2003 IBC: Special Inspections
Understanding and Developing a Special Inspection Program

Handout Available

• http://www.acec.org/coalitions/CA SE/case-publications.cfm
When???

• 1704.1 Where application is made for construction for the types of work listed in 1704
  • Exceptions:
    • Work of a minor nature
    • Work not requiring engineer or architect
    • R-3 or U accessory to residential

1704 types of work

• Structural Fabrications
• Steel Construction
• Concrete Construction
• Masonry Construction
• Wood Construction
• Soils
• Pile foundations
• Pier foundations
• Wall panels and veneers
• Sprayed fire-resistant materials
• Exterior insulation and finish systems
• Special cases
• Smoke control
• Seismic resistance
3 Tier Inspection Process

1. Inspection by Building Official (Sec 109)
2. Inspection by Qualified Special Inspector (Sec 1704)
3. Structural Observation by Registered Design Professional (Sec 1709) and (Sec 106.1.4 & 106.1.5.1)

- Hidden slide for notes
What Are Special Inspections?

- Monitoring of materials and workmanship critical to the integrity of the building structure as dictated by the architect/engineer of record or building official.

- Review of the work to assure that the approved plans and specifications are being followed and in compliance with relevant codes and ordinances.

What Are Special Inspections?

- Quality control measure that assures that certain critical structural or fire and life safety design features are incorporated into construction of the building structure.
Why Special Inspections?

• High amount of structural failures causing incredible losses of money and human lives.

• August, 1982: Subcommittee examines structural failure causes.

Why Special Inspections?

• Model code organizations develop Special Inspection provisions

• Special Inspections have saved lives and financial losses
Why Special Inspections?

• Special Inspections allow for:
  • prompt responses to contractor’s field questions
  • expediting corrective measures to address contractor errors

Why Special Inspections?

• Special Inspections allow for:
  • helping build and maintain team communication and working relationships with the contractor
  • minimizing misinterpretation of the intent of the structural design, building code, or ordinance
Who Benefits?

• Public pays less for inspections

• Owners receive a better product

• Contractor can schedule inspections when building department is closed.

Who Benefits?

• Building Department can efficiently communicate required corrections

• Building Department can efficiently communicate required corrections or owner-directed changes before they are built into the structure
Major Players

- Building Official/ Department
- Special Inspector (SI)
- Contractor/ Builder
- Agents of the Special Inspector
- Registered Design Professional

Building Official / Department

- Review SI Work with Owner, Registered Design Professional, Contractor
- Review Project Documents and Special Inspection Work with SI
- Monitor / Audit SI Activities
Building Official / Department

- Review Special Inspection Reports
- Perform Regular Inspections at Jobsite
- Issue Final Acceptance / Certificate of Occupancy

Special Inspector

- Review Construction Documents
- Attend Pre-construction Meeting
- Establish Communication System
- Signify Presence at Job Site
- Observe all Work Requiring SI
Special Inspector

- Identify Nonconforming Work
- Report Nonconforming Work
- Provide Periodic Inspection Reports
- Provide Final Inspection Report

Registered Design Professional

- Identify Special Inspection Requirements
- Coordinate Special Inspection Activities
- Chair Pre-Construction Meeting
Registered Design Professional

- Make Periodic Site Visits
- Specify Tests and Testing Procedures
- Document Plan Revisions to Building Official
- Designate “Alternate” Registered Design Professional

Contractor / Builder

- Building
- Cooperate with special inspectors, building officials, and the registered design professional
- Attend Pre-construction meeting
Agents of Special Inspector

- Review Construction Documents
- Attend Pre-construction Meeting
- Establish Communication System
- Signify Presence at Job Site
- Observe all Work Requiring SI

Agents of Special Inspector

- Identify Nonconforming Work
- Report Nonconforming Work
- Provide Periodic Inspection Reports
- Provide Final Inspection Report
Owner

The owner employs the special inspector(s) to inspect the work identified as requiring special inspection.

Section 1702

Definitions
Definitions

- Certificate of Compliance
- Inspection Certificate
- Label
- Manufacturer’s Designation
- Mark

• Hidden slide for notes
Definitions

- Special Inspection
- Continuous Special Inspection
- Periodic Special Inspection
- Special Inspector

Section 1703

Approvals
Approved Agencies Ensure…

- **Independency** – No conflict of interest
- **Equipment** – Adequate to perform required tests
- **Personnel** – Experienced / Educated in conducting, supervising, and evaluating tests and inspections

Section 1704

Special Inspections
Key Aspects of SI...

• Performed in addition to that performed by jurisdiction building inspector.

• Special Inspector to be employed/paid by the owner or registered design professional ... NOT the contractor!

Key Aspects of SI...

• Applies principally to “structural framing” system of the building.

• Special Inspector is to be qualified and demonstrate qualifications for the type of construction requiring special inspection to the building official.
SI NOT Required for…

- Minor work when approved by the building official.
- Construction not required to be designed by a Registered Design Professional.
- Occupancies constructed in accordance with the “International Residential Code (IRC).”
- Work performed by an “approved fabricator.”

Permit Application

Is the scope of work minor? NO YES

Does this project exceed the threshold limit? NO YES

BD to require review of primary structural aspects by independent structural engineer AND
A statement of professional opinion is required prior to issuance of C.O.
CGS 29-276b & IBC 106.1.5.1

In all cases, plans pertaining to non-load bearing interior design, prepared by a registered interior designer, shall be acceptable as part of the required construction documents
CGS 20-377k

Use Groups A, E, I, H or transient R OR
R, F, M, or S, 3 stories or more, or exceeding 30,000 sq. ft. OR
Non-transient R with over 16 units or 24,000 sq. ft.

Construction documents shall be accompanied by a site plan showing to scale the size and location of new construction and existing structures on the site, distances from lot lines, street grades and proposed finished grades. IBC 106.2, IRC R106.2

One or more sets of construction documents are required
IBC 106.1

Under 5,000 sq. ft. of total area?

NO YES

Over 24,000 sq. ft.?

NO YES

Is building not 1 & 2 family with over 3 stories and/or an accessory structure to same OR
An agricultural building?

One or more sets of construction documents are required
IRC R106

One or more sets of construction documents are required
IRC R106

One or more sets of construction documents are required
IBC 106.1

One or more sets of construction documents are required
IRC R106

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IRC R106

One or more sets of construction documents are required
IRC R106
Section 1704.1.1

Building Permit Requirements

Registered Design Professional

Responsibilities:
• Part of the submittal documents
• Designates Special Inspection work
• Names individuals / firms to perform Special Inspections
• Outlines the duties of the Special Inspector
Building Official

Responsibilities:

The building official gives or denies the final approval of the Special Inspection Program.

Section 1704.1.2

Report Requirement
Special Inspector

Requirements:
• Review structural details and perform inspections to verify compliance with approved construction documents.
• Keep accurate records of inspections.
• Furnish Inspection reports to the building official and registered design professional.

Special Inspector

Requirements:
• Notify the contractor of observed discrepancies needing corrections.
• Notify the building official and registered design professional of **UNCORRECTED** discrepancies.
• Submit a final inspection report to building official and registered design professional.
Section 1704.2

Inspection of Fabricators

Remember

Special Inspection is **REQUIRED** for shop fabricated items.
Exception

Fabricator has an approved independent inspections or quality control agency to conduct periodic in-plant inspections that ensure conformance with the agency’s approved quality control program.

Section 1704.2.2

Approved Fabricator
Approving Fabricators

Fabricator approval is to be based on an Approved Special Inspection Agency review of:

• Written procedural and quality control manuals.

• Periodic auditing of fabrication practices.

1704.2.2 2009 Amendments

• **Fabricator approval.** Special inspections required by Section 1704.2.1 are not required where the work is done on the premises of the following certified fabricators:
  • 1. A fabricator of structural steel that is certified by the American Institute of Steel Construction Inc.'s Fabricator Certification Program.
  • 2. A fabricator of precast concrete that is certified by the Precast/Prestressed Concrete Institute's Plant Certification Program.
  • 3. A fabricator of cold-formed steel trusses that is certified by the Truss Plate Institute's Quality Assurance Program.
  • 4. A fabricator of wood trusses that is certified by the Truss Plate Institute’s Quality Assurance Program.

• Such fabricators shall not be exempt from special inspections required by Sections 1704.3, 1704.4 or 1704.6. **At the completion of fabrication, the certified fabricator shall submit a certificate of compliance to the building official stating that the work was performed in accordance with the approved construction documents.**
Section 1702 Definitions

• Approved Fabricator

• Fabricated Item

Notes

• Fabricated items do NOT include materials produced in accordance with “Referenced Standards.” (IBC Chapter 35)

• Special Inspection is not required for work performed by an Approved Fabricator.
Required Conditions

- Approved Special Inspection Agency is to notify the building official of any change in workmanship and quality control.

- Fabricator to submit “Certificate of Compliance” to the building official at the completion of shop fabricated items.

Section 1704.3

Steel Construction
About This Section

This section...

• Discusses the types of work requiring special inspections in regards to steel construction.

• Has been divided into several sub-sections concerning welding and bolting.

Handout Available

• http://www.acec.org/coalitions/CA SE/case-publications.cfm
Section 1704.3.1

Welding

Verifying Welding Compliance

Special Inspections are required for steel construction in order to verify welding compliance with:

- AWS D1.1
- AWS D1.3
Exceptions

Periodic special inspection (while work is in progress) is permitted for welding under the following conditions:

• Single pass fillet welds ≤ 5/16 in.
• Floor and roof decks
• Welded studs
• Welded sheet steel
• Stair and railings

Exceptions

If the steel fabrication process is void of any welding, thermal cutting or heating operation. The fabricator to submit detailed procedure for material control (material specification, grade, and mill test reports).
Exceptions

Welding done in an approved fabricator shop is also exempt from special inspection (See “Exception” Sec 1704.2.1)

Inspector Requirements

The following criteria are required for the approval of a special inspector of welding.

• Welding inspectors are to be certified.

• AWS D1.1 to be the basis for welding inspector qualification
Section 1704.3.2

Details

Details Compliance

Special inspections are required for steel construction in order to verify compliance with framing and connection details on construction documents, except for the noted exceptions.
Section 1704.3.3

High Strength Bolting

About High-Strength Bolting

High-strength bolting requires special inspections to verify proper installation per AISC specifications.
About High-Strength Bolting

Periodic special inspection is permitted to verify:

- Bolts, nuts, and washers are as specified
- Bolted parts and surface conditions
- Installation and tightening procedures.

Bolts Requiring Pretensioning

- Observe pre-installation testing and calibration procedures.
- Verify bolted parts in snug contact.
Bolts Requiring Pretensioning

Monitor installation and tightening on a **PERIODIC BASIS** for:

- Turn-of-nut method **WITH** matchmarking
- Direct tension indicator method
- Alternate design fastener (twist-off bolt) method

Bolts Requiring Pretensioning

Monitor installation and tightening on **CONTINUOUS BASIS** for:

- Calibrated wrench method
- Turn-of-nut method **WITHOUT** matchmarking
Bolts Requiring Snug Tight Condition

- Verify bolted parts are in snug contact.
- Monitor installation and tightening on a periodic basis.

Section 1704.4
Concrete Construction
Continuous Inspection

- Welding of reinforcing steel
- Bolts installed in concrete
- Sampling/testing fresh concrete
- Concrete/shotcrete placement
- Prestressing tendon stressing/grouting

Periodic Inspection

- Reinforcing steel / prestressing tendons
- Concrete mix proportions
- Concrete curing
- Precast concrete erection
- In-situ concrete strength verification
Exceptions

• Isolated footing for buildings 3 stories (or less) in height.

• Nonstructural slabs-on-ground, including prestressed slabs designed for an effective prestress no greater than 150 psi

Exceptions

• Continuous wall footing for buildings 3 stories (or less) in height where:
  • Footings support walls of light-frame construction
  • Footings constructed according to Table 1805.4
  • Structural design on $f'_c$ not greater than 2500 psi
Exceptions

- Foundation walls constructed according to Tables 1805.5(1) / 1805.5(2) / 1805.5(3) / 1805.5(4)
- Patios / driveways / sidewalks

Section 1704.5

Masonry Construction
Definitions

• IBC 1602.1:
  • Essential Facilities
  • Nonessential Facilities

Seismic Design Category

• To find SDC:
  • Find Building Classification Category in Table 1604.5 and Seismic Use Groups Importance Factors in 1616.2
  • Find Soils Site Class in Table 1615.1.1
  • Find Site Coefficient Acceleration from Tables 1615.1.2(1) and (2)
  • Compute Design Spectral Response Acceleration Parameters from 1615.1.2, Appendix K and 1615.1.3
  • Find the SDC from most severe Category of Tables 1616.3(1) or 1616.3(2)
IBC 2109

- Empirically Designed Masonry

Not permitted for:
- Building assigned to SDC D, E, or F
- “Seismic Force Resistance System” of building assigned to SDC B or C
- Building where design and wind speed exceeds 110 mph

- Engineered Masonry: IBC 2107 or 8

Work Requiring Inspection

- Empirically designed masonry in essential facilities (Level 1 Special Inspection – Table 1704.5.1)

- Engineered Masonry in non-essential facilities (Level 1 Special Inspection – Table 1704.5.1)
Work Requiring Inspection

- Engineered masonry in essential facilities (Level 2 Special Inspection – Table 1704.5.3)

NOTE: Half-stress designs of masonry in order to exempt special inspections are **NOT** permitted in the IBC

Exceptions

- Empirically designed masonry / glass unit masonry / masonry veneer in non-essential facilities
- Masonry foundation wall constructed according to Tables 1805.5(1) / 1805.5(2) / 1805.5 (3) / 1805.5 (4)
Section 1704.6

Wood Construction

Requirements

Special Inspection is required of shop fabrication of wood structural elements and assemblies, as well as the construction of “high-load” diaphragms. Table 2306.3.2
Section 1704.7

Soils

Inspection Required Of...

- Site preparation
- Fill placement
- In-place density verification
Section 1704.8

Pile Foundations

Requirements

Pile foundations require special inspections.
Section 1704.9

Pier Foundations

Requirements

Special inspections are required of pier foundations in buildings assigned to Seismic Design Categories C, D, E, and F.
Section 1704.11

Sprayed Fire-Resistant Materials

Requirements

Inspections are to ensure that the following properties meet the requirements of the code. Methods of determining these properties must be in accordance with ASTM E605 or E736 standards.

- Thickness
- Density
- Bond Strength
Section 1704.12

Exterior Insulation and Finish Systems (EIFS)

Requirements

Exterior insulation and finish systems (EIFS) require special inspections.
Section 1704.13

Special Cases

Requirements

Special inspection must be performed if the building official determines that it is warranted for a given type of work.
Section 1704.14

Smoke Control

Requirements

Special inspection is required of smoke control systems.
Sections 1705 and 1706 have been deleted by the CT Supplement

Section 1707

Special Inspections for Seismic Resistance
Continuous Special Inspection

- Structural welding according to AISC 34-1
- Any field gluing operations for structural wood glued to built-up members

Periodic Special Inspection

- Nailing, bolting, anchoring, and other fastening of components of seismic-force-resisting system of wood structures (drag struts, braces, and hold downs)
- During welding, screw attachment, bolting,anchoring and other fastening of components (struts, braces, and hold-downs) of cold-formed steel framing.
Applicability

- Seismic-force-resisting systems are required in buildings assigned to Seismic Design Categories C, D, E, or F
- Designated seismic systems are required in buildings assigned to Seismic Design Categories D, E, or F

Determine SDC

- Step 1, determine importance
  - Table 1604.5
  - Classify the importance of the Occupancy
  - Categories I, II, III, IV
Determine SDC

• Step 2, determine Seismic Group
  • Note (a) Table 1604.5
    • Categories I and II equal Seismic Group I
    • Category III equals Seismic Group II
    • Category IV equals Seismic Group III

• Step 3, classify site soils
  • Table 1615.1.1
    • Classify the site for soil type
      • Site Class A is hard rock
      • Site Class B is rock
      • Site Class C is dense soil or soft rock
      • Site Class D is stiff soil
      • Site Class E is soft soil
      • Site Class F is swampy
Determine SDC

- Step 4, determine mapped spectral response acceleration
- Use Appendix K for Spectral Response Acceleration factors
- Find municipality
  - \( S_s \) = short period
  - \( S_1 \) = 1-second period

Determine SDC

- Step 5, Determine Site Coefficients \( F_a \) and \( F_V \)
  - Use Tables 1615.1.2(1) and (2)
  - Use \( S_s \) and \( S_1 \)
  - Use Site Class
  - Read both \( F_a \) and \( F_V \) from tables
Determine SDC

• Step 6, Compute Maximum Considered Earthquake (MCE) Spectral Response Accelerators
  • Section 1615.1.2
    • Short periods, $S_{MS} = F_a \times S_s$
    • 1-second periods, $S_{M1} = F_v \times S_1$

Determine SDC

• Step 7, Compute Spectral Response Acceleration Parameters
  • Section 1615.1.3
    • Short periods, $S_{DS} = 2 \times S_{MS} / 3$
    • 1-second periods, $S_{D1} = 2 \times S_{M1} / 3$
Determine SDC

- Step 8, Determine Seismic Design Category (SDC)
- Tables 1616.3(1) and (2)
  - Use $S_{DS}$ and Seismic Group, and
  - Use $S_{D1}$ and Seismic Group
    - Compare SDC for each
    - Select most restrictive
      - A is least restrictive
      - D is most restrictive

- Use the SDC determined from steps 1-8 in Section 1707 to determine need for seismic restraint special inspections.
- Please notice that seismic restraint is determined in 1613 - 1623, required special inspections of seismic restraint is in 1707
Applicability

• Selectively applies to other nonstructural components in SDC C, D, E or F structures

Section 1707.6

Architectural Components
Periodic Special Inspection

In buildings assigned to Seismic Design Categories D, E, and F during the erection and fastening of the following:

- Exterior cladding
- Non-load bearing walls
- Veneers

Exceptions

- Architectural components in structures ≤ 30 ft in height
- Cladding and veneers ≤ 5 psf in weight
- Interior nonbearing walls ≤ 15 psf in weight
Section 1707.7

Mechanical and Electrical Components

Periodic SI During...

In building assigned to Seismic Design Categories C, D, E, and F

- Anchorage of electrical equipment for emergency standby power systems.

- Installation of piping systems (and associated mechanical units) intended to carry flammable, combustible, or highly toxic contents.
• Installation of HVAC ductwork intended to contain hazardous materials

NOTE: For other electrical equipment, periodic special inspection required only for buildings assigned to SDC E or F.

Component Testing, Certification, and Inspection

The following electrical and mechanical components require special testing, certification and inspection in buildings assigned to Seismic Design Categories C, D, E, or F.
Component Testing, Certification, and Inspection

- Equipment using combustible energy sources
- Electrical motors, transformers, switchgear unit substations and motor control centers
- Reciprocating and rotating-type machinery
- Piping distribution systems ≥ 3 in.
- Tanks, heat exchangers, and pressure valves.
Manufacturer Responsibilities

• Maintain an “Approved Quality Control Program” evidenced by a label on each piece of equipment installed in a building assigned to SDC E or F.

• For designated seismic systems submit the “Certificate of Compliance” to the registered design professional and the building official. The special inspector is to verify that component's anchorage and labels conform to the certificate of compliance.
Component Testing, Certification, and Inspection

Basis of certifications is to be by shaking table tests, 3-D shock tests, analytical methods using dynamic characteristics and forces, or by more rigorous means.

Section 1708

Structural Testing for Seismic Resistance
Applications

• Structural testing for seismic resistance applies to buildings assigned to Seismic Design Categories C, D, E, or F.

• Depending on the Seismic Design Category, special testing is required for Seismic-Force-Resisting Systems and Designated Seismic Systems.

Section 1708.3

Reinforcing and Prestressing Steel
Requirements

• Certified mill test reports are to be provided for rebar and PT Steel used in buildings assigned to SDCs C, D, E, and F

• A615 rebar is to conform to ACI 318 “modifications” for use in SDCs D, E, and F

Requirements

• Where A615 is to be welded, “weldability” is to be determined by chemical tests
Section 1708.4

Structural Steel

Testing Requirements

• Structural steel testing is to conform to AISC 341
• Acceptance criteria for nondestructive test is indicated in AWS D1.1
• Welding structural steel “base metal” thicker than 1.5 inches is to be ultrasonically tested for soundness.
Section 1709

Structural Observations

Why?

- Structural observations are needed to ensure that the structural system is constructed in general conformance with the construction documents.

- This reduces the number of structural errors and inadequacies which allows for a higher level of reliability and safety.
IMPORTANT!

Structural observation does **NOT** waive inspection required by section 1704

Requirements

- Performed by a Registered Design Professional
- Provided for structures assigned to Seismic Design Categories D, E, or F, under specific conditions
- Provided for structures with design wind speed greater than 110 mph, under specific conditions
Requirements

- Provided when specifically requested by the registered design professional or building official
- Visual observation of structural system for compliance with approved construction documents
- Performed at significant construction stages and at completion of the structural system

High Seismic Risk Areas

In areas that are at a high risk for seismic activity, structural observations are to be provided for structures assigned to Seismic Design Categories D, E, or F under one or more of the following conditions.
High Seismic Risk Areas

- Structures classified in Seismic Use Group I with a height greater than 75 ft.

- Structures classified in Seismic Group I, assigned to Seismic Design Category E, and height greater than 2 stories

High Seismic Risk Areas

- All structures classified in Seismic Group II or III

- When so designated by the registered design professional or building official
Structural observations are to be provided for:

- structures designed for a wind speed greater than 110 mph (3 second gusts)
- structures classified in Occupancy Category III or IV
- structures greater than 75 ft

Section 1710

Design Strengths of Materials
Requirements

Design strengths and permissible stresses of structural material are to conform to specification and design methods referenced in the International Building Code.

Section 1711

Alternative Test Procedure
Requirements

Design strengths and permissible stresses of structural material that are not covered by this code are to be established by tests to determine quality and proper manner of use.

Section 1712

Test Safe Load
Requirements

New systems of construction (or structural units) not covered by this code are to be established by full-scale tests to determine quality and safe load carrying capacity.

Section 1713

In-situ Load Tests
Requirements

Where reasonable doubt exists as to the stability or load-carrying capacity of a completed building, the building official may require an engineering assessment, either by structural analysis or in-situ load test, or both.

Section 1714

Preconstruction Load Tests
For proposed construction using materials and construction methods not covered by material and/or design standards that are referenced by the code, the test procedure or section 1714.3 must be used.

Council of American Structural Engineers

- http://www.acec.org/CASE/index.cfm
Handout Available

- http://www.acec.org/coalitions/CA
  SE/case-publications.cfm