
USACE / NAVFAC / AFCESA / NASA UFGS-01 45 35 (August 2008)

Preparing Activity: USACE Superseding
UFGS-01 45 35 (October 2007)

UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UML dated January 2010

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SECTION 01 45 35

SPECIAL INSPECTION FOR SEISMIC-RESISTING SYSTEMS 08/08

NOTE: This guide specification covers the requirements for special inspection and testing for seismic-resisting systems when required by Chapter 2 of FEMA 450 NEHRP RECOMMENDED PROVISIONS FOR SEISMIC REGULATIONS FOR NEW BUILDINGS AND OTHER STRUCTURES. This specification will apply only to buildings.

Edit this guide specification for project specific requirements by adding, deleting, or revising text. For bracketed items, choose applicable items(s) or insert appropriate information.

Remove information and requirements not required in respective project, whether or not brackets are present.

Comments and suggestions on this guide specification are welcome and should be directed to the technical proponent of the specification. A listing of technical proponents, including their organization designation and telephone number, is on the Internet.

Recommended changes to a UFGS should be submitted as a Criteria Change Request (CCR).

PART 1 GENERAL

NOTE: This guide specification will be applicable to both new buildings designed according to UFC 3-310-04 SEISMIC DESIGN FOR BUILDINGS, and existing building seismic rehabilitation designs.

In addition to the special inspection and testing specified requirements, the structural designer of the seismic-resisting structural systems must perform "structural observations" during construction when required by paragraph 2.5 of FEMA 450. All observed deficiencies will be immediately

2009) Building Code Requirements for Structural Concrete and Commentary

ACI 318M

(2008; Errata 2008; Errata 2009) Metric Building Code Requirements for Structural Concrete and Commentary

ACI 530/530.1

(2008; Errata 2008; Errata 2009) Building Code Requirements and Specification for Masonry Structures; Containing Building Code Requirements for Masonry Structures, Specification for Masonry Structures and Companion Commentaries

AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)

AISC 341

(2005; Supp 2005) Seismic Provisions for Structural Steel Buildings

AISC 360

(2005) Specification for Structural Steel Buildings, with Commentary

ASTM INTERNATIONAL (ASTM)

ASTM A 435/A 435M

(1990; R 2007) Standard Specification for Straight-Beam Ultrasonic Examination of Steel Plates

ASTM A 615/A 615M

(2009b) Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement

ASTM A 898/A 898M

(2007) Standard Specification for Straight Beam Ultrasonic Examination of Rolled Steel Structural Shapes

U.S. FEDERAL EMERGENCY MANAGEMENT AGENCY (FEMA)

FEMA 450

(2003) NEHRP Recommended Provisions for Seismic Regulations for New Buildings and Other Structures

1.2 SYSTEM DESCRIPTION

Perform the Special Inspection for seismic-resisting system components as specified. Special Inspector personnel shall be in addition to the quality control inspections and inspectors required elsewhere in this section.

1.2.1 Continuous Special Inspection

Continuous special inspection is the full time observation of the work by the Special Inspector present in the work area whenever work is being performed. Perform continuous special inspection where specified for items as shown on the drawings.

1.2.2 Periodic Special Inspection

Periodic special inspection is the intermittent observation of the work by a Special Inspector present in the work area while work is being performed.

The intermittent observation periods shall be: at times of significant work; recurrent over the complete work period; and total at least 25 percent of the total work time. Perform periodic special inspection where specified for items as shown on the drawings.

1.3 SUBMITTALS

NOTE: Review submittal description (SD) definitions in Section 01 33 00 SUBMITTAL PROCEDURES and edit the following list to reflect only the submittals required for the project. Submittals should be kept to the minimum required for adequate quality control.

A "G" following a submittal item indicates that the submittal requires Government approval. Some submittals are already marked with a "G". Only delete an existing "G" if the submittal item is not complex and can be reviewed through the Contractor's Quality Control system. Only add a "G" if the submittal is sufficiently important or complex in context of the project.

For submittals requiring Government approval on Army projects, a code of up to three characters within the submittal tags may be used following the "G" designation to indicate the approving authority. Codes for Army projects using the Resident Management System (RMS) are: "AE" for Architect-Engineer; "DO" for District Office (Engineering Division or other organization in the District Office); "AO" for Area Office; "RO" for Resident Office; and "PO" for Project Office. Codes following the "G" typically are not used for Navy, Air Force, and NASA projects.

Choose the first bracketed item for Navy, Air Force and NASA projects, or choose the second bracketed item for Army projects.

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for [Contractor Quality Control approval.][information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government.] Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-07 Certificates

Special Inspector[; G][; G, [____]]

Certification attesting that the Special Inspector is qualified by knowledge and experience to perform the specified Special Inspections. Information, which provides evidence of the knowledge and experience necessary to qualify a person as a Special Inspector for the category of work being certified, will accompany the qualification.

Quality Assurance Plan[; G][; G, [_____]]

A copy of the Quality Assurance Plan covered by a certificate indicating that the plan meets the content specified in this section.

1.4 QUALITY ASSURANCE PLAN

NOTE: The designer should retain this paragraph only when Chapter 2 of FEMA 450 requires that a Quality Assurance Plan be developed.

Develop a quality assurance plan containing the following:

- a. A list of all items that require quality assurance Special Inspection and testing, including the type, frequency, extent, and duration of the special inspection for each item on this list.
- b. A list of all items that require quality assurance testing, including the type and frequency of testing for each item on this list.
- c. The content, distribution, and frequency of special inspection reports.
- d. The content, distribution, and frequency of testing reports.
- e. The procedures, controls, and people used within the Contractor's organization to develop, sign, and distribute Special Inspection and Testing reports along with the position title and pertinent qualifications of all Contractor personnel involved.

1.5 SPECIAL INSPECTOR

NOTE: The requirements listed in this section have been included in the national model codes for many years, and it is a premise of FEMA 450 that there will be available an adequate supply of knowledge and experienced inspectors to provide the necessary special inspections for the various structural categories of work. Special training may have to be implemented for the nonstructural categories.

Use a Special Inspector to perform Special Inspections required by this section. The Special Inspector is a person employed by the Contractor and approved by the Government as being qualified by knowledge and experience to perform the Special Inspection for the category of work being constructed. Special Inspectors shall perform their duties independent from the construction quality control staff employed by the Contractor. More than one Special Inspector may be required to provide the varied knowledge and experience necessary to adequately inspect all of the categories of work requiring Special Inspection.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

3.1 PERFORMANCE OF INSPECTIONS

NOTE: Include only those requirements applicable to the project and the applicable Seismic Design Category. Add any additional necessary requirements.

The designer must indicate on the drawings all locations and all features for which special inspection is required in Chapter 2 of FEMA 450, including the locations of all structural elements requiring inspection, such as intermediate moment frames, special moment frames, shear walls, etc. The designer must also clearly indicate the components of these elements that require special inspection, such as boundary elements of shear walls.

Performe Special Inspections for the following where designated on the drawings:

3.1.1 [Piers] [Piles] [Caissons]

- a. Continuous special inspection during [driving of piles] [and] [placement of concrete in [piers] [piles] [caissons]].
- b. Periodic special inspection during construction of [drilled piles] [piers] [caissons] including the placement of reinforcing steel.

3.1.2 Reinforcing Steel

- a. Periodic special inspection during and upon completion of the placement of reinforcing steel in [intermediate moment frames] [special moment frames] [shear walls].
- b. Continuous special inspection during the welding of reinforcing steel resisting flexural and axial forces [in intermediate moment frames] [in special moment frames] [in boundary members of concrete shear walls] [and during welding of shear reinforcement].

3.1.3 Structural Concrete

Periodic special inspection during and on completion of the placement of concrete in [intermediate moment frames] [special moment frames] [boundary members of shear walls].

3.1.4 Prestressed Concrete

Periodic special inspection during the placement and after completion of placement of prestressing steel. Continuous special inspection during all stressing and grouting operations and during the placement of concrete.

3.1.5 Structural Masonry

- a. Periodic special inspection during the preparation of mortar, the laying of masonry units, and placement of reinforcement and prior to

placement of grout.

b. Continuous special inspection during the welding of reinforcement, grouting, consolidation and reconsolidation [and] [placement of bent-bar anchors].

3.1.6 Structural Steel

NOTE: The designer must indicate on the drawings
all locations where welds are loaded to less than
50% of their design strength, thus requiring only
periodic special inspection.

a. Continuous special inspection for all structural welding, except that periodic special inspection is permitted for single-pass 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.

b. Periodic special inspection in accordance with AISC 360 for the installation of bolts in [intermediate moment frames][special moment frames][special truss moment frames][special concentrically braced frames][eccentrically braced frames] except that bolts not required to be fully tensioned need not be inspected for bolt tension, other than to ensure that the plies of the connected elements have been brought into snug contact

3.1.7 Structural Wood

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

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

3.1.8 Cold-Formed Steel Framing

a. Periodic special inspections during all welding operations of elements of the seismic-force-resisting system.

b. 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.

3.1.9 Architectural Components

NOTE: If multiple conditions relative to structure
height or cladding or veneer weight exist on a
project, the designer should indicate on the
drawings where special inspection done according to
this specification paragraph is both required and not
required, i.e., the structure height is 9 m (30

feet) or less or the cladding or veneer weight is
240 kg/m² (5 lb/ft²) or less.

Perform special inspection of the architectural components ensuring that the methods of anchoring and fastening indicated on the drawings are being complied with at the onset of construction of the components, and that the specified or shown number, spacing, and types of fasteners were actually installed. Special inspection for architectural components shall be as follows:

- a. Periodic special inspection during the erection and fastening of [exterior cladding] [interior nonloadbearing partition walls] [exterior nonloadbearing walls] [masonry veneer].
- b. Periodic special inspection during the anchorage of [access floors] [suspended ceilings] [storage racks 2.4 m 8 feet or greater in height].

3.1.10 Mechanical and Electrical Components

NOTE: The registered design professional should consider requirements to demonstrate the seismic performance of mechanical and electrical components critical to the post-earthquake life safety of the occupants. Any requirements should be clearly indicated on the construction documents. Any currently accepted technology should be acceptable to demonstrate compliance with the requirements.

Perform special inspection of the mechanical and electrical components ensuring that the methods of anchoring and fastening indicated on the drawings are being complied with at the onset of construction of the component, and that the specified or shown number, spacing, and types of fasteners were actually installed. Special inspection for mechanical and electrical components shall be as follows:

- a. Periodic special inspection during the anchorage of electrical equipment for emergency or standby power systems.
- b. Periodic special inspection during the installation of anchorage of all other electrical equipment.
- c. Periodic special inspection during installation for flammable, combustible, or highly toxic piping systems and their associated mechanical units.
- d. Periodic special inspection during the installation of HVAC ductwork that will contain hazardous materials.

3.1.11 Seismic Isolation System

Periodic special inspection during the fabrication and installation of isolator units.

3.1.12 Energy Dissipation System

Periodic special inspection during the fabrication and installation of

energy dissipation devices.

3.2 TESTING

NOTE: The specified testing of the structural materials follows procedures and tests long established by industry standards. The acceptance criteria for each material to be tested should be included in the construction documents prepared for the project.

The designer must indicate on the drawings all locations and all features for which testing, to be reviewed by the special inspector, is required in Chapter 2 of FEMA 450. This includes indicating the locations of all structural elements requiring testing, such as intermediate moment frames, special moment frames, shear walls, etc. The designer must also clearly indicate the material, etc. in these elements that require testing, such as the flexural reinforcement used in the boundary elements of shear walls.

Designers should note that, before ASTM A 615 reinforcing steel is specified as an optional material used to resist earthquake-induced flexural and axial forces in special moment frames or in boundary elements of shear walls of structures in Seismic Design Categories D, E, and F, they must verify that the requirements of Sec. 21.2.5.1 of ACI 318 have been satisfied. Also, before ASTM A 615 reinforcing steel is used where it must be welded, chemical tests must be performed to verify the weldability in accordance with Sec. 3.5.2 of ACI 318.

The special inspector shall be responsible for verifying that the testing requirements are performed by an approved testing agency for compliance with the following, where shown on the drawings:

a. Reinforcing and Prestressing Steel: Special testing of reinforcing and prestressing steel shall be as follows:

(1) Examine certified mill test reports for each shipment of reinforcing steel used in reinforced concrete [intermediate frames] [special moment frames] [boundary members of reinforced concrete shear walls] [reinforced masonry shear walls]. The special inspector shall determine conformance with the construction documents.

(2) Examine the reports for chemical tests, done in accordance with Sec. 3.5.2 of ACI 318M ACI 318, which were performed to determine the weldability of ASTM A 615/A 615M reinforcing steel.

b. Structural Concrete: Verify that samples of structural concrete obtained at the project site, along with all material components obtained at the batch plant, have been tested in accordance with the requirements of ACI 318M ACI 318 and comply with all acceptance

provisions contained therein.

c. Structural Masonry: Verify that all quality assurance testing of structural masonry along with all material components is in accordance with the requirements of **ACI 530/530.1** and complies with all acceptance provisions contained therein.

d. Structural Steel:

(1) Verify that all quality assurance testing needed to confirm required material properties [contained in Section **05 12 00** STRUCTURAL STEEL] [and] [given in the quality assurance plan] has been done in accordance with applicable provisions in **AISC 341** and **AISC 360** and that the test results comply with all acceptance provisions contained therein.

(2) When a flange or a plate of steel member with a base metal thickness greater than **38 mm 1.5 inches**, is joined by welding so that the flange or plate is subjected to through-thickness weld shrinkage strains, verify that the required ultrasonic testing for discontinuities behind and adjacent to such welds has been done after joint completion. Further verify that any material discontinuities rejected on the basis of the requirements contained in [Section **05 12 00** STRUCTURAL STEEL] [and] [**ASTM A 435/A 435M** or **ASTM A 898/A 898M**, (Level 1 Criteria)] were repaired and were retested after the repairs and found acceptable.

e. Seismically Isolated Structures: Verify that the required system and component tests for seismically isolated structures have been done in accordance with **FEMA 450** and comply with all acceptance provisions contained therein.

f. Energy Dissipation Systems: Verify that the required system and component tests for seismic energy dissipation systems have been done in accordance with **FEMA 450** and comply with all acceptance provisions contained therein.

3.3 REPORTING AND COMPLIANCE PROCEDURES

NOTE: The success of a quality assurance plan depends upon the experience, training, and knowledge of the special inspector and the accuracy and thoroughness of the reports prepared by the special inspector. It should be emphasized that both the special inspector and the Contractor are required to submit to the Government a final certification attesting that the completed work is in conformance with the approved construction documents.

The Contractor, having day-to-day knowledge of the construction of the project, is in the best position to state whether or not all the construction has been completed in accordance with the approved construction documents. To be fully aware however, the Contractor must institute a system of reporting within its organization that enables the Contractor to effectively practice quality control. The special inspector can only attest to the work

personally inspected and, therefore, the special inspector acts more as an auditor or monitor of the quality control program exercised by the Contractor and the testing conducted by the testing agency.

Continuous inspection does not imply that the special inspector has observed all of the work as it is being installed, rather it implies that the special inspector has observed all of the critical conditions of the work to be sufficiently confident that the work was completed in conformance with the construction documents.

a. On the first day of each month, furnish to the Government five copies of the combined progress reports of the special inspector's observations listing all special inspections of construction or reviews of testing performed during that month, noting all uncorrected deficiencies, and describing the corrections made both to these deficiencies and to previously reported deficiencies. Each monthly report shall be signed by all special inspectors who performed special inspections of construction or reviewed testing during that month, regardless of whether they reported any deficiencies. Each monthly report shall be signed by the Contractor.

b. At completion of construction, each special inspector shall prepare and sign a final report attesting that all work they inspected and all testing and test reports they reviewed were completed in accordance with the approved construction documents and that deficiencies identified were satisfactorily corrected. Submit a combined final report containing the signed final reports of all the special inspectors. Sign the combined final report attesting that all final reports of special inspectors that performed work to comply with these construction documents are contained therein, and that the Contractor has reviewed and approved all of the individual inspector's final reports.

-- End of Section --