structural components. The absence of the structural engineer has permitted flaws and changes on site to go unnoticed and uncorrected."* The Subcommittee recommended that *"Professional organizations, such as the Building Officials and Code Administrators International, the International Conference of Building Officials, and the Southern Building Code Conference International, should make every effort to ensure that provisions are written into building codes and adopted in public forum which make the on-site presence of the structural engineer mandatory during the construction of structural components on public facilities."*

Photo above: 1987 collapse of L'Ambiance Plaza, Bridgeport, CT

Introduction

Building Code requirements for inspection and testing are not a new idea. Provisions for inspection of structural components were contained in the first edition of the *Uniform Building Code (UBC)* printed in 1927. The term “Special Inspections” first appeared in the 1961 edition of the *UBC*. The *National Building Code (BOCA)* first introduced Special Inspection requirements in 1988.

The *International Building Code (IBC)*, first published in 2000, merged the UBC and BOCA Special Inspection provisions into Chapter 17. Since the UBC and BOCA codes had somewhat different philosophies concerning inspection and testing, Chapter 17 of the 2000 and 2003 IBC contains some inconsistencies which are highlighted in the Commentary section of this document.

The 2003 *NFPA Building Construction and Safety Code (NFPA 5000)* also contains provisions for inspection and testing. NFPA chose to use the term “Quality Assurance” in lieu of “Special Inspections” to avoid confusion with the IBC provisions. The Quality Assurance requirements are contained in Chapter 40 of the NFPA 5000.

The authority to enforce the provisions contained in the Building Code rests with the local Building Official. Since a Building Official cannot be expected to be an expert in all of the technical building systems contained in a modern structure, Special Inspectors are needed who have “special” expertise to inspect critical building components. Special Inspectors report to the Building Official, but are engaged by the building Owner or Owner’s agent.



Initially, Special Inspection requirements were limited to structural components and the emphasis was on structural safety. Testing and inspection agencies often performed the required tests and inspections. However, in many jurisdictions, the Structural Engineer of Record (SER) served as a Special Inspector and performed many of the required inspections.

This philosophy has changed gradually. The 1996 BOCA code first introduced requirements for Special Inspection of non-structural building components. Spray fireproofing systems and EIFS systems were added to the list of building components subject to Special Inspections. With the IBC code, this list has grown and now includes mechanical and electrical systems such as smoke control systems and

seismic restraint of emergency power conduits. In addition to the SER and structural testing/inspection agencies, there is now a role for the Architect, Geotechnical Engineer, Mechanical Engineer, Electrical Engineer and other design professionals in the Special Inspection process.

Projects subjected to a well executed Special Inspection program with qualified inspectors should experience a significant improvement in the quality of construction. Construction deficiencies can be identified and corrected before they become costly or dangerous problems. This is especially true when the SER serves as the Special Inspector.



A poorly executed Special Inspection program with unqualified inspectors could be worse than having no special inspections at all, especially if reports are distributed indicating that all of the work is in compliance with the Contract Documents. In this case, the Building Official and project team members would be left with a false sense of security.

Roles and Responsibilities

The Code requires special inspection potentially involving structural, civil/site, mechanical/electrical/plumbing, and architectural design disciplines. A special inspections program can be prepared and implemented in various ways and still achieve the Code intent. Common approaches include:

1. Within a given design discipline (eg. structural), assigning separate special inspectors or testing agencies to different construction materials or processes without a coordinator managing the program within that given design discipline. Each inspector or agency is retained individually by the Owner (or Owner's agent) and is independently responsible for their specific portions of the program.
2. Assigning one overall special inspector/coordinator to manage the project's entire special inspection program, involving all design disciplines.
3. Assigning a separate special inspector coordinator for each design discipline to manage the inspection and testing efforts within the given discipline.

CASE believes that the third approach is generally the most practical for most building projects. Therefore, this Guideline focuses on having a single entity coordinate the Structural Inspection and

Testing Program and anticipates that other entities will be involved in the non-structural aspects.

This Guideline does not discuss the requirements for non-structural tests and inspections in significant detail. However, the *Statement of Special Inspections*, contained in the Appendix, is set up to facilitate having the project's entire special inspection program under a single document, should the project's RDP's desire this approach.

Special Inspection Coordinator

The **Special Inspector (SI)**, also referred to in this Guideline as the **Special Inspection Coordinator** is the individual or firm responsible for managing and coordinating the inspection and testing program. The SI will often perform many of the required inspections and tests. The SI is responsible for collecting reports from inspection and testing agencies. The SI submits interim reports to the Building Official and to the appropriate Registered Design Professional. At the conclusion of the construction, the SI is required to submit a *Final Report of Special Inspections* certifying that all of the required inspections and tests have been completed and that all identified deficiencies have been corrected or resolved.

The SI has no control over the Contractor's means and methods of construction and does not have the authority to stop the work. The SI's role is to verify construction compliance with the Contract Documents, as supplemented with shop drawings or other submittals. The contractor must be notified of any deficiencies identified so that corrective action can be taken. The SI should defer to the Registered Design Professional in Responsible Charge for the requirements of remedial work to correct deficiencies.

The SI is not responsible for construction site safety and is not required to inspect the work for compliance with OSHA regulations.

The SI serves as an agent of the Owner, but is responsible to and submits reports to the Building Official. It is recommended that the Registered Design Professional, Prime Design Professional, Contractor and Owner also receive copies of the reports.

It is imperative that the SI not have a conflict of interest. Therefore, the Code requires the SI to be engaged and paid by the Owner, or the Owner's agent and not be engaged by the Contractor.



Structural Engineer of Record

The **Structural Engineer of Record (SER)** is the Registered Design Professional in Responsible Charge of the structural system. The SER is responsible for preparing the *Statement of Special Inspections* (SSI) for the structural elements subject to inspection and testing.

The SER should review inspection and testing reports pertaining to the structural system and take appropriate actions when deficiencies are identified.

The SER will often serve as the Special Inspection Coordinator and perform many of the structural inspections. Special Inspection services are not a part of the SER's basic construction phase services such as shop drawing review and structural observation. Special Inspection services should generally be performed under a separate contract directly with the building Owner. Refer to CASE's standard contract for further assistance.

Architect of Record

The **Architect of Record** is the Registered Design Professional in Responsible Charge of the architectural building elements and is often the Prime Design Professional for "typical" building projects. The Architect is responsible for preparing a *Statement of Special Inspections* (SSI) for the architectural components such as EIFS systems or veneers.

The Architect, when serving as the Prime Design Professional, must inform the building owner of the Special Inspection requirements and assist the Owner in engaging one or more qualified Special Inspectors, inspectors and testing agencies.

The Prime Design Professional is responsible for confirming that each Registered Design Professional prepares a SSI for their individual building systems.

Mechanical / Electrical / Plumbing Engineer of Record

The **Mechanical / Electrical / Plumbing Engineers of Record (MEP)** are the Registered Design Professionals in Responsible Charge of the HVAC systems, electrical systems, fire protection systems and plumbing systems. The MEP's are responsible for preparing their own portions of the *Statement of Special Inspections* (SSI) for the MEP systems such as smoke control systems, emergency power systems or piping containing hazardous materials.

Building Official

The **Building Official (BO)**, also referred to as the **Authority Having Jurisdiction (AHJ)** is the individual responsible for enforcing the Building Code.

The Code requires the permit applicant to submit a *Statement of Special Inspections* (SSI) prior to issuance of a Building Permit. The BO should review the SSI and verify that all mandated inspections and tests are included, verify that the Special Inspector as well as the inspection and testing agencies are qualified to perform their roles, and review the qualifications of fabricators seeking exemption from shop inspections as allowed by the Code.

The BO should review inspection and testing reports and take appropriate actions if identified deficiencies are not corrected.

Prior to issuance of a Certificate of Occupancy, the Code requires the Special Inspector to submit a *Final Report of Special Inspections* to the BO.

Contractor

The **Contractor**, either a General Contractor (GC), Design-Builder (DB), or Construction Manager (CM), is responsible for the construction of the building, including coordination and direction of all subcontractors, fabricators and material suppliers. The contractual responsibility of a Construction Manager (CM) can vary widely, therefore it is important to define the CM's role and responsibility relative to special inspection. The Contractor is responsible for completing the construction work in compliance with the Contract Documents and the Building Code. The Special Inspection and Quality Assurance program does not relieve the Contractor of his or her responsibility to perform Quality Control.



The Contractor is responsible for means and methods of construction as well as for construction site safety.

The Contractor is responsible for scheduling inspections and tests. Sufficient notice and lead time must be allowed for the inspection and testing to be performed without impeding the construction operations.

The Contractor must cooperate with the inspection and testing agencies. Safe access must be provided to allow inspections and tests to be performed. This may require the Contractor to provide scaffolding, ladders, or lifts.

When deficiencies are identified, the Contractor must take corrective actions to comply with the contract documents or remedy the deficiencies as directed by the Registered Design Professional.

The Contractor is responsible for testing services that are required for material submittals and are not part of the Special Inspection program, such as aggregate tests, concrete mix designs, testing of controlled fill materials, etc.

Inspector

Inspectors are firms or individuals responsible for performing specific inspections as part of the Special Inspection program. Each Inspector reports to the Special Inspection Coordinator. They may be engaged by the Special Inspection Coordinator, by the Owner or by the Owner's agent.

At the completion of the required inspections, the Inspector submits an *Agent's Final Report of Special Inspections* to the Special Inspection Coordinator.

Testing Agency

Testing Agencies are firms responsible for performing specific tests as part of the Special Inspection program. Each Testing Agency reports to the Special Inspection Coordinator. They may be engaged by the Special Inspection Coordinator, by the Owner or by the Owner's agent.

At the completion of the required testing, the Testing Agency submits an *Agent's Final Report of Special Inspections* to the Special Inspection Coordinator.

Owner

The **Owner** is responsible for engaging the Special Inspection Coordinator, Inspectors, and Testing Agencies. The Owner is responsible for the cost of the inspection and testing program.

Preparing the Plan

The Code requires the program of inspection and testing for a project to be prepared by the Registered Design Professional (RDP) in responsible charge of the building system requiring inspections and testing. The Structural Engineer of Record (SER) should determine what level of inspection and testing is required for the structural elements such as foundations, concrete, structural steel, etc.. The Architect and MEP engineers must prepare aspects of the inspection and testing program for the building systems for which they have responsibility.

In some circumstances there may be more than one RDP responsible for different portions of the structural system. For instance, a pre-engineered metal building will often have a SER for the foundations and a different SER for the superstructure. Each SER should prepare an inspection and testing program for their portions of the structure.

The inspection and testing program for soils and foundations such as controlled fill placement or deep foundations should generally be prepared by the SER. In some circumstances, the SER may delegate the inspection and testing program for these items to a geotechnical or civil engineer.

The Code requires a *Statement of Special Inspections* (SSI) to be submitted to the Building Official (BO) along with the application for Building Permit. The SSI is a form that indicates specific inspection and testing to be performed, specific firms to perform them, and the qualifications of the individual inspectors and testing technicians.



Each RDP is responsible for preparing a SSI. This will result in multiple SSI forms being submitted to the Building Official. In some cases, the inspection and testing program for all of the disciplines may be merged into a single SSI.

In preparing the program, the RDP must use judgement to determine the appropriate level of inspection and testing for the project. Complex projects will require more intense inspections than simple projects. The Building Code mandates a minimum level of inspection and testing. In addition to complying with code mandated requirements, the RDP will often require additional inspections or tests that are appropriate for the specific projects. These are referred to as discretionary inspections or tests.

The RDP should evaluate the credentials of the firms that will be engaged to perform the inspections and testing to confirm that they are qualified and do not have a conflict of interest. The RDP must also specify the specific qualifications or certifications required of the individual inspectors or testing technicians.

The Building Official is required to review and approve the SSI prior to issuing a Building Permit.

The RDP should also include a summary of the inspection and testing program in the Contract Documents. Prior to bidding, the Contractor should be informed of his responsibilities and the level of inspection and testing that the work will be subjected to. Therefore, the SSI is often included in the Project Manual along with the technical specifications and general conditions.

Refer to the Appendix for a sample Statement of Special Inspections to be used as a starting point in developing a Special Inspection program tailored to the needs of each specific project.

Qualifications

In preparing the SSI, the RDP should specify the required credentials for the individuals performing specific inspections or tests. These requirements will vary depending on the complexity of the project. The following is a discussion of some of the credentials and certifications that should be considered.

Engineering licensure: Engineering education and experience is a valuable prerequisite for performing inspections that require judgment in interpreting the Construction Documents and determining if the work conforms with their intent.

Professional Engineering (PE) registration with a specialty in Structural Engineering or Geotechnical Engineering is a commonly specified credential for the inspection of critical structural and foundation elements.

Engineer-in-Training (EIT) registration can be specified for inspections that can be performed by an engineer who has not yet attained PE licensure, generally under the supervision of a PE.

American Concrete Institute (ACI): There are several certification programs for concrete testing technicians and inspectors.

Concrete Field Testing Technician – Grade 1 is a certification for technicians who perform the field tests of concrete. The tests include concrete sampling, casting compression test cylinders, testing temperature, slump, air-content and unit weight.



Concrete Construction Inspector is a certification for inspectors who inspect reinforcing steel placement, concrete placement, batching, curing and protection.

Laboratory Testing Technician – Grade 1 or 2 and *Strength Testing Technician* are certifications for laboratory testing technicians.

American Welding Society (AWS): Certification programs include the inspection of welding and structural steel.

Certified Welding Inspector (CWI) is a certification for technicians performing visual inspection of welds.

Certified Structural Steel Inspector is a new certification program that is a joint effort of AWS and AISC.

American Society of Non-Destructive Testing (ASNT):

Non-Destructive Testing Technician – Level II or III is a certification for technicians performing non-destructive testing of welds such as ultrasonic testing.

International Code Council (ICC): Originally an ICBO certification program for Special Inspectors, the program includes the following certifications:

Structural Masonry Special Inspector

Structural Steel and Welding Special Inspector

Spray-Applied Fireproofing Special Inspector

Prestressed Concrete Special Inspector

Reinforced Concrete Special Inspector

National Institute for Certification in Engineering Technologies (NICET): Certification programs are oriented towards the testing of materials for highway and transportation structures. Each certification has four levels.

Concrete Technician – Levels I, II, III and IV

Soils Technician – Levels I, II, III and IV

Geotechnical Engineering Technician – Levels I, II, III and IV

Exterior Design Institute (EDI):

EIFS Third Party Inspector certification covers forensic and construction inspection of Exterior Insulation and Finish Systems.



Conflicts of Interest

It is still common practice in some areas for the Contractor to hire an inspector and testing agency to perform special inspections and structural testing. This practice is not in the public interest and constitutes a conflict of interest.

The Code requires inspectors and testing agencies to be engaged by the Owner or the Owner's agent and not by the Contractor. This clearly avoids the conflict of interest on a traditional Design-Bid-Build project. There are some projects where the Owner is also the Contractor and a potential conflict of interest may be unavoidable.

Inspectors and testing agencies are required to disclose to the Building Official any potential conflicts of interest. Even if an inspector is hired directly by the Owner for a particular project, that same inspector could be working for the project's Contractor on a different project. This represents a potential conflict of interest and should be disclosed.

There is a misconception that has been expressed by a few individuals that it is a conflict of interest for the SER to serve as the Special Inspector. This is unfounded and contrary to the recommendations given by the U.S. House Subcommittee as previously noted. The role of the Special Inspector is to verify that the construction is in compliance with the Construction Documents and this goal is supremely consistent with the interests of the SER, as well as the Owner and the public.

Conducting the Program

Prior to the start of construction, it is advisable to have a pre-construction conference to discuss the inspection and testing program and to make sure that all of the participants understand their roles and responsibilities. The conference should be attended by the Special Inspection Coordinator, Registered Design Professional, Contractor, Subcontractors, Inspectors and Testing Agencies.

The Contractor is required to schedule inspections and tests and give ample advance notice to the Inspectors and Testing Agencies so that the work will not be delayed.

If a deficiency is identified during an inspection, or if a test fails, the Contractor should be immediately notified so that corrective steps can be taken promptly. It is not the role of the inspector to direct the Contractor as to what remedial work is required to correct a deficiency. That is the responsibility of the Registered Design Professional.

The Inspectors and Testing Agencies should prepare reports that document each inspection or test and clearly identify the work that was inspected or tested, any deficiencies that were identified and their resolution. The inspection and testing reports must be submitted to the Special Inspection Coordinator in a timely manner.

The Special Inspection Coordinator collects and reviews the inspection and testing reports. The Special Inspection Coordinator distributes Interim Reports to the Building Official and Registered Design Professional. It is advisable to also distribute Interim Reports to the Contractor and Owner. Interim Reports include all of the individual inspection and testing reports along with a summary. The frequency of Interim Reports (usually weekly) is subject to the approval of the Building Official.

After all of the required inspections and tests have been performed, each Inspector and Testing Agency should submit an *Agent's Final Report of Special Inspections* to the Special Inspections Coordinator. The Special Inspection Coordinator should then submit a *Final Report of Special Inspections* certifying that all of the required inspections and tests have been completed and that all identified deficiencies have been corrected or resolved.

Refer to Appendix for sample *Statement of Special Inspections*, *Final Report of Special Inspections*, *Contractor's Statement of Responsibility*, and *Fabricator's Certification of Compliance* forms.

Contracts and Fees

The Special Inspector should contract for services directly with the Owner or the Owner's agent. The other Inspectors and Testing Agencies may also contract directly with the Owner, or they may be engaged by the Special Inspector.

When the SER or other Registered Design Professional serves as the Special Inspector, it is important that they distinguish the Special Inspection services from their Basic Services. When a site visit for structural observation is performed, it should be clearly identified as such on the field report so as not to be confused with a Special Inspection.

It is strongly recommended that fees for Special Inspection services be established on an hourly rate basis. The Owner may request that the Special Inspector estimate the total fee for services, but such estimate should not be a "not to exceed" or "lump sum" amount. The Special Inspector does not have control over the Contractor's scheduling or the quality of workmanship. These factors can have a dramatic effect on the amount of time that is required to properly perform the Special Inspections and Structural Testing.

Under certain circumstances it may be appropriate to back-charge the Contractor for some of the inspection and testing costs as follows:

- When work must be re-inspected or re-tested due to the Contractor's work failing to meet the requirements of the Contract Documents.
- When work must be re-inspected or re-tested due to the work not being completed at the time the Contractor scheduled an inspection or test.
- When excessive travel expenses are incurred to perform inspection or testing of work performed at a fabricator's shop that is geographically remote from the project site.

The Contract Documents should clearly delineate the circumstances under which the Contractor could be back-charged. In any event, all inspection and testing costs should be billed to the Owner who is responsible for back-charging the Contractor.

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 commentary generally apply to both the IBC 2000 and the IBC 2003. Note that CASE and NCSEA have reviewed and submitted needed revisions to the IBC 2006. However, the final IBC 2006 language was not determined at the date of this Guideline's publication.

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.

Continuous Special Inspection has been defined as *“The full-time observation of work requiring special inspection by an approved special inspector who is present in the area where the work is being performed.”*

Periodic Special Inspection has been defined as *“The part-time or intermittent observation of work requiring special inspection by an approved special inspector who is present in the area where the work has been or is being performed and at the completion of the work.”*

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 for certain items. 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 are required to be performed in the fabricator's shop. The code requires that the Special Inspector review the fabricator's quality control procedures. The Code does not specifically state that inspection of the structural elements being fabricated is required, however this is generally understood as the intent.

While there is no question that a fabricator should have a quality control program, review of the program by the Special Inspector probably provides only minimal 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 and Midwest, 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 jurisdictions, 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. See Appendix D for a standard form that can be used for obtaining this certification.

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.

Steel shop inspections are not required when “*the fabricator does not perform any welding, thermal cutting or heating operations of any kind ...*”. Since it is very unusual for steel to be fabricated without some flame cutting, this exemption rarely applies.

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 generally struck with a 3 lb hammer. If the impact 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 match marking.

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. The Code can be interpreted to mean all details, or just elements critical to the lateral stability of the system such as those providing bracing, stiffening, etc. Therefore, the RDP should clearly indicate which details are deemed to require inspection for a specific project.

Concrete Inspection

The requirements for Special Inspection of concrete construction cover both cast-in-place and precast concrete. Most foundation concrete for buildings less than three stories, 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 and structural topping slabs.

Reinforcing steel must be inspected prior to concrete placement. Not only should the grade, size, cover, 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.

If the increased allowable loads stated in the Code are used in design, 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, 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 even though the necessary qualifications are not the same. Furthermore, 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 may be 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, conditions of low humidity, or windy conditions.

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 not required for masonry veneers (except for essential facilities), glass block, or foundation walls conforming to the prescriptive design requirement in the code.

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 be 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. In fact, no site inspections are required for conventional wood frame construction.

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. This is judged to be a shortcoming since most construction quality problems occur during handling, erection, bracing and modification of these elements in the field.

Site 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. However, the type and frequency of inspection is not defined.



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 need to be free of paint or other materials that could impair bond. Metal deck surfaces need to be solvent cleaned to remove oil left on the surface by galvanizing operations.

The inspector must verify that the fireproofing is properly applied, including that the flutes of the metal deck are completely filled over beams. During cold weather, precautions need to 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, bond strength and density 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 s.f 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 was once customary.

Quality Assurance for Seismic and Wind

Perhaps the most confusing provisions in Chapter 17 are those pertaining to Quality Assurance for seismic resistance and wind requirements. It is important to note that these provisions do not actually require any additional inspections or testing. The specific inspection and testing requirements involving seismic resistance are covered in the later section of the chapter. The Code does not have a companion section for wind, therefore no additional inspection or testing is required for wind.

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. A page has been included in the *Statement of Special Inspections* form that is intended to serve as the Quality Assurance Plan.

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. A standard form has been included in Appendix C.

As previously stated, the provisions for Quality Assurance do not actually require any additional inspections or testing, but they do require additional paperwork on the part of the RDP and Contractor. Therefore, these provisions are judged to be of limited value, except perhaps in making the Contractor more aware of his responsibilities.

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 larger projects in Seismic Design Categories D, E, and F. Although it is customary for the SER to perform structural observation as part of basic services on most projects, this is not always the case. Therefore, the code has made structural observation mandatory for certain projects. Where practical, it is strongly recommended that structural observation services be performed by the SER on all projects, whether or not required by the Code.

APPENDIX A

Statement of Special Inspections

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*Structural Engineers Coalition - Connecticut
Form 101 - Statement of Special Inspections
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Guideline Program for Structural Testing and Special Inspections, 4th Edition
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APPENDIX B

Final Report of Special Inspections

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Form 102 – Final Report of Special Inspections
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APPENDIX C

Contractor's Statement of Responsibility

APPENDIX D

Fabricator's Certificate of Compliance