

CHAPTER 17

STRUCTURAL TESTS AND INSPECTIONS

SECTION 1701 GENERAL

1701.1 Scope. Provisions of this chapter shall govern structural tests and inspections of materials, assemblies and construction to determine structural adequacy and protection.

1701.2 Tests. The building official may require a load test of any construction whenever there is a reason to question its safety for the intended use. Such tests are to be made at the expense of the owner or his agent. The testing shall be done by an approved testing laboratory, or under the supervision of a registered architect or engineer. Load tests are not required for construction that has been designed in accordance with applicable standards listed elsewhere in this code unless the construction has been damaged or there is reason to question the safety of the construction. Nothing in this chapter shall be deemed to modify load test procedures that are included in design standards referenced elsewhere in this code.

SECTION 1702 DEFINITIONS

For definitions, see Chapter 2.

SECTION 1703 TEST REPORTS

Copies of the test procedure and the test report shall be submitted to the building official. The number of copies to be submitted shall be determined by the building official. As a minimum, the test report shall identify the test procedure used, a detailed description of the construction tested, the various load capacities for which the construction was tested, and the type of failure observed.

SECTION 1704 ALLOWABLE LOADS AND ALLOWABLE STRESSES

1704.1 Allowable loads

1704.1.1 For a specific in-place construction the allowable load may be determined by testing, provided the testing is in conformance with this chapter.

1704.1.2 Load tests may be used to determine the allowable load for a construction or construction components that will be manufactured in quantities, provided a load is selected so that at least 95 percent of the construction or construction components will have load tests that are equal to or greater than the selected load. The selected load shall be modified by a factor of safety to establish the allowable load, or the load shall be used with load factors and strength reduction factors. Where standards exist, the

established allowable load shall not exceed the allowable load determined by the standard.

1704.2 Allowable stresses

1704.2.1 Load tests for a specific in-place construction are not intended to be used as a method for determining acceptable allowable working stresses of a material as an alternate to the established standard method of determining such stresses.

1704.2.2 Load tests may be used to determine the allowable stresses for a construction or construction components that will be manufactured in quantities, provided a stress is selected so that at least 95 percent of the construction or construction components will have a stress that is equal to or greater than the selected stress. The selected stress shall be modified by a factor of safety to establish the allowable stress, or the stress shall be used with load factors and strength reduction factors. Where standards exist, the established allowable stresses shall not exceed the allowable stresses determined by the standard.

1704.3 Inclusion limit

1704.3.1 The determination of the load or stress at the 95% value shall be based on a confidence level of at least 75%.

1704.3.2 If the construction or construction components have a nationally recognized standard that establishes an inclusion limit different from the 95 percent value, the inclusion limit in the standard shall be used instead of the 95 percent value.

SECTION 1705 LOAD AND DEFLECTION

1705.1 Load. The live load, dead load and wind load shall be at least equal to that required in Chapter 16. The construction shall sustain, without structural failure or excessive deflection, a superimposed load equal to two times the live load.

1705.2 Deflection. The maximum deflection of the construction shall be limited by Table 1610.1. The construction shall recover at least 75 percent of its maximum deflection within 24 hours after the load is removed.

SECTION 1706 TEST PROCEDURE

1706.1 Established test procedures. The construction shall be tested in accordance with one or more of the following test procedures:

ANSI Z97.1, Safety Glazing Materials used in Buildings - Safety Performance Specifications and Methods of Test

- ASTM D 1143, Testing Piles Under Static Axial Compressive Load
- ASTM D 1761, Testing Mechanical Fasteners in Wood
- ASTM D 3689, Testing Individual Piles Under Static Axial Tensile Load
- ASTM E 72, Conducting Strength Tests of Panels for Building Construction
- ASTM E 196, Gravity Load Testing of Floors and Flat Roofs
- ASTM E 330, Standard Test Methods for Structural Performance of Exterior Windows, Curtain Walls, and Doors by Uniform Static Air Pressure
- ASTM E 447, Standard Test Methods for Compressive Strength of Masonry Prisms

1706.2 Other test procedures. In the absence of an established test procedure governing any specific material or construction, the building official may recognize a test procedure that is established by a nationally recognized organization in the business of establishing test procedures or where no test procedure exists may accept authenticated reports from recognized sources which meet the requirements of this code.

**SECTION 1707
MATERIALS AND ASSEMBLY TESTS**

1707.1 Concrete. The test procedure, test load and acceptance criteria of ACI 318 shall be used for reinforced concrete structures.

1707.2 Glass. The test procedure, test load and acceptance criteria for glass subjected to either impact loads or wind loads shall be in accordance with 2405.

1707.3 Wood

1707.3.1 Joist hangers, framing anchors and similar devices shall be tested in accordance with ASTM D 1761 and be labeled and listed for their load-carrying capacity. The allowable direct load capacity shall be the lower value determined by 1707.3.1.1, 1707.3.1.2, 1707.3.1.3, 1707.3.1.4 or 1707.3.1.5. The allowable direct load capacity shall be for a normal duration of loading if limited by 1707.3.1.4 or 1707.3.1.5. The loads calculated in 1707.3.1.4 and 1707.3.1.5 may be increased for load duration, as allowed by the National Design Specification for Wood Construction, as long as they do not exceed the direct load from 1707.3.1, 1707.3.2 and 1707.3.3. Sections 1707.3.1, 1707.3.2 and 1707.3.3 are maximum direct loads and no load duration increase is allowed. The design values of metal fastening devices as determined by the provisions of Chapter 22 shall not be exceeded.

1707.3.1.1 When each individual ultimate direct load does not vary from the average ultimate load of three tests by more than 20%, the allowable direct load shall be the lowest ultimate direct load divided by three.

1707.3.1.2 When at least one of the ultimate direct loads varies from the average ultimate load by more than 20%, at least six tests shall be performed. The

allowable direct load shall be the average of the ultimate direct loads divided by six.

1707.3.1.3 The allowable direct load shall be the direct load at which the vertical movement of the joist with respect to the header is 1/8 inch (3.2 mm) in any test.

1707.3.1.4 The allowable direct load shall be the allowable design for nails or other fasteners used to secure the device to wood members.

1707.3.1.5 The allowable direct load shall be the allowable design load for the wood members forming the connection.

1707.3.2 Allowable torsional moment capacity for joist hangers shall be the average torsional load at which the lateral movement of the top or bottom of the joist with respect to the original position of the joist is 1/8 inch (3.2 mm) based on a minimum of at least three tests.

1707.3.3 Wood structural panels shall conform to U.S. Product Standards PS 1 or PS 2. Wood structural panels of species or construction not covered in PS 1, when used structurally, shall meet the performance standards in U.S. Product Standard PS 2 for its type.

1707.4 Exterior Window and Door Assemblies. This section defines performance and construction requirements for exterior window and door assemblies installed in wall systems. Waterproofing, sealing and flashing systems are not included in the scope of this section.

1707.4.1 The design pressure for window and door assemblies shall be calculated in accordance with component and cladding wind loads in 1606.

1707.4.2 Exterior Windows and Glass Doors.

1707.4.2.1 Testing and Labeling. Exterior windows and glass doors shall be tested by an approved independent testing laboratory, and bear an AAMA or WDMA or other approved label identifying the manufacturer, performance characteristics and approved product evaluation entity to indicate compliance with the requirements of the following specification:

ANSI/AAMA/NWWDA 101/I.S. 2-97

1707.4.2.2 Supplemental Label. A supplemental temporary label conforming to AAMA 203, Procedural Guide for the Window Inspection and Notification System, shall be acceptable for establishing calculated allowable design pressures higher than indicated on the label required by 1707.4.2.1 for window sizes smaller than that required by the ANSI/AAMA/NWWDA 101/IS2 test requirements. This supplemental label shall remain on the window until final approval by the building official.

1707.4.3 Exterior Door Assemblies. Each exterior door assembly not covered by 1707.4.2 shall be listed and tested for a time period equal to the quantity $3600/V$, where the time period is in seconds and V is in miles per hour taken from Figure 1606. The time period shall also include a 10 second period at a load equal to 1.5 times the design pressure.

1707.4.4 Anchorage Methods. The methods cited in this section apply only to anchorage of window and door assemblies to the main wind force resisting system.

1707.4.4.1 Anchoring Requirements. Window and door assemblies shall be anchored in accordance with the published manufacturer's recommendations to achieve the design pressure specified. Substitute anchoring systems used for substrates not specified by the fenestration manufacturer shall provide equal or greater anchoring performance as demonstrated by accepted engineering practice.

1707.4.4.2 Masonry, Concrete or Other Structural Substrate. Where the wood shim or buck thickness is less than 1 1/2 inches, window and door assemblies shall be anchored through the jamb or by jamb clip. Anchors shall be securely fastened directly into the masonry, concrete or other structural substrate material. Shims shall be made from materials capable of sustaining applicable loads, located and applied in a thickness capable of sustaining applicable loads. Anchors shall be provided to transfer load from the window or door frame to the rough opening substrate.

Where the wood buck thickness is 1 1/2 inches or greater, the buck shall be securely fastened to transfer load to the masonry, concrete or other structural substrate and the buck shall extend beyond the interior face of the window or door frame. Window and door assemblies shall be anchored through the jamb or by jamb clip or through the flange to the secured wood buck. Tapered bucks shall extend beyond the interior face of the window or door frame such that full support of the frame is provided. Shims shall be made from materials capable of sustaining applicable loads, located and applied in a thickness capable of sustaining applicable loads. Anchors shall be provided to transfer load from the window or door frame assembly to the secured wood buck.

1707.4.4.3 Wood or Other Approved Framing Material. Where the framing material is wood or other approved framing material, window and glass door assemblies shall be anchored through the jamb or by jamb clip or through the flange. Shims shall be made from materials capable of sustaining applicable loads, located and applied in a thickness capable of sustaining applicable loads. Anchors shall be provided to transfer load from the window or door frame to the rough opening substrate.

1707.4.5 Mullions occurring between individual window and glass door assemblies.

1707.4.5.1 Mullions. Mullions shall be tested by an approved testing laboratory or be engineered in accordance with accepted engineering practice. Both methods shall use performance criteria cited in 1707.4.5.2, 1707.4.5.3 and 1707.4.5.4.

1707.4.5.2 Load Transfer. Mullions shall be designed to transfer the design pressure loads applied by the window and door assemblies to the rough opening substrate.

1707.4.5.3 Deflection. Mullions shall be capable of resisting the design pressure loads applied by the window and door assemblies to be supported without deflecting more than $L/175$, where L is the span of the mullion in inches.

1707.4.5.4 Structural Safety Factor. Mullions shall be capable of resisting a load of 1.5 times the design pressure loads applied by the window and door assemblies to be supported without exceeding the appropriate material stress levels. If tested by an approved laboratory, the 1.5 times the design pressure load shall be sustained for 10 seconds, and the permanent deformation shall not exceed 0.4% of the mullion span after the 1.5 times design pressure load is removed.

1707.5 Concrete and clay roof tiles

1707.5.1 Overturning resistance. Concrete and clay roof tiles shall be tested to determine their resistance to overturning in accordance with the SBCCI SSTD 11.

1707.5.2 Wind tunnel testing. When roof tiles do not satisfy the limitations in Chapter 16 for rigid tile, a wind tunnel test may be used to determine the wind characteristic of the concrete or clay tile roof covering in accordance with the SBCCI SSTD 11.



SECTION 1708 INSPECTION OF SPRAY-APPLIED FIRE RESISTANT MATERIALS

1708.1 General

1708.1.1 Sprayed fibrous and cementitious materials used for structural fire resistance shall provide the fire resistance ratings set forth in this code. The density, thickness and cohesion/adhesion of the spray-applied fire resistant materials shall be determined in accordance with 1708.1.2 through 1708.1.4.

1708.1.2 Thickness measurement and acceptance criteria:

1. 25% of the structural frame, columns and beams in each story shall be inspected for thickness determination in accordance with ASTM E 605.
2. 10% of beams (other than structural frame members) on each floor shall be selected at random and shall be measured for thickness as required by these methods.

1708.1.3 - 1708.1.4

3. Floor thickness measurements, where required, shall be taken on a random basis for each 10,000 sq ft (929 m²) of area.
4. The average thickness as determined by this procedure shall not be less than that specified in inches (millimeters) subject to a tolerance of $\pm 1/8$ inch (3.2 mm). The acceptance of measurements with a minus tolerance greater than $1/8$ inch (3.2 mm) shall not be permitted. Measurements greater than $1/8$ inch (3.2 mm) above the required shall not be used to determine the thickness average.

Exception: When installed within tolerances allowed by publications listed in 701.5.2.

5. Where thicknesses are less than that required, the condition shall be corrected. The location of any uncorrected areas shall be reported to the building official.

1708.1.3 Density measurement and acceptance criteria:

1. Density test specimens shall be taken from a column, a beam and a deck for each 10,000 sq ft (929 m²) of floor area or fraction thereof or from each floor if the floor area is smaller than 10,000 sq ft (929 m²) in accordance with ASTM E 605.
2. No density sample shall have a density less than 95 percent of the specified density. Where the density is below the 95 percent tolerance allowed above, the work shall be corrected to the satisfaction of the building official.

1708.1.4 Cohesion/adhesion test and acceptance shall be made in accordance with the following criteria:

1. There shall be a cohesion/adhesion test taken from a column, a beam and a deck for each 10,000 sq ft (929 m²) of floor area or fraction thereof, or from each floor if the floor area is smaller than 10,000 sq ft (929 m²) in accordance with ASTM E 736.
2. The following equipment shall be used:
 1. Bottle screw cap, metal or rigid plastic 2 inches to 3 1/4 inches (51 mm to 83 mm) in diameter and 1/2 inch (12 mm) in nominal depth. A hook shall be attached at the center. Where the deck profile does not allow the use of a 3 1/4 inch (83 mm) diameter cap, a smaller cap shall be used.
 2. Adhesive, single or two component, suitable for adhering cap to spray-applied fire resistant materials.
 3. Weighing scale, spring-type (fish hook), with a capacity suitable for the spray-applied fire resistant materials being tested, typically 26 to 66 lb (12 to 30 kg) capacity.

3. The test specimen shall be the in-place spray-applied fire resistant material as applied to any field condition surface. Where a 12 inch by 12 inch (300 mm by 300 mm) area is not available, such as on beams and fluted deck, the width of the beam or the

width of a flute by 12 inch (300 mm) length shall be used. The area shall be at least 4 inch by 12 inch (100 mm by 300 mm).

4. Condition the specimen at atmospheric conditions or in accordance with the manufacturer's recommendations for a period sufficient to be considered dry.
5. Apply adhesive sufficient to fill the metal or plastic cap, and immediately place the cap against the surface of the spray-applied fire resistant material.
6. Support the cap at the surface until the adhesive has adequately cured. Wipe away any excess adhesive around the cap before it cures or carefully cut it away after it cures.
7. Engage the scale with the hook and exert an increasing force at a minimum uniform or incremental rate of approximately 11 pounds/minute (5 kg/min) perpendicular to the surface.
8. Force shall be applied until failure occurs, a predetermined value is reached or until the capacity of the scale is exceeded.
9. Record the force in pounds-force (Newtons) at the time failure occurs or other end point is reached.
10. Field test may be performed by replacing the scale (Item 2.3) with a fixed weight sufficient to exert the minimum force specified in Item 12. The weight must be supported for a minimum 1 minute duration.
11. Calculate the cohesive/adhesive force (bond strength) as follows:

$$CA = F/A$$

Where:

CA = cohesive/adhesive force, lb./ft² (Pa).

F = recorded force, lb (N).

A = area of the cap, ft² (m²).

12. Cohesive/Adhesive Acceptance Criteria. No sample shall have a cohesive/adhesive force of less than 150 psf (7.18 kN/m²). Where the cohesive/adhesive force is less than 150 psf (7.18 kN/m²), the work shall be corrected to the satisfaction of the building official.