

## CHAPTER 17

# STRUCTURAL TESTS AND SPECIAL INSPECTIONS

### SECTION 1701 GENERAL

**1701.1 Scope.** The provisions of this chapter shall govern the quality, workmanship and requirements for materials covered. Materials of construction and tests shall conform to the applicable standards listed in this code.

**1701.2 New materials.** New building materials, equipment, appliances, systems or methods of construction not provided for in this code, and any material of questioned suitability proposed for use in the construction of a building or structure, shall be subjected to the tests prescribed in this chapter and in the approved rules to determine character, quality and limitations of use.

**1701.3 Used materials.** The use of second-hand materials that meet the minimum requirements of this code for new materials shall be permitted.

### SECTION 1702 DEFINITIONS

**1702.1 General.** The following words and terms shall, for the purposes of this chapter and as used elsewhere in this code, have the meanings shown herein.

**APPROVED AGENCY.** An established and recognized agency regularly engaged in conducting tests or furnishing inspection services, when such agency has been approved.

**APPROVED FABRICATOR.** An established and qualified person, firm or corporation approved by the building official pursuant to Chapter 17 of this code.

**CERTIFICATE OF COMPLIANCE.** A certificate stating that materials and products meet specified standards or that work was done in compliance with approved construction documents.

**FABRICATED ITEM.** Structural, load-bearing or lateral load-resisting assemblies consisting of materials assembled prior to installation in a building or structure, or subjected to operations such as heat treatment, thermal cutting, cold working or reforming after manufacture and prior to installation in a building or structure. Materials produced in accordance with standard specifications referenced by this code, such as rolled structural steel shapes, steel-reinforcing bars, masonry units and plywood sheets, shall not be considered "fabricated items."

**INSPECTION CERTIFICATE.** An identification applied on a product by an approved agency containing the name of the manufacturer, the function and performance characteristics, and the name and identification of an approved agency that indicates that the product or material has been inspected and evaluated by an approved agency (see Section 1703.5 and "Label," "Manufacturer's designation" and "Mark").

**LABEL.** An identification applied on a product by the manufacturer that contains the name of the manufacturer, the func-

tion and performance characteristics of the product or material, and the name and identification of an approved agency and that indicates that the representative sample of the product or material has been tested and evaluated by an approved agency (see Section 1703.5 and "Inspection certificate," "Manufacturer's designation" and "Mark").

**MANUFACTURER'S DESIGNATION.** An identification applied on a product by the manufacturer indicating that a product or material complies with a specified standard or set of rules (see also "Inspection certificate," "Label" and "Mark").

**MARK.** An identification applied on a product by the manufacturer indicating the name of the manufacturer and the function of a product or material (see also "Inspection certificate," "Label" and "Manufacturer's designation").

**SPECIAL INSPECTION.** Inspection as herein required of the materials, installation, fabrication, erection or placement of components and connections requiring special expertise to ensure compliance with approved construction documents and referenced standards (see Section 1704).

**SPECIAL INSPECTION, CONTINUOUS.** 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.

**SPECIAL INSPECTION, PERIODIC.** 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.

**SPRAYED FIRE-RESISTANT MATERIALS.** Cementitious or fibrous materials that are spray applied to provide fire-resistant protection of the substrates.

**STRUCTURAL OBSERVATION.** The visual observation of the structural system by a registered design professional for general conformance to the approved construction documents at significant construction stages and at completion of the structural system. Structural observation does not include or waive the responsibility for the inspection required by Section 109, 1704 or other sections of this code.

### SECTION 1703 APPROVALS

**1703.1 Approved agency.** An approved agency shall provide all information as necessary for the building official to determine that the agency meets the applicable requirements.

**1703.1.1 Independent.** An approved agency shall be objective and competent. The agency shall also disclose possible conflicts of interest so that objectivity can be confirmed.

**1703.1.2 Equipment.** An approved agency shall have adequate equipment to perform required tests. The equipment shall be periodically calibrated.

**1703.1.3 Personnel.** An approved agency shall employ experienced personnel educated in conducting, supervising and evaluating tests and/or inspections.

**1703.2 Written approval.** Any material, appliance, equipment, system or method of construction meeting the requirements of this code shall be approved in writing after satisfactory completion of the required tests and submission of required test reports.

**1703.3 Approved record.** For any material, appliance, equipment, system or method of construction that has been approved, a record of such approval, including the conditions and limitations of the approval, shall be kept on file in the building official's office and shall be open to public inspection at appropriate times.

**1703.4 Performance.** Specific information consisting of test reports conducted by an approved testing agency in accordance with standards referenced in Chapter 35, or other such information as necessary, shall be provided for the building official to determine that the material meets the applicable code requirements.

**1703.4.1 Research and investigation.** Sufficient technical data shall be submitted to the building official to substantiate the proposed use of any material or assembly. If it is determined that the evidence submitted is satisfactory proof of performance for the use intended, the building official shall approve the use of the material or assembly subject to the requirements of this code. The cost offsets, reports and investigations required under these provisions shall be paid by the permit applicant.

**1703.4.2 Research reports.** Supporting data, where necessary to assist in the approval of materials or assemblies not specifically provided for in this code, shall consist of valid research reports from approved sources.

**1703.5 Labeling.** Where materials or assemblies are required by this code to be labeled, such materials and assemblies shall be labeled by an approved agency in accordance with Section 1703. Products and materials required to be labeled shall be labeled in accordance with the procedures set forth in Sections 1703.5.1 through 1703.5.3.

**1703.5.1 Testing.** An approved agency shall test a representative sample of the product or material being labeled to the relevant standard or standards. The approved agency shall maintain a record of the tests performed. The record shall provide sufficient detail to verify compliance with the test standard.

**1703.5.2 Inspection and identification.** The approved agency shall periodically perform an inspection, which shall be in-plant if necessary, of the product or material that is to be labeled. The inspection shall verify that the labeled product or material is representative of the product or material tested.

**1703.5.3 Label information.** The label shall contain the manufacturer's or distributor's identification, model number, serial number or definitive information describing the product or material's performance characteristics and approved agency's identification.

**1703.6 Heretofore approved materials.** The use of any material already fabricated or of any construction already erected, which conformed to requirements or approvals heretofore in effect, shall be permitted to continue, if not detrimental to life, health or safety to the public.

**1703.7 Evaluation and follow-up inspection services.** Where structural components or other items regulated by this code are not visible for inspection after completion of a prefabricated assembly, the permit applicant shall submit a report of each prefabricated assembly. The report shall indicate the complete details of the assembly, including a description of the assembly and its components, the basis upon which the assembly is being evaluated, test results and similar information and other data as necessary for the building official to determine conformance to this code. Such a report shall be approved by the building official.

**1703.7.1 Follow-up inspection.** The permit applicant shall provide for special inspections of fabricated items in accordance with Section 1704.2.

**1703.7.2 Test and inspection records.** Copies of necessary test and inspection records shall be filed with the building official.

## SECTION 1704 SPECIAL INSPECTIONS

**1704.1 General.** Where application is made for construction as described in this section, the owner or the registered design professional in responsible charge acting as the owner's agent shall employ one or more special inspectors to provide inspections during construction on the types of work listed under Section 1704. The special inspector shall be a qualified person who shall demonstrate competence, to the satisfaction of the building official, for inspection of the particular type of construction or operation requiring special inspection. These inspections are in addition to the inspections specified in Section 109.

### Exceptions:

1. Special inspections are not required for work of a minor nature or as warranted by conditions in the jurisdiction as approved by the building official.
2. Special inspections are not required for building components unless the design involves the practice of professional engineering or architecture as defined by applicable state statutes and regulations governing the professional registration and certification of engineers or architects.
3. Unless otherwise required by the building official, special inspections are not required for occupancies in Group R-3 as applicable in Section 101.2 and occupancies in Group U that are accessory to a residential occupancy including, but not limited to, those listed in Section 312.1.

**1704.1.1 Building permit requirement.** The permit applicant shall submit a statement of special inspections prepared by the registered design professional in responsible charge in accordance with Section 106.1 as a condition for permit issuance. This statement shall include a complete list of ma-

materials and work requiring special inspections by this section, the inspections to be performed and a list of the individuals, approved agencies or firms intended to be retained for conducting such inspections.

**1704.1.2 Report requirement.** Special inspectors shall keep records of inspections. The special inspector shall furnish inspection reports to the building official, and to the registered design professional in responsible charge. Reports shall indicate that work inspected was done in conformance to approved construction documents. Discrepancies shall be brought to the immediate attention of the contractor for correction. If the discrepancies are not corrected, the discrepancies shall be brought to the attention of the building official and to the registered design professional in responsible charge prior to the completion of that phase of the work. A final report documenting required special inspections and correction of any discrepancies noted in the inspections shall be submitted at a point in time agreed upon by the permit applicant and the building official prior to the start of work.

**1704.2 Inspection of fabricators.** Where fabrication of structural load-bearing members and assemblies is being performed on the premises of a fabricator's shop, special inspection of the fabricated items shall be required by this section and as required elsewhere in this code.

**1704.2.1 Fabrication and implementation procedures.** The special inspector shall verify that the fabricator maintains detailed fabrication and quality control procedures that provide a basis for inspection control of the workmanship and the fabricator's ability to conform to approved construction documents and referenced standards. The special inspector shall review the procedures for completeness and adequacy relative to the code requirements for the fabricator's scope of work.

**Exception:** Special inspections as required by Section 1704.2 shall not be required where the fabricator is approved in accordance with Section 1704.2.2.

**1704.2.2 Fabricator approval.** Special inspections required by this code are not required where the work is done on the premises of a fabricator registered and approved to perform such work without special inspection. Approval shall be based upon review of the fabricator's written procedural and quality control manuals and periodic auditing of fabrication practices by a nationally recognized accrediting authority. At completion of fabrication, the approved fabricator shall submit a certificate of compliance to the building official stating that the work was performed in accordance with the approved construction documents.

**1704.3 Steel construction.** The special inspections for steel elements of buildings and structures shall be as required by Section 1704.3 and Table 1704.3. Where required, special inspection of steel shall also comply with Section 1715.

**Exceptions:**

1. Special inspection of the steel fabrication process shall not be required where the fabricator does not perform any welding, thermal cutting or heating operation of any kind as part of the fabrication process. In such cases, the fabri-

cator shall be required to submit a detailed procedure for material control that demonstrates the fabricator's ability to maintain suitable records and procedures such that, at any time during the fabrication process, the material specification, grade and mill test reports for the main stress-carrying elements are capable of being determined.

2. The special inspector need not be continuously present during welding of the following items, provided the materials, welding procedures and qualifications of welders are verified prior to the start of the work; periodic inspections are made of the work in progress and a visual inspection of all welds is made prior to completion or prior to shipment of shop welding.
  - 2.1. Single-pass fillet welds not exceeding  $\frac{5}{16}$  inch (7.9 mm) in size.
  - 2.2. Floor and roof deck welding.
  - 2.3. Welded studs when used for structural diaphragm.
  - 2.4. Welded sheet steel for cold-formed steel framing members such as studs and joists.
  - 2.5. Welding of stairs and railing systems.

**1704.3.1 Welding.** Welding inspection shall be in compliance with AWS D1.1. The basis for welding inspector qualification shall be AWS D1.1.

**1704.3.2 Details.** The special inspector shall perform an inspection of the steel frame to verify compliance with the details shown on the approved construction documents, such as bracing, stiffening, member locations and proper application of joint details at each connection.

**1704.3.3 High-strength bolts.** Installation of high-strength bolts shall be periodically inspected in accordance with AISC specifications.

**1704.3.3.1 General.** While the work is in progress, the special inspector shall determine that the requirements for bolts, nuts, washers and paint; bolted parts and installation and tightening in such standards are met. For bolts requiring pretensioning, the special inspector shall observe the preinstallation testing and calibration procedures when such procedures are required by the installation method or by project plans or specifications; determine that all plies of connected materials have been drawn together and properly snugged and monitor the installation of bolts to verify that the selected procedure for installation is properly used to tighten bolts. For joints required to be tightened only to the snug-tight condition, the special inspector need only verify that the connected materials have been drawn together and properly snugged.

**1704.3.3.2 Periodic monitoring.** Monitoring of bolt installation for pretensioning is permitted to be performed on a periodic basis when using the turn-of-nut method with matchmarking techniques, the direct tension indicator method or the alternate design fastener (twist-off bolt) method. Joints designated as snug tight need be inspected only on a periodic basis.

STRUCTURAL TESTS AND SPECIAL INSPECTIONS

TABLE 1704.3  
REQUIRED VERIFICATION AND INSPECTION OF STEEL CONSTRUCTION

VERIFICATION AND INSPECTION	CONTINUOUS	PERIODIC	REFERENCED STANDARD <sup>a</sup>	IBC REFERENCE
1. Material verification of high-strength bolts, nuts and washers:				
a. Identification markings to conform to ASTM standards specified in the approved construction documents.	—	X	Applicable ASTM material specifications; AISC 335, Section A3.4; AISC LRFD, Section A3.3	—
b. Manufacturer's certificate of compliance required.	—	X	—	—
2. Inspection of high-strength bolting:				
a. Bearing-type connections.	—	X	AISC LRFD Section M2.5	1704.3.3
b. Slip-critical connections.	X	X		
3. Material verification of structural steel:				
a. Identification markings to conform to ASTM standards specified in the approved construction documents.	—	—	ASTM A 6 or ASTM A 568	1708.4
b. Manufacturers' certified mill test reports.	—	—	ASTM A 6 or ASTM A 568	
4. Material verification of weld filler materials:				
a. Identification markings to conform to AWS specification in the approved construction documents.	—	—	AISC, ASD, Section A3.6; AISC LRFD, Section A3.5	—
b. Manufacturer's certificate of compliance required.	—	—	—	—
5. Inspection of welding:				
a. Structural steel:	—	—		
1) Complete and partial penetration groove welds.	X	—	AWS D1.1	1704.3.1
2) Multipass fillet welds.	X	—		
3) Single-pass fillet welds $> 5/16''$	X	—		
4) Single-pass fillet welds $\leq 5/16''$	—	X		
5) Floor and deck welds.	—	X	AWS D1.3	—
b. Reinforcing steel:	—	—		
1) Verification of weldability of reinforcing steel other than ASTM A 706.	—	X	AWS D1.4 ACI 318: 3.5.2	1903.5.2
2) Reinforcing steel-resisting flexural and axial forces in intermediate and special moment frames, and boundary elements of special reinforced concrete shear walls and shear reinforcement.	X	—		
3) Shear reinforcement.	X	—		
4) Other reinforcing steel.	—	X		
6. Inspection of steel frame joint details for compliance with approved construction documents:		X		
a. Details such as bracing and stiffening.	—	—	—	1704.3.2
b. Member locations.	—	—		
c. Application of joint details at each connection.	—	—		

For SI: 1 inch = 25.4 mm.

a. Where applicable, see also Section 1707.1, Special inspection for seismic resistance.

**1704.3.3.3 Continuous monitoring.** Monitoring of bolt installation for pretensioning using the calibrated wrench method or the turn-of-nut method without matchmarking shall be performed on a continuous basis.

**1704.4 Concrete construction.** The special inspections and verifications for concrete construction shall be as required by this section and Table 1704.4.

**Exception:** Special inspections shall not be required for:

1. Isolated spread concrete footings of buildings three stories or less in height that are fully supported on earth or rock.
2. Continuous concrete footings supporting walls of buildings three stories or less in height that are fully supported on earth or rock where:
  - 2.1. The footings support walls of light frame construction;
  - 2.2. The footings are designed in accordance with Table 1805.4.2; or

- 2.3. The structural design is based on a  $f_c$  no greater than 2,500 pounds per square inch (psi) (17.2 Mpa).
3. Nonstructural concrete slabs supported directly on the ground, including prestressed slabs on grade, where the effective prestress in the concrete is less than 150 psi (1.03 Mpa).
4. Concrete foundation walls constructed in accordance with Table 1805.5(1), 1805.5(2), 1805.5(3) or 1805.5(4).
5. Concrete patios, driveways and sidewalks, on grade.

**1704.4.1 Materials.** In the absence of sufficient data or documentation providing evidence of conformance to quality standards for materials in Chapter 3 of ACI 318, the building official shall require testing of materials in accordance with the appropriate standards and criteria for the material in Chapter 3 of ACI 318. Weldability of reinforcement, except that which conforms to ASTM A 706, shall be determined in accordance with the requirements of Section 1903.5.2.

**TABLE 1704.4  
REQUIRED VERIFICATION AND INSPECTION OF CONCRETE CONSTRUCTION**

VERIFICATION AND INSPECTION	CONTINUOUS	PERIODIC	REFERENCED STANDARD <sup>a</sup>	IBC REFERENCE
1. Inspection of reinforcing steel, including prestressing tendons, and placement.	—	X	ACI 318: 3.5, 7.1-7.7	1903.5, 1907.1, 1907.7, 1914.4
2. Inspection of reinforcing steel welding in accordance with Table 1704.3, Item 5B.	—	—	AWS D1.4 ACI 318: 3.5.2	1903.5.2
3. Inspect bolts to be installed in concrete prior to and during placement of concrete where allowable loads have been increased.	X	—	—	1912.5
4. Verifying use of required design mix.	—	X	ACI 318: Ch. 4, 5.2-5.4	1904, 1905.2-1905.4, 1914.2, 1914.3
5. At the time fresh concrete is sampled to fabricate specimens for strength tests, perform slump and air content tests, and determine the temperature of the concrete.	X	—	ASTM C 172 ASTM C 31 ACI 318: 5.6, 5.8	1905.6, 1914.10
6. Inspection of concrete and shotcrete placement for proper application techniques.	X	—	ACI 318: 5.9, 5.10	1905.9, 1905.10, 1914.6, 1914.7, 1914.8
7. Inspection for maintenance of specified curing temperature and techniques.	—	X	ACI 318: 5.11-5.13	1905.11, 1905.13, 1914.9
8. Inspection of prestressed concrete: a. Application of prestressing forces. b. Grouting of bonded prestressing tendons in the seismic-force-resisting system.	X X	—	ACI 318: 18.20 ACI 318: 18.18.4	—
9. Erection of precast concrete members.	—	X	ACI 318: Ch. 16	—
10. Verification of in-situ concrete strength, prior to stressing of tendons in posttensioned concrete and prior to removal of shores and forms from beams and structural slabs.	—	X	ACI 318: 6.2	1906.2

For SI: 1 inch = 25.4 mm.

a. Where applicable, see also Section 1707.1, Special inspection for seismic resistance.

**1704.5 Masonry construction.** Masonry construction shall be inspected and evaluated in accordance with the requirements of this section, depending on the classification of the building or structure or nature of occupancy, as defined by this code (see Table 1604.5 and Section 1616.2).

**Exception:** Special inspections shall not be required for:

1. Empirically designed masonry, glass unit masonry or masonry veneer designed by Section 2109, 2110 or ACI 530/ASCE 5/TMS 402, Chapters 5, 6 or 7, when they are part of nonessential buildings (see Table 1604.5 and Section 1616.2).
2. Masonry foundation walls constructed in accordance with Table 1805.5(1), 1805.5(2), 1805.5(3) or 1805.5(4).

**1704.5.1 Empirically designed masonry, glass unit masonry and masonry veneer in essential facilities.** The minimum inspection program for masonry designed by Chapter 14, Section 2109 or 2110, or by Chapter 5, 6 or 7 of ACI 530/ASCE 5/TMS 402, in essential facilities (see Table 1604.5 and Section 1616.2) shall comply with Table 1704.5.1.

**1704.5.2 Engineered masonry in nonessential facilities.** The minimum special inspection program for masonry designed by Section 2106, 2107 or 2108, or by chapters other than Chapters 5, 6 or 7 of ACI 530/ASCE 5/TMS 402, in nonessential facilities (see Table 1604.5 and Section 1616.2), shall comply with Table 1704.5.1.

**1704.5.3 Engineered masonry in essential facilities.** The minimum special inspection program for masonry designed by Section 2106, 2107 or 2108, or by chapters other than Chapters 5, 6 or 7 of ACI 530/ASCE 5/TMS 402, in essential facilities (see Table 1604.5 and Section 1616.2), shall comply with Table 1704.5.3.

**1704.6 Wood construction.** Special inspections of the fabrication process of prefabricated wood structural elements and assemblies shall be in accordance with Section 1704.2. Special inspections of site-built assemblies shall be in accordance with Section 1704.1.

**1704.6.1 Fabrication of high-load diaphragms.** High-load diaphragms using values from Table 2306.3.2 shall be installed with special inspections as indicated in Section 1704.1. The special inspector shall inspect the wood structural panel sheathing to ascertain whether it is of the grade and thickness shown on the approved building plans. Additionally, the special inspector must verify the nominal size of framing members at adjoining panel edges, the nail or staple diameter and length, the number of fastener lines and that spacing between fasteners in each line and at edge margins agrees with the approved building plans.

**1704.7 Soils.** The special inspections for existing site soil conditions, fill placement and load-bearing requirements shall follow Sections 1704.7.1 through 1704.7.3. The approved soils

report, required by Section 1802.2, shall be used to determine compliance.

**Exception:** Special inspections not required during placement of fill less than 12 inches (305 mm) deep.

**1704.7.1 Site preparation.** Prior to placement of the prepared fill, the special inspector shall determine that the site has been prepared in accordance with the approved soils report.

**1704.7.2 During fill placement.** During placement and compaction of the fill material, the special inspector shall determine that the material being used and the maximum lift thickness comply with the approved report, as specified in Section 1803.5.

**1704.7.3 Evaluation of in-place density.** The special inspector shall determine, at the approved frequency, that the in-place dry density of the compacted fill complies with the approved report.

**1704.8 Pile foundations.** A special inspector shall be present when pile foundations are being installed and during tests. The special inspector shall make and submit to the building official records of the installation of each pile and results of load tests. Records shall include the cutoff and tip elevation of each pile relative to a permanent reference.

**1704.9 Pier foundations.** Special inspection is required for pier foundations for buildings assigned to Seismic Design Category C, D, E or F in accordance with Section 1616.3.

**1704.10 Wall panels and veneers.** Special inspection is required for exterior and interior architectural wall panels and the anchoring of veneers for buildings assigned to Seismic Design Category E or F in accordance with Section 1616.3. Special inspection of such masonry veneer shall be in accordance with Section 1704.5.

**1704.11 Sprayed fire-resistant materials.** Special inspections for sprayed fire-resistant materials applied to structural elements and decks shall be in accordance with Sections 1704.11.1 through 1704.11.5. Special inspections shall be based on the fire-resistance design as designated in the approved construction documents.

**1704.11.1 Structural member surface conditions.** The surfaces shall be prepared in accordance with the approved fire-resistance design and the approved manufacturer's written instructions. The prepared surface of structural members to be sprayed shall be inspected before the application of the sprayed fire-resistant material.

**1704.11.2 Application.** The substrate shall have a minimum ambient temperature before and after application as specified in the approved manufacturer's written instructions. The area for application shall be ventilated during and after application as required by the approved manufacturer's written instructions.

TABLE 1704.5.1  
LEVEL 1 SPECIAL INSPECTION

INSPECTION TASK	FREQUENCY OF INSPECTION		REFERENCE FOR CRITERIA			
	Continuous during task listed	Periodically during task listed	IBC section	ACI 530/ASCE 5/TMS 402 <sup>a</sup>	ACI 530.1/ASCE 6/TMS 602 <sup>a</sup>	
1. As masonry construction begins, the following shall be verified to ensure compliance:						
a. Proportions of site-prepared mortar.	—	X	—	—	Art. 2.6A	
b. Construction of mortar joints.		X			Art. 3.3B	
c. Location of reinforcement and connectors.		X			Art. 3.4, 3.6A	
d. Prestressing technique.	—	X	—	—	Art. 3.6B	
e. Grade and size of prestressing tendons and anchorages.	—	X	—	—	Art. 2.4B, 2.4H	
2. The inspection program shall verify:						
a. Size and location of structural elements.	—	X	—	—	Art. 3.3G	
b. Type, size and location of anchors, including other details of anchorage of masonry to structural members, frames or other construction.	—	X	—	Sec. 1.2.2(e), 2.1.4, 3.1.6	—	
c. Specified size, grade and type of reinforcement.	—	X	—	Sec. 1.12	Art. 2.4, 3.4	
d. Welding of reinforcing bars.	X	—	—	Sec. 2.1.10.6.2, 3.2.3.4(b)	—	
e. Protection of masonry during cold weather (temperature below 40°F) or hot weather (temperature above 90°F).	—	X	Sec. 2104.3, 2104.4	—	Art. 1.8C, 1.8D	
f. Application and measurement of prestressing force.	—	X	—	—	Art. 3.6B	
3. Prior to grouting, the following shall be verified to ensure compliance:						
a. Grout space is clean.	—	X	—	—	Art. 3.2D	
b. Placement of reinforcement and connectors and prestressing tendons and anchorages.		X			Sec. 1.12	Art. 3.4
c. Proportions of site-prepared grout and prestressing grout for bonded tendons.		X			—	Art. 2.6B
d. Construction of mortar joints.		X			—	Art. 3.3B
4. Grout placement shall be verified to ensure compliance with code and construction document provisions.	X	—	—	—	Art. 3.5	
a. Grouting of prestressing bonded tendons.	X	—	—	—	Art. 3.6C	
5. Preparation of any required grout specimens, mortar specimens and/or prisms shall be observed.	X	—	Sec. 2105.2.2, 2105.3	—	Art. 1.4	
6. Compliance with required inspection provisions of the construction documents and the approved submittals shall be verified.	—	X	—	—	Art. 1.5	

For SI: °C = (°F - 32)/1.8.

a. The specific standards referenced are those listed in Chapter 35.

TABLE 1704.5.3  
LEVEL 2 SPECIAL INSPECTION

INSPECTION TASK	FREQUENCY OF INSPECTION		REFERENCE FOR CRITERIA		
	Continuous during task listed	Periodically during task listed	IBC section	ACI 530/ASCE 5/TMS 402 <sup>a</sup>	ACI 530.1/ASCE 6/TMS 602 <sup>a</sup>
1. From the beginning of masonry construction, the following shall be verified to ensure compliance:					
a. Proportions of site-prepared mortar, grout and prestressing grout for bonded tendons.	—	X	—	—	Art. 2.6A
b. Placement of masonry units and construction of mortar joints.	—	X	—	—	Art. 3.3B
c. Placement of reinforcement, connectors and prestressing tendons and anchorages.	—	X	—	Sec. 1.12	Art. 3.4, 3.6A
d. Grout space prior to grouting.	X	—	—	—	Art. 3.2D
e. Placement of grout.	X	—	—	—	Art. 3.5
f. Placement of prestressing grout.	X	—	—	—	Art. 3.6C
2. The inspection program shall verify:					
a. Size and location of structural elements.	—	X	—	—	Art. 3.3G
b. Type, size and location of anchors, including other details of anchorage of masonry to structural members, frames or other construction.	X	—	—	Sec. 1.2.2(e), 2.1.4.3.1.6	—
c. Specified size, grade and type of reinforcement.	—	X	—	Sec. 1.12	Art. 2.4, 3.4
d. Welding of reinforcement.	X	—	—	Sec. 2.1.10.6.2, 3.2.3.4(b)	—
e. Protection of masonry during cold weather (temperature below 40°F) or hot weather (temperature above 90°F).	—	X	Sec. 2104.3, 2104.4	—	Art. 1.8C, 1.8D
f. Application and measurement of prestressing force.	X	—	—	—	Art. 3.6B
3. Preparation of any required grout specimens, mortar specimens and/or prisms shall be observed.	X	—	Sec. 2105.2.2, 2105.3	—	Art. 1.4
4. Compliance with required inspection provisions of the construction documents and the approved submittals shall be verified.	—	X	—	—	Art. 1.5

For SI: °C = (°F - 32)/1.8.

a. The specific standards referenced are those listed in Chapter 35.

**1704.11.3 Thickness.** The average thickness of the sprayed fire-resistant materials applied to structural elements shall not be less than the thickness required by the approved fire-resistant design. Individual measured thickness, which exceeds the thickness specified in a design by 1/4 inch (6.4 mm) or more, shall be recorded as the thickness specified in the design plus 1/4 inch (6.4 mm). For design thicknesses 1 inch (25 mm) or greater, the minimum allowable individual thickness shall be the design thickness minus 1/4 inch (6.4 mm). For design thicknesses less than 1 inch (25 mm), the minimum allowable individual thickness shall be the design thickness minus 25 percent. Thickness shall be determined in accordance with ASTM E 605. Samples of the sprayed

fire-resistant materials shall be selected in accordance with Sections 1704.11.3.1 and 1704.11.3.2.

**1704.11.3.1 Floor, roof and wall assemblies.** The thickness of the sprayed fire-resistant material applied to floor, roof and wall assemblies shall be determined in accordance with ASTM E 605, taking the average of not less than four measurements for each 1,000 square feet (93 m<sup>2</sup>) of the sprayed area on each floor or part thereof.

**1704.11.3.2 Structural framing members.** The thickness of the sprayed fire-resistant material applied to structural members shall be determined in accordance with ASTM E 605. Thickness testing shall be performed on not less than 25 percent of the structural members on each floor.



**1704.11.4 Density.** The density of the sprayed fire-resistant material shall not be less than the density specified in the approved fire-resistant design. Density of the sprayed fire-resistant material shall be determined in accordance with ASTM E 605.

**1704.11.5 Bond strength.** The cohesive/adhesive bond strength of the cured sprayed fire-resistant material applied to structural elements shall not be less than 150 pounds per square foot (psf) (7.18 kN/m<sup>2</sup>). The cohesive/adhesive bond strength shall be determined in accordance with the field test specified in ASTM E 736 by testing in-place samples of the sprayed fire-resistant material selected in accordance with Sections 1704.11.5.1 and 1704.11.5.2.

**1704.11.5.1 Floor, roof and wall assemblies.** The test samples for determining the cohesive/adhesive bond strength of the sprayed fire-resistant materials shall be selected from each floor, roof and wall assembly at the rate of not less than one sample for every 10,000 square feet (929 m<sup>2</sup>) or part thereof of the sprayed area in each story.

**1704.11.5.2 Structural framing members.** The test samples for determining the cohesive/adhesive bond strength of the sprayed fire-resistant materials shall be selected from beams, girders, joists, trusses and columns at the rate of not less than one sample for each type of structural framing member for each 10,000 square feet (929 m<sup>2</sup>) of floor area or part thereof in each story.

**1704.12 Exterior insulation and finish systems (EIFS).** Special inspections shall be required for all EIFS applications.

**Exceptions:**

1. Special inspections shall not be required for EIFS applications installed over a water-resistive barrier with a means of draining moisture to the exterior.
2. Special inspections shall not be required for EIFS applications installed over masonry or concrete walls.

**1704.13 Special cases.** Special inspections shall be required for proposed work that is, in the opinion of the building official, unusual in its nature, such as, but not limited to, the following examples:

1. Construction materials and systems that are alternatives to materials and systems prescribed by this code.
2. Unusual design applications of materials described in this code.
3. Materials and systems required to be installed in accordance with additional manufacturer's instructions that prescribe requirements not contained in this code or in standards referenced by this code.

**1704.14 Special inspection for smoke control.** Smoke control systems shall be tested by a special inspector.

**1704.14.1 Testing scope.** The test scope shall be as follows:

1. During erection of ductwork and prior to concealment for the purposes of leakage testing and recording of device location.

2. Prior to occupancy and after sufficient completion for the purposes of pressure difference testing, flow measurements and detection and control verification.

**1704.14.2 Qualifications.** Special inspection agencies for smoke control shall have expertise in fire protection engineering, mechanical engineering and certification as air balancers.

## SECTION 1705

### QUALITY ASSURANCE FOR SEISMIC RESISTANCE

**1705.1 Scope.** A quality assurance plan for seismic requirements shall be provided for Building Categories III and IV in accordance with Section 1705.2 for the following:

1. The seismic-force-resisting systems in structures assigned to Seismic Design Category C, D, E or F, in accordance with Section 1616.
2. Designated seismic systems in structures assigned to Seismic Design Category D, E or F.
3. The following additional systems in structures assigned to Seismic Design Category C:
  - 3.1. Heating, ventilating and air-conditioning (HVAC) ductwork containing hazardous materials and anchorage of such ductwork.
  - 3.2. Piping systems and mechanical units containing flammable, combustible or highly toxic materials.
  - 3.3. Anchorage of electrical equipment used for emergency or standby power systems.
4. The following additional systems in structures assigned to Seismic Design Category D:
  - 4.1. Systems required for Seismic Design Category C.
  - 4.2. Exterior wall panels and their anchorage.
  - 4.3. Suspended ceiling systems and their anchorage.
  - 4.4. Access floors and their anchorage.
  - 4.5. Steel storage racks and their anchorage, where the factor,  $I_p$ , determined in Section 9.6.1.5 of ASCE 7, is equal to 1.5.
5. The following additional systems in structures assigned to Seismic Design Category E or F:
  - 5.1. Systems required for Seismic Design Categories C and D.
  - 5.2. Electrical equipment.

**Exceptions:**

1. A quality assurance plan is not required for structures designed and constructed in accordance with the conventional construction provisions of Section 2308.
2. A quality assurance plan is not required for structures designed and constructed in accordance with the following:
  - 2.1. The structure is constructed of light wood framing or light framed cold-formed steel; the design spectral response acceleration at short periods,  $S_{DS}$ , as determined in Section 1615.1,

does not exceed 0.5g, and the height of the structure does not exceed 35 feet (10 668 mm) above grade plane; or

- 2.2. The structure is constructed using a reinforced masonry structural system or reinforced concrete structural system; the design spectral response acceleration at short periods,  $S_{DS}$ , as determined in Section 1615.1, does not exceed 0.5g, and the height of the structure does not exceed 25 feet (7620 mm) above grade plane; or
- 2.3. The structure is classified as Seismic Use Group I, as determined in Section 1616.2; and
- 2.4. The structure does not have any of the following plan or vertical irregularities as defined in Section 1616.5:
  - a. Torsional irregularity.
  - b. Nonparallel systems.
  - c. Stiffness irregularity—extreme soft story and soft story.
  - d. Discontinuity in capacity—weak story.

**1705.2 Quality assurance plan preparation.** The design of each designated seismic system shall include a quality assurance plan prepared by a registered design professional. The quality assurance plan shall identify the following:

1. The designated seismic systems and seismic-force-resisting systems that are subject to quality assurance in accordance with Section 1705.1.
2. The special inspections and testing to be provided as required by Sections 1704 and 1708 and other applicable sections of this code, including the applicable standards referenced by this code.
3. The type and frequency of testing required.
4. The type and frequency of special inspections required.
5. The required frequency and distribution of testing and special inspection reports.
6. The structural observations to be performed.
7. The required frequency and distribution of structural observation reports.

**1705.3 Contractor responsibility.** Each contractor responsible for the construction of a seismic-force-resisting system, designated seismic system, or component listed in the quality assurance plan shall submit a written contractor's statement of responsibility to the building official and to the owner prior to the commencement of work on the system or component. The contractor's statement of responsibility shall contain the following:

1. Acknowledgment of awareness of the special requirements contained in the quality assurance plan.
2. Acknowledgment that control will be exercised to obtain conformance with the construction documents approved by the building official.

3. Procedures for exercising control within the contractor's organization, the method and frequency of reporting and the distribution of the reports.
4. Identification and qualifications of the person(s) exercising such control and their position(s) in the organization.

## SECTION 1706 QUALITY ASSURANCE FOR WIND REQUIREMENTS

**1706.1 Scope.** A quality assurance plan shall be provided in accordance with Section 1706.1.1.

**1706.1.1 Where required.** A quality assurance plan for wind requirements shall be provided for all structures constructed in the following areas:

1. In wind exposure Categories A and B, where the 3-second-gust basic wind speed is 120 miles per hour (mph) (52.8 m/sec) or greater.
2. In wind exposure Categories C and D, where the 3-second-gust basic wind speed is greater than 110 mph (49 m/sec).

**Exception:** A quality assurance plan is not required for structures designed and constructed in accordance with the *Oregon Residential Specialty Code* or the conventional construction provisions of Section 2308 of this code, provided that all of the applicable items listed in Section 1706.1.2 are inspected during construction by a qualified person approved by the building official.

**1706.1.2 Detailed requirements.** Where required by Section 1706.1.1, a quality assurance plan shall be provided for the following:

1. Roof cladding and roof framing connections.
2. Wall connections to roof and floor diaphragms and framing.
3. Roof and floor diaphragm systems, including collectors, drag struts and boundary elements.
4. Vertical windforce-resisting systems, including braced frames, moment frames and shear walls.
5. Windforce-resisting system connections to the foundation.
6. Fabrication and installation of components and assemblies required to meet the impact-resistance requirements of Section 1609.1.4.

**Exception:** Fabrication of manufactured components and assemblies that have a label indicating compliance with the wind-load and impact-resistance requirements of this code.

**1706.2 Quality assurance plan preparation.** The design of each main windforce-resisting system and each wind-resisting component shall include a quality assurance plan prepared by a registered design professional.

**Exception:** For construction that is not required to be designed by a registered design professional, the quality assur-

ance plan may be prepared by a qualified person approved by the building official.

The quality assurance plan shall identify the following:

1. The main windforce-resisting systems and wind-resisting components that are subject to quality assurance in accordance with Section 1706.1.
2. The special inspections and testing to be provided as required by Section 1704 and other applicable sections of this code, including the applicable standards referenced by this code.
3. The type and frequency of testing required.
4. The type and frequency of special inspections required.
5. The required frequency and distribution of testing and special inspection reports.
6. The structural observations to be performed.
7. The required frequency and distribution of structural observation reports.

**1706.3 Contractor responsibility.** Each contractor responsible for the construction of a main windforce-resisting system or a wind-resisting component listed in the quality assurance plan shall submit a written statement of responsibility to the building official and the owner prior to the commencement of work on the system or component. The contractor's statement of responsibility shall contain the following:

1. Acknowledgment of awareness of the special requirements contained in the quality assurance plan;
2. Acknowledgment that control will be exercised to obtain conformance with the construction documents approved by the building official;
3. Procedures for exercising control within the contractor's organization, the method and frequency of reporting and the distribution of the reports; and
4. Identification and qualifications of the person(s) exercising such control and their position(s) in the organization.

## SECTION 1707 SPECIAL INSPECTIONS FOR SEISMIC RESISTANCE

**1707.1 Special inspections for seismic resistance.** Special inspection as specified in this section is required for the following, where required in Section 1704.1. For Building Categories III and IV, special inspections itemized in Sections 1707.2 through 1707.8 are required for the following:

1. The seismic-force-resisting systems in structures assigned to Seismic Design Category C, D, E or F, as determined in Section 1616.
2. Designated seismic systems in structures assigned to Seismic Design Category D, E or F.
3. Architectural, mechanical and electrical components in structures assigned to Seismic Design Category C, D, E or F that are required in Sections 1707.6 and 1707.7.

**1707.2 Structural steel.** Continuous special inspection for structural welding in accordance with AISC 341.

**Exceptions:**

1. Single-pass fillet welds not exceeding  $\frac{5}{16}$  inch (7.9 mm) in size.
2. Floor and roof deck welding.

**1707.3 Structural wood.** Continuous special inspection during field gluing operations of elements of the seismic-force-resisting system. Periodic special inspections for nailing, bolting, anchoring and other fastening of components within the seismic-force-resisting system, including drag struts, braces and hold-downs.

**Exception:** Fastening of wood sheathing used for wood shear walls, shear panels and diaphragms where the fastener spacing is more than 4 inches (102 mm) on center (o.c.).

**1707.4 Cold-formed steel framing.** Periodic special inspections during welding operations of elements of the seismic-force-resisting system. Periodic special inspections for screw attachment, bolting, anchoring and other fastening of components within the seismic-force-resisting system, including struts, braces, and hold-downs.

**1707.5 Storage racks and access floors.** Periodic special inspection during the anchorage of access floors and storage racks 8 feet (2438 mm) or greater in height in structures assigned to Seismic Design Category D, E or F.

**1707.6 Architectural components.** Periodic special inspection during the erection and fastening of exterior cladding, interior and exterior nonbearing walls and interior and exterior veneer in structures assigned to Seismic Design Category D, E or F.

**Exceptions:**

1. Special inspection is not required for architectural components in structures 30 feet (9144 mm) or less in height.
2. Special inspection is not required for cladding and veneer weighing 5 psf (24.5N/m<sup>2</sup>) or less.
3. Special inspection is not required for interior nonbearing walls weighing 15 psf (73.5 N/m<sup>2</sup>) or less.

**1707.7 Mechanical and electrical components.** Periodic special inspection is required during the anchorage of electrical equipment for emergency or standby power systems in structures assigned to Seismic Design Category C, D, E or F. Periodic special inspection is required during the installation of anchorage of other electrical equipment in structures assigned to Seismic Design Category E or F. Periodic special inspection is required during installation of piping systems intended to carry flammable, combustible or highly toxic contents and their associated mechanical units in structures assigned to Seismic Design Category C, D, E or F. Periodic special inspection is required during the installation of HVAC ductwork that will contain hazardous materials in structures assigned to Seismic Design Category C, D, E or F.

**1707.7.1 Component inspection.** Special inspection is required for the installation of the following components,

> where the component has a Component Importance Factor of 1.5 in accordance with Section 9.6.1.5 of ASCE 7.

1. Equipment using combustible energy sources.
2. Electrical motors, transformers, switchgear unit substations and motor control centers.
3. Reciprocating and rotating-type machinery.
4. Piping distribution systems 3 inches (76 mm) and larger.
5. Tanks, heat exchangers and pressure vessels.

**1707.7.2 Component and attachment testing.** The component manufacturer shall test or analyze the component and the component mounting system or anchorage for the design forces in Chapter 16 for those components having a Component Importance Factor of 1.0 or 1.5 in accordance with Chapter 16. The manufacturer shall submit a certificate of compliance for review and acceptance by the registered design professional responsible for the design, and for approval by the building official. The basis of certification shall be by test on a shaking table, by three-dimensional shock tests, by an analytical method using dynamic characteristics and forces from Chapter 16 or by more rigorous analysis. The special inspector shall inspect the component and verify that the label, anchorage or mounting conforms to the certificate of compliance.

**1707.7.3 Component manufacturer certification.** Each manufacturer of equipment to be placed in a building assigned to Seismic Design Categories E or F, in accordance with Chapter 16, where the equipment has a Component Importance Factor of 1.0 or 1.5 in accordance with Chapter 16, shall maintain an approved quality control program. Evidence of the quality control program shall be permanently identified on each piece of equipment by a label.

**1707.8 Seismic isolation system.** Provide periodic special inspection during the fabrication and installation of isolator units and energy dissipation devices if used as part of the seismic isolation system.

### SECTION 1708 STRUCTURAL TESTING FOR SEISMIC RESISTANCE

**1708.1 Masonry.** Testing and verification of masonry materials and assemblies prior to construction shall comply with the requirements of this section, depending on the classification of building or structure or nature of occupancy, as defined in this code (see Table 1604.5 or Section 1616.2).

**1708.1.1 Empirically designed masonry and glass unit masonry in nonessential facilities.** For masonry designed by Section 2109 or 2110, or by Chapter 5 or 7 of ACI 530/ASCE 5/TMS 402, in nonessential facilities (see Table 1604.5 or Section 1616.2), certificates of compliance used in masonry construction shall be verified prior to construction.

**1708.1.2 Empirically designed masonry and glass unit masonry in essential facilities.** The minimum testing and verification prior to construction for masonry designed by Section 2109 or 2110, or by Chapter 5 or 7 of ACI

530/ASCE 5/TMS 402, in essential facilities (see Table 1604.5 or Section 1616.2), shall comply with the requirements of Table 1708.1.2, Level 1 Quality Assurance.

**TABLE 1708.1.2  
LEVEL 1 QUALITY ASSURANCE**

MINIMUM TESTS AND SUBMITTALS
Certificates of compliance used in masonry construction.
Verification of $f'_m$ prior to construction, except where specifically exempted by this code.

**1708.1.3 Engineered masonry in nonessential facilities.** The minimum testing and verification prior to construction for masonry designed by Section 2107 or 2108, or by chapters other than Chapter 5, 6 or 7 of ACI 530/ASCE 5/TMS 402, in nonessential facilities (see Table 1604.5 or Section 1616.2), shall comply with Table 1708.1.2, Level 1 Quality Assurance.

**1708.1.4 Engineered masonry in essential facilities.** The minimum testing and verification prior to construction for masonry designed by Section 2107 or 2108, or by chapters other than Chapter 5, 6 or 7 of ACI 530/ASCE 5/TMS 402, in essential facilities (see Table 1604.5 or Section 1616.2), shall comply with Table 1708.1.4, Level 2 Quality Assurance.

**TABLE 1708.1.4  
LEVEL 2 QUALITY ASSURANCE**

MINIMUM TESTS AND SUBMITTALS
Certificates of compliance used in masonry construction.
Verification of $f'_m$ prior to construction and every 5,000 square feet during construction.
Verification of proportions of materials in mortar and grout as delivered to the site.

For SI: 1 square foot = 0.0929 m<sup>2</sup>.

**1708.2 Testing for seismic resistance.** The tests specified in Sections 1708.3 through 1708.6 are required for the following:

1. The seismic-force-resisting systems in structures assigned to Seismic Design Category C, D, E or F, as determined in Section 1616.
2. Designated seismic systems in structures assigned to Seismic Design Category D, E or F.
3. Architectural, mechanical and electrical components in structures assigned to Seismic Design Category C, D, E or F that are required in Section 1708.5.

**1708.3 Reinforcing and prestressing steel.** Certified mill test reports shall be provided for each shipment of reinforcing steel used to resist flexural, shear and axial forces in reinforced concrete intermediate frames, special moment frames and boundary elements of special reinforced concrete or reinforced masonry shear walls. Where ASTM A 615 reinforcing steel is used to resist earthquake-induced flexural and axial forces in special moment frames and in wall boundary elements of shear walls in structures assigned to Seismic Design Category D, E or F, as determined in Section 1616, the testing requirements of ACI 318 shall be met. Where ASTM A 615 reinforcing steel is

to be welded, chemical tests shall be performed to determine weldability in accordance with Section 1903.5.2.

**1708.4 Structural steel.** The testing contained in the quality assurance plan shall be as required by AISC 341 and the additional requirements herein. The acceptance criteria for nondestructive testing shall be as required in AWS D1.1 as specified by the registered design professional.

Base metal thicker than 1.5 inches (38 mm), where subject to through-thickness weld shrinkage strains, shall be ultrasonically tested for discontinuities behind and adjacent to such welds after joint completion. Any material discontinuities shall be accepted or rejected on the basis of ASTM A 435 or ASTM A 898 (Level 1 criteria) and criteria as established by the registered design professional(s) in responsible charge and the construction documents.

**1708.5 Mechanical and electrical equipment.** Each manufacturer of designated seismic system components shall test or analyze the component and its mounting system or anchorage and submit a certificate of compliance for review and acceptance by the registered design professional in responsible charge of the design of the designated seismic system and for approval by the building official. The evidence of compliance shall be by actual test on a shake table, by three-dimensional shock tests, by an analytical method using dynamic characteristics and forces, by the use of experience data (i.e., historical data demonstrating acceptable seismic performance) or by more rigorous analysis providing for equivalent safety. The special inspector shall examine the designated seismic system and determine whether the anchorages and label conform with the evidence of compliance.

**1708.6 Seismically isolated structures.** For required system tests, see Section 9.13.9 of ASCE 7.

### SECTION 1709 STRUCTURAL OBSERVATIONS

**1709.1 Structural observations.** Structural observations shall be provided for those structures included in Seismic Design Category D, E or F, as determined in Section 1616, where one or more of the following conditions exist:

1. The structure is included in Seismic Use Group II or III,
2. The height of the structure is greater than 75 feet (22 860 mm) above the base,
3. The structure is in Seismic Design Category E and Seismic Use Group I and greater than two stories in height,
4. When so designated by the registered design professional in responsible charge of the design,
5. When such observation is specifically required by the building official.

Structural observations shall also be provided for those structures sited where the basic wind speed exceeds 110 mph (49 m/sec) determined from Figure 1609, where one or more of the following conditions exist:

1. The structure is included in Category III or IV according to Table 1604.5.

2. The height of the structure is greater than 75 feet (22 860 mm).
3. When so designated by the registered design professional in responsible charge of the design,
4. When such observation is specifically required by the building official.

The owner shall employ a registered design professional to perform structural observations as defined in Section 1702.

Deficiencies shall be reported in writing to the owner and the building official. At the conclusion of the work included in the permit, the structural observer shall submit to the building official a written statement that the site visits have been made and identify any reported deficiencies which, to the best of the structural observer's knowledge, have not been resolved.

### SECTION 1710 DESIGN STRENGTHS OF MATERIALS

**1710.1 Conformance to standards.** The design strengths and permissible stresses of any structural material that are identified by a manufacturer's designation as to manufacture and grade by mill tests, or the strength and stress grade is otherwise confirmed to the satisfaction of the building official, shall conform to the specifications and methods of design of accepted engineering practice or the approved rules in the absence of applicable standards.

**1710.2 New materials.** For materials that are not specifically provided for in this code, the design strengths and permissible stresses shall be established by tests as provided for in Section 1711.

### SECTION 1711 ALTERNATIVE TEST PROCEDURE

**1711.1 General.** In the absence of approved rules or other approved standards, the building official shall make, or cause to be made, the necessary tests and investigations; or the building official shall accept duly authenticated reports from approved agencies in respect to the quality and manner of use of new materials or assemblies as provided for in Section 104.11. The cost of all tests and other investigations required under the provisions of this code shall be borne by the permit applicant.

### SECTION 1712 TEST SAFE LOAD

**1712.1 Where required.** Where proposed construction is not capable of being designed by approved engineering analysis, or where proposed construction design method does not comply with the applicable material design standard, the system of construction or the structural unit and the connections shall be subjected to the tests prescribed in Section 1714. The building official shall accept certified reports of such tests conducted by an approved testing agency, provided that such tests meet the requirements of this code and approved procedures.

## SECTION 1713 IN-SITU LOAD TESTS

**1713.1 General.** Whenever there is a reasonable doubt as to the stability or load-bearing capacity of a completed building, structure or portion thereof for the expected loads, an engineering assessment shall be required. The engineering assessment shall involve either a structural analysis or an in-situ load test, or both. The structural analysis shall be based on actual material properties and other as-built conditions that affect stability or load-bearing capacity, and shall be conducted in accordance with the applicable design standard. If the structural assessment determines that the load-bearing capacity is less than that required by the code, load tests shall be conducted in accordance with Section 1713.2. If the building, structure or portion thereof is found to have inadequate stability or load-bearing capacity for the expected loads, modifications to ensure structural adequacy or the removal of the inadequate construction shall be required.

**1713.2 Test standards.** Structural components and assemblies shall be tested in accordance with the appropriate material standards listed in Chapter 35. In the absence of a standard that contains an applicable load test procedure, the test procedure shall be developed by a registered design professional and approved. The test procedure shall simulate loads and conditions of application that the completed structure or portion thereof will be subjected to in normal use.

**1713.3 In-situ load tests.** In-situ load tests shall be conducted in accordance with Section 1713.3.1 or 1713.3.2 and shall be supervised by a registered design professional. The test shall simulate the applicable loading conditions specified in Chapter 16 as necessary to address the concerns regarding structural stability of the building, structure or portion thereof.

**1713.3.1 Load test procedure specified.** Where a standard listed in Chapter 35 contains an applicable load test procedure and acceptance criteria, the test procedure and acceptance criteria in the standard shall apply. In the absence of specific load factors or acceptance criteria, the load factors and acceptance criteria in Section 1713.3.2 shall apply.

**1713.3.2 Load test procedure not specified.** In the absence of applicable load test procedures contained within a standard referenced by this code or acceptance criteria for a specific material or method of construction, such existing structure shall be subjected to a test procedure developed by a registered design professional that simulates applicable loading and deformation conditions. For components that are not a part of the seismic-load-resisting system, the test load shall be equal to two times the unfactored design loads. The test load shall be left in place for a period of 24 hours. The structure shall be considered to have successfully met the test requirements where the following criteria are satisfied:

1. Under the design load, the deflection shall not exceed the limitations specified in Section 1604.3.
2. Within 24 hours after removal of the test load, the structure shall have recovered not less than 75 percent of the maximum deflection.
3. During and immediately after the test, the structure shall not show evidence of failure.

## SECTION 1714 PRECONSTRUCTION LOAD TESTS

**1714.1 General.** In evaluating the physical properties of materials and methods of construction that are not capable of being designed by approved engineering analysis or do not comply with applicable material design standards listed in Chapter 35, the structural adequacy shall be predetermined based on the load test criteria established in this section.

**1714.2 Load test procedures specified.** Where specific load test procedures, load factors and acceptance criteria are included in the applicable design standards listed in Chapter 35, such test procedures, load factors and acceptance criteria shall apply. In the absence of specific test procedures, load factors or acceptance criteria, the corresponding provisions in Section 1714.3 shall apply.

**1714.3 Load test procedures not specified.** Where load test procedures are not specified in the applicable design standards listed in Chapter 35, the load-bearing and deformation capacity of structural components and assemblies shall be determined on the basis of a test procedure developed by a registered design professional that simulates applicable loading and deformation conditions. For components and assemblies that are not a part of the seismic-load-resisting system, the test shall be as specified in Section 1714.3.1. Load tests shall simulate the applicable loading conditions specified in Chapter 16.

**1714.3.1 Test procedure.** The test assembly shall be subjected to an increasing superimposed load equal to not less than two times the superimposed design load. The test load shall be left in place for a period of 24 hours. The tested assembly shall be considered to have successfully met the test requirements if the assembly recovers not less than 75 percent of the maximum deflection within 24 hours after the removal of the test load. The test assembly shall then be reloaded and subjected to an increasing superimposed load until either structural failure occurs or the superimposed load is equal to two and one-half times the load at which the deflection limitations specified in Section 1714.3.2 were reached, or the load is equal to two and one-half times the superimposed design load. In the case of structural components and assemblies for which deflection limitations are not specified in Section 1714.3.2, the test specimen shall be subjected to an increasing superimposed load until structural failure occurs or the load is equal to two and one-half times the desired superimposed design load. The allowable superimposed design load shall be taken as the lesser of:

1. The load at the deflection limitation given in Section 1714.3.2.
2. The failure load divided by 2.5.
3. The maximum load applied divided by 2.5.

**1714.3.2 Deflection.** The deflection of structural members under the design load shall not exceed the limitations in Section 1604.3.

**1714.4 Wall and partition assemblies.** Load-bearing wall and partition assemblies shall sustain the test load both with and without window framing. The test load shall include all design load components. Wall and partition assemblies shall be tested both with and without door and window framing.

**1714.5 Exterior window and door assemblies.** The design pressure rating of exterior windows and doors in buildings shall be determined in accordance with Section 1714.5.1 or 1714.5.2.

**Exception:** Structural wind load design pressures for window units smaller than the size tested in accordance with Section 1714.5.1 or 1714.5.2 shall be permitted to be higher than the design value of the tested unit provided such higher pressures are determined by accepted engineering analysis. All components of the small unit shall be the same as the tested unit. Where such calculated design pressures are used, they shall be validated by an additional test of the window unit having the highest allowable design pressure.

**1714.5.1 Aluminum, vinyl and wood exterior windows and glass doors.** Aluminum, vinyl and wood exterior windows and glass doors shall be labeled as conforming to AAMA/NWWDA 101/I.S.2 or 101/I.S.2/NAFS. The label shall state the name of the manufacturer, the approved labeling agency and the product designation as specified in AAMA/NWWDA 101/I.S.2 or 101/I.S.2/NAFS. Products tested and labeled as conforming to AAMA/NWWDA 101/I.S.2 or 101/I.S.2/NAFS shall not be subject to the requirements of Sections 2403.2 and 2403.3.

**1714.5.2 Exterior windows and door assemblies not provided for in Section 1714.5.1.** Exterior window and door assemblies shall be tested in accordance with ASTM E 330. Exterior window and door assemblies containing glass shall comply with Section 2403. The design pressure for testing shall be calculated in accordance with Chapter 16. Each assembly shall be tested for 10 seconds at a load equal to 1.5 times the design pressure.

**1714.6 Test specimens.** Test specimens and construction shall be representative of the materials, workmanship and details normally used in practice. The properties of the materials used to construct the test assembly shall be determined on the basis of tests on samples taken from the load assembly or on representative samples of the materials used to construct the load test assembly. Required tests shall be conducted or witnessed by an approved agency.

## SECTION 1715 MATERIAL AND TEST STANDARDS

### 1715.1 Test standards for joist hangers and connectors.

**1715.1.1 Test standards for joist hangers.** The vertical load-bearing capacity, torsional moment capacity and deflection characteristics of joist hangers shall be determined in accordance with ASTM D 1761, using lumber having a specific gravity of 0.49 or greater, but not greater than 0.55, as determined in accordance with AFPA NDS for the joist and hangers.

**1715.1.2 Vertical load capacity for joist hangers.** The vertical load capacity for the joist hanger shall be determined by testing three joist hanger assemblies as specified in ASTM D 1761. If the ultimate vertical load for any one of the tests varies more than 20 percent from the average ultimate vertical load, at least three additional tests shall be conducted. The allowable vertical load for a normal duration of

loading of the joist hanger shall be the lowest value determined from the following:

1. The lowest ultimate vertical load from any test divided by three (where three tests are conducted and each ultimate vertical load does not vary more than 20 percent from the average ultimate vertical load).
2. The average ultimate vertical load for all tests divided by six (where six or more tests are conducted).
3. The vertical load at which the vertical movement of the joist with respect to the header is 0.125 inch (3.2 mm) in any test.
4. The allowable design load for nails or other fasteners utilized to secure the joist hanger to the wood members.
5. The allowable design load for the wood members forming the connection.

### 1715.1.3 Torsional moment capacity for joist hangers.

The torsional moment capacity for the joist hanger shall be determined by testing at least three joist hanger assemblies as specified in ASTM D 1761. The allowable torsional moment for normal duration of loading of the joist hanger shall be the average torsional moment at which the lateral movement of the top or bottom of the joist with respect to the original position of the joist is 0.125 inch (3.2 mm).

### 1715.1.4 Design value modifications for joist hangers.

Allowable design values for joist hangers that are determined by Item 4 or 5 in Section 1715.1.2 shall be permitted to be modified by the appropriate duration of loading factors as specified in AFPA NDS but shall not exceed the direct loads as determined by Item 1, 2 or 3 in Section 1715.1.2. Allowable design values determined by Item 1, 2 or 3 in Sections 1715.1.2 and 2305.1 shall not be modified by duration of loading factors.

### 1715.2 Concrete and clay roof tiles.

**1715.2.1 Overturning resistance.** Concrete and clay roof tiles shall be tested to determine their resistance to overturning due to wind in accordance with SBCCI SSTD 11 and Chapter 15.

**1715.2.2 Wind tunnel testing.** When roof tiles do not satisfy the limitations in Chapter 16 for rigid tile, a wind tunnel test shall be used to determine the wind characteristics of the concrete or clay tile roof covering in accordance with SBCCI SSTD 11 and Chapter 15.

