

Chapter 3

QUALITY ASSURANCE

3.1 SCOPE: This chapter provides minimum requirements for quality assurance for *seismic-force-resisting systems* and *designated seismic systems*. These requirements supplement the testing and inspection requirements contained in the reference standards given in Chapters 8 through 14.

3.2 QUALITY ASSURANCE: A *quality assurance plan* shall be submitted to the authority having jurisdiction. A *quality assurance plan*, *special inspection(s)*, and testing as set forth in this chapter shall be provided for the following:

1. The *seismic-force-resisting systems* in *structures* assigned to *Seismic Design Categories C, D, E, and F*.
2. *Designated seismic systems* in *structures* assigned to *Seismic Design Categories D, E, and F* that are required in Table 6.1.7.

Exception: *Structures* that comply with the following criteria are exempt from the preparation of a *quality assurance plan* but those *structures* are not exempt from *special inspection(s)* or testing requirements:

1. The *structure* is constructed of light wood framing or light gauge cold-formed steel framing, S_{DS} does not exceed 0.50, the height of the *structure* does not exceed 35 ft above grade, and the *structure* meets the requirements in Items 3 and 4 below
or
2. The *structure* is constructed using a reinforced masonry structural system or *reinforced concrete* structural system, S_{DS} does not exceed 0.50, the height of the *structure* does not exceed 25 ft above grade, and the *structure* meets the requirements in Items 3 and 4 below.
3. The *structure* is classified as *Seismic Use Group I*.
4. The *structure* does not have any of the following plan irregularities as defined in Table 5.2.3.2 or any of the following vertical irregularities as defined in Table 5.2.3.3:
 - a. Torsional irregularity,
 - b. Extreme torsional irregularity,
 - c. Nonparallel systems,
 - d. Stiffness irregularity -- soft *story*,
 - e. Stiffness irregularity -- extreme soft *story*,
 - f. Discontinuity in capacity -- weak *story*.

3.2.1 Details of Quality Assurance Plan: The *registered design professional* in responsible charge of the design of a *seismic-force-resisting system* and a *designated seismic system* shall be responsible for the portion of the *quality assurance plan* applicable to that system. The *quality assurance plan* shall include:

1. The *seismic-force-resisting systems* and *designated seismic systems* in accordance with this chapter that are subject to quality assurance,
2. The *special inspections* and testing to be provided as required by the *Provisions* and the reference standards in Chapters 4 through 14,
3. The type and frequency of testing,
4. The type and frequency of *special inspections*,
5. The frequency and distribution of testing and *special inspection* reports,
6. The *structural observations* to be performed, and
7. The frequency and distribution of *structural observation* reports.

3.2.2 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 authority having jurisdiction 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 authority having jurisdiction;
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.

3.3 SPECIAL INSPECTION: The *owner* shall employ a *special inspector(s)* to observe the construction for compliance with the requirements presented below.

3.3.1 Piers, Piles, Caissons: *Continuous special inspection* during driving of piles and placement of concrete in piers, piles, and caissons. *Periodic special inspection* during construction of drilled piles, piers, and caissons including the placement of reinforcing steel.

3.3.2 Reinforcing Steel:

3.3.2.1: *Periodic special inspection* during and upon completion of the placement of reinforcing steel in *intermediate moment frames*, in *special moment frames*, and in *shear walls*.

3.3.2.2: *Continuous special inspection* during the welding of reinforcing steel resisting flexural and axial forces in *intermediate moment frames* and *special moment frames*, in *boundary members* of concrete *shear walls*, and during welding of shear reinforcement.

3.3.3 Structural Concrete: *Periodic special inspection* during and upon completion of the placement of concrete in *intermediate moment frames*, in *special moment frames*, and in *boundary members* of *shear walls*.

3.3.4 Prestressed Concrete: *Periodic special inspection* during the placement and after completion of placement of prestressing steel and *continuous special inspection* is required during all stressing and grouting operations and during the placement of concrete.

3.3.5 Structural Masonry:

3.3.5.1: *Periodic special inspection* during the preparation of mortar, the laying of masonry units, and the placement of reinforcement and prior to the placement of grout

3.3.5.2: *Continuous special inspection* during the welding of reinforcement, grouting, consolidation, reconsolidation, and placement of bent-bar anchors as required by Sec. 11.3.12.2.

3.3.6 Structural Steel:

3.3.6.1: *Continuous special inspection* for all structural welding.

Exception: *Periodic special inspection* is permitted for single-pass fillet or resistance welds and welds loaded to less than 50 percent of their *design strength* provided the qualifications of the welder and the welding electrodes are inspected at the beginning of the work and all welds are inspected for compliance with the approved *construction documents* at the completion of welding.

3.3.6.2: *Periodic special inspection* in accordance with AISC LRFD or AISC ASD for installation and tightening of fully tensioned high-strength bolts in slip-critical *connections* and in *connections* subject to direct tension. Bolts in *connections* identified as not being slip-critical or subject to direct tension need not be inspected for bolt tension other than to ensure that the plies of the connected elements have been brought into snug contact.

3.3.7 Structural Wood:

3.3.7.1: *Continuous special inspection* during all field gluing operations of elements of the *seismic-force-resisting system*.

3.3.7.2: *Periodic special inspection* for nailing, bolting, anchoring, and other fastening of components within the *seismic-force-resisting system* including *drag struts*, braces, and *tie-downs*.

3.3.7.3: *Periodic Special Inspections* for wood *shear walls*, *shear panels*, and *diaphragms*, that are included in the *seismic force resisting system* when the *Provisions* require the spacing of nails, screws, or fasteners for wood sheathing to be 4 inches or less on center.

3.3.8 Cold-Formed Steel Framing:

3.3.8.1: *Periodic special inspection* during all welding operations of elements of the *seismic-force-resisting system*.

3.3.8.2: *Periodic special inspection* for screw attachment, bolting, anchoring, and other fastening of *components* within the *seismic-force-resisting system*, including struts, braces, and hold-downs.

3.3.9 Architectural Components: *Special inspection* for architectural *components* shall be as follows:

1. *Periodic special inspection* during the erection and fastening of exterior cladding, interior and exterior nonbearing *walls*, and interior and exterior *veneer* in *Seismic Design Categories* D, E, and F.

Exceptions:

- a. Architectural components less than 30 ft (9 m) above grade or walking surface,
 - b. Cladding and *veneer* weighing 5 lb/ft² (24.5 N/m²) or less, and
 - c. Interior nonbearing walls weighing 15 lb/ft² (73.5 N/m²) or less.
2. *Periodic special inspection* during erection of glass 30 ft (9m) or more above an adjacent grade or walking surface in *glazed curtain walls*, *glazed storefronts*, and interior *glazed partitions* in *Seismic Design Categories* D, E, and F.
 3. *Periodic special inspection* during the anchorage of access floors, suspended ceilings, and *storage racks* 8 ft (2.4 m) or greater in height in *Seismic Design Categories* D, E, and F.

3.3.10 Mechanical and Electrical Components: *Special inspection* for mechanical and electrical *components* shall be as follows:

1. *Periodic special inspection* during the anchorage of electrical equipment for emergency or standby power systems in *Seismic Design Categories* C, D, E, and F;
2. *Periodic special inspection* during the installation of anchorage of all other electrical equipment in *Seismic Design Categories* E and F;
3. *Periodic special inspection* during installation of flammable, combustible, or highly toxic piping systems and their associated mechanical units in *Seismic Design Categories* C, D, E, and F;
4. *Periodic special inspection* during the installation of HVAC ductwork that will contain hazardous materials in *Seismic Design Categories* C, D, E, and F; and
5. *Periodic special inspection* during the installation of vibration isolation systems when the *construction documents* indicate a maximum clearance (air gap) between the equipment support frame and restraint of less than or equal to 1/4 inch.

3.3.11 Seismic Isolation System: *Periodic special inspection* during the fabrication and installation of *isolator units* and energy dissipation devices if used as part of the *seismic isolation system*.

3.4 TESTING: The *special inspector(s)* shall be responsible for verifying that the testing requirements are performed by an approved *testing agency* for compliance with the requirements below.

3.4.1 Reinforcing and Prestressing Steel: Special testing of reinforcing and prestressing steel shall be as indicated in the requirements below.

3.4.1.1: Examine certified mill test reports for each shipment of reinforcing steel used to resist flexural and axial forces in *reinforced concrete intermediate frames*, *special moment frames*, and *boundary members* of reinforced concrete *shear walls* or reinforced masonry *shear walls* and determine conformance with the *construction documents*.

3.4.1.2: Where ASTM A615 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* of *Seismic Design Categories* D, E, and F, verify that the requirements of Sec. 21.2.5.1 of ACI 318 have been satisfied.

3.4.1.3: Where ASTM A615 reinforcing steel is to be welded, verify that chemical tests have been performed to determine weldability in accordance with Sec. 3.5.2 of ACI 318.

3.4.2 Structural Concrete: Samples of structural concrete shall be obtained at the project site and tested in accordance with requirements of ACI 318.

3.4.3 Structural Masonry: Quality assurance testing of structural masonry shall be in accordance with the requirements of ACI 350.

3.4.4 Structural Steel: The testing needed to establish that the construction is in conformance with these *Provisions* shall be included in a *quality assurance plan*. The minimum testing contained in the *quality assurance plan* shall be as required in AISC Seismic and the following requirements:

3.4.4.1 Base Metal Testing: Base metal thicker than 1.5 in. (38 mm), when 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 A435, *Specification for Straight Beam Ultrasound Examination of Steel Plates*, or ASTM A898, *Specification for Straight Beam Ultrasound Examination for Rolled Steel Shapes*, (Level 1 Criteria), and criteria as established by the *registered design professional(s)* in responsible charge and the *construction documents*.

3.4.5 Mechanical and Electrical Equipment: As required to ensure compliance with the seismic design requirements herein, the *registered design professional* in responsible charge shall clearly state the applicable requirements on the *construction documents*. Each manufacturer of *designated seismic system components* shall test or analyze the *component* and its mounting system or anchorage as required and shall submit evidence of compliance for review and acceptance by the *registered design professional* in responsible charge of the *designated seismic system* and for approval by the authority having jurisdiction. 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 shall determine whether the anchorages and label conform with the evidence of compliance.

3.4.6 Seismically Isolated Structures: For required system tests, see Sec. 13.9.

3.5 STRUCTURAL OBSERVATIONS: *Structural observations* shall be provided for those *structures* included in *Seismic Design Categories* D, E, and F when one or more of the following conditions exist:

1. The *structure* is included in *Seismic Use Group* II or *Seismic Use Group* III or
2. The height of the *structure* is greater than 75 ft above the *base* or
3. The *structure* is in *Seismic Design Category* E or F and *Seismic Use Group* I and is greater than two *stories* in height.

Observed deficiencies shall be reported in writing to the *owner* and the authority having jurisdiction.

3.6 REPORTING AND COMPLIANCE PROCEDURES: Each *special inspector* shall furnish copies of inspection reports, noting any work not in compliance with the approved *construction documents* and corrections made to previously reported work to the authority having jurisdiction, *registered design professional* in responsible charge, the *owner*, the *registered design professional* preparing the *quality assurance plan*, and the contractor. All deficiencies shall be brought to the immediate attention of the contractor for correction.

At completion of construction, each *special inspector* shall submit a report certifying that all inspected work was completed substantially in compliance with the approved *construction documents*. Work not in compliance with the approved *construction documents* shall be described in the report.

At completion of construction, the contractor shall submit a final report to the authority having jurisdiction certifying that all construction work incorporated into the *seismic-force-resisting system* and other *designated seismic systems* was constructed substantially in compliance with the approved *construction documents*.