CHAPTER 9
REHABILITATION STRATEGIES AND TECHNIQUES FOR NONSTRUCTURAL SYSTEMS

9-1. General

A general set of alternative methods is available for the rehabilitation of nonstructural components. These methods are briefly outlined in the following paragraphs, in approximate order of their cost and effectiveness, together with examples of each to clarify the intent of this classification. The choice of rehabilitation technique and its design is, however, the province of the design professional, and the use of alternative methods to those noted below or otherwise customarily in use is acceptable, provided it can be shown that the acceptance criteria can be met.

a. Replacement. Replacement involves the complete removal of the component and its connections, and its replacement by new components: for example, the removal of exterior cladding panels, the installation of new connections, and installation of new panels. As with structural components, the criteria for the installation of new nonstructural components as part of a seismic rehabilitation project will be the same as for new construction.

b. Strengthening and stiffening. Strengthening or stiffening involves additions to the component to improve its strength or stiffness to meet the required force or displacement levels: for example, secondary bracing could be installed between a structural brace and a support to prevent buckling.

c. Repair. Repair involves the repair of any damaged parts or members of the component, to enable the component to meet its acceptance criteria: for example, some corroded attachments for a precast concrete cladding system might be repaired or replaced without removing or replacing the entire panel system.

d. Bracing. Bracing involves the addition of members and attachments that brace the component internally, and/or to the building structure. A suspended ceiling system might be rehabilitated by the addition of diagonal wire bracing and vertical compression struts.

e. Attachment. Attachment refers to methods that are primarily mechanical, such as bolting, by which nonstructural components are attached to the structure or other supporting components. Typical attachments are the bolting of items of mechanical equipment to a reinforced concrete floor or base. Supports and attachments for mechanical and electrical equipment should be designed according to good engineering principals. The following guidelines are recommended:

(1) Attachments and supports transferring seismic loads should be constructed of materials suitable for the application, and designed and constructed in accordance with FEMA 302.

(2) Attachments embedded in concrete should be suitable for cyclic loads.

(3) Rod hangers may be considered seismic supports if the length of the hangar from the supporting structure is 12 inches or less. Rod hangars

should not be constructed in a manner that would subject the rod to bending moments.

(4) Seismic supports should be constructed so that support engagement is maintained.

(5) Friction clips should not be used for anchorage attachment.

(6) Expansion anchors should not be used for mechanical equipment rated over 10 hp, unless undercut expansion anchors are used.

(7) Drilled and grouted-in-place anchors for tensile load applications should use either expansive cement or expansive epoxy grout.

(8) Supports should be specifically evaluated if weak-axis bending of cold-formed support steel is relied on for the seismic load path.

(9) Components mounted on vibration isolation systems should have a bumper restraint or snubber in the vertical and each horizontal direction. The design force should be taken as $2F_p$.

(10) Oversized washers should be used at bolted connections through the base sheet metal if the base is not reinforced with stiffeners.

Lighting fixtures resting in a suspended ceiling grid may be rehabilitated by adding wires that directly attach the fixtures to the floor above, or to the floor structure to prevent their falling.

9-2. Rehabilitation Criteria for Nonstructural Components

The acceptance criteria for the rehabilitation of existing nonstructural components shall be in compliance with the provisions of Chapter 6 of FEMA 302. Design and detailing of new structural supports, bracing, and attachments for nonstructural components shall be in accordance with the applicable provisions of FEMA 302.

9-3. Rehabilitation Techniques for Nonstructural Architectural Components

a. General. Nonstructural architectural components must be supported and/or braced to resist the seismic inertia forces defined in Section 6.1.3 of FEMA 302. In addition, they must also resist or accommodate the building deformations resulting from seismic ground motion, as prescribed in Section 6.1.4 of FEMA 302. Architectural exterior and interior panels, partitions, and veneers that are rigid or semi-rigid and continuous shall be supported and attached in a manner that will preclude their participation in the lateral resistance of the building structural system. These components shall not be vertically supported at more than one diaphragm level, and shall be rigidly attached to the structural system on only one edge of the component. The following paragraphs describe and depict appropriate details for representative architectural components. When the rehabilitation options developed in accordance with paragraph 6-2c propose replacement of a deficient support or bracing system, or provide components of a support or bracing system that were omitted for an existing component, the following techniques provide guidance to mitigate the deficiencies. When the rehabilitation options propose strengthening or stiffening the existing supports or bracing, it may be assumed that the bracing and support system configuration is acceptable, but that individual members may need strengthening, stiffening, or replacing.

b. Exterior curtain walls.

(1) Deficiencies. Common deficiencies of the attachments for rigid curtain walls (e.g., precast concrete panels) are:

(a) Inadequate strength to transfer the panel seismic inertia forces to the building structural system.

(b) Inadequate flexibility and ductility to accommodate interstory drifts.

(2) Strengthening techniques. When rigid curtain wall panels are installed between two floor levels of a flexible structure (e.g., a steel-moment frame), the interstory drift must be accommodated. Plate glass windows are resiliently mounted in frames that allow sufficient clearance for the frame to distort due to interstory drift without damage to the glass. Figures 5.1a and 5.1b in FEMA 172 illustrate a typical connection detail for precast concrete panels in a steel frame building. Note that the panels are rigidly attached to the lower story, and attached with flexible spacer rods at the top story. The interstory drift is accommodated in the horizontal gap between the panels that is caulked with resilient material. The gravity loads and the in-plane seismic inertia forces are transferred to the building frame by the angles at the base of the panel. As indicated in Figure 5.1b, the angle has an oversize hole for panel alignment with a temporary erection bolt, and then is welded to the vertical restrainer plates when the panel is in position. Figure 10-3 in TM 809-04 indicates the necessary panel details for this attachment procedure. If the precast panels are deficient or unsuitable for proper attachment, consideration should be given to removal and replacement with properly designed panels. Glass fiber reinforced concrete (GFRC) panels have been used successfully on many recent building projects. These panels can provide the same outward appearance as ordinary reinforced concrete, but can be much thinner, and therefore significantly lighter in weight, thus reducing the seismic demand on the existing structural members.

c. Appendages. Cornices, parapets, ornamentation, and other architectural appendages that have inadequate anchorage capacity must be rehabilitated to prevent damage and personnel injury from falling debris. Cornice anchorages can be strengthened by removing the cornice material, adding anchorages, and reinstalling the material. A technique that has been used in rehabilitating heavy and ornate cornice work is to remove the cornice, and reconstruct it with adequate anchorage and new, lighter material such as lightweight concrete or plaster. Parapets can be reduced in height so that the parapet dead load will resist uplift from out-of-plane seismic forces, or they can be strengthened with shotcrete or braced back to roof framing (Figures 5.2a and 5.2b in FEMA 172). All elements must be checked for their ability to sustain new forces imposed by the corrective measures.

d. Veneers. Stone and masonry veneers with inadequate anchorage should be strengthened by adding new anchors. Veneers typically must be removed and replaced for this process. Typical details for approved anchorage of masonry veneers are prescribed in Chapter 12 of ACI 530.

e. Partitions. Heavy partitions such as those of concrete block may fail from excessive flexural stresses due to their out-of-plane seismic inertia forces, or excessive in-plane shear stress caused by interstory drifts. Such partitions should be retrofitted with connections like those shown in Figure 5.4a in FEMA 172 that restrain out-of-plane displacement and allow in-plane displacement. Alternatively, unreinforced masonry partitions can be removed and replaced with drywall partitions. Partitions that cross seismic joints should be reconstructed to allow for longitudinal and transverse movement at joints. Plaster or drywall partitions in office buildings generally need lateral support from ceilings or from the floor or roof framing above the partition. Steel channels are sometimes provided at the top of the partitions. The channels are attached to the ceiling or floor framing; they provide lateral support to the partition, but allow vertical and longitudinal displacement of the floor or ceiling without imposing any loads to the partition. Partitions that do not extend to the floor or roof framing and are not laterally supported by a braced ceiling should be braced to the framing above (as indicated in Figure 5.4b of FEMA 172) with a maximum 12-foot spacing between braces. Hollow clay tile partitions occur in many existing buildings as corridor walls or as nonstructural enclosures for elevator shafts or stairwells. Hollow clay tile is a very strong but brittle material, and it is very susceptible to shattering into fragments that could be hazardous to building occupants. In many cases, it is not possible to isolate these partitions from the lateral displacements of the structural framing, and in those cases, it is advisable to consider either removal of these partitions and replacement with drywall construction, or "basketing" of the potential clay tile fragments with wire mesh.

f. Ceilings. Unbraced suspended ceilings can swing independently of the supporting floor and cause damage or collapse of the ceiling panels, particularly at the perimeters. Providing four-way (12-gauge wire minimum) diagonals and a compression strut between the ceiling grid and the supporting floor at no more than 12 feet on center and within 6 feet of partition walls will significantly improve the seismic performance of the suspended ceiling. Figure 5.5 in FEMA 172 shows a typical detail of the four-way diagonals and the compression strut. In addition to the braces, the connections between the main runners and cross runners should be capable of transferring tension loads. Lay-in ceilings are particularly vulnerable to the relative displacement of the supporting grid members. Splices and connections of the T-bar sections that comprise the grid may have to be stiffened or strengthened with new metal clips and self-threading screws.

g. Lighting fixtures. Suspended fluorescent fixtures are susceptible to several types of seismic damage. Fixtures that are supported by suspended ceiling grids can lose their vertical support when the ceiling sways and distorts under seismic shaking. Independent wire ties connected directly from each of the fixture corners (or at least diagonally opposite corners) to the structural floor above can be added to prevent the fixture from falling (Figure 5.6 in FEMA 172). Pendant-mounted fixtures often are supported by electrical wires. Wire splices can pull apart and allow the fixtures to fall. The fixtures also may swing and impact adjacent objects, resulting in breakage and fallen fixtures. Safety wires can be installed to prevent the fixtures from falling, and diagonal wires can prevent them from swaying. Some fixture manufacturers also provide threaded metal conduit to protect the wiring and to support the fixture, as well as wire straps or cages that can be added to prevent the fluorescent tubes from falling away from the fixture if they become dislodged.

h. Glass doors and windows. Seismic rehabilitation of glass windows and doors to prevent breakage may be a significant effort. Inadequate edge clearances around the glass to allow the building, and hence, the window frame, to rack in an earthquake without bearing on the glass is the principal cause of breakage. Redesign (along with close installation inspection) of the frame and/or glazing to provide sufficient clearance is necessary to prevent seismic breakage. A technique suggested by Reiterman (1985) to reduce life-safety hazards from falling glass is to apply adhesive solar film to the windows. The film will hold together the glass fragments, while also reducing heat and glare. The application of solar film to insulating glass may cause heat build-up inside the glass, and the possible adverse effects of this build-up need to be considered since damage can result.

i. Raised computer access floors. Access floors typically are constructed of 2-foot by 2-foot wood, aluminum, or steel panels supported on adjustable column pedestals. The column pedestals frequently are fastened to the subfloors with mastic. Some assemblies have stringers that connect the top of the pedestals (Figure 5.8 in FEMA 172), and others have lateral braces. When subjected to lateral loads, access floors typically are very flexible, unless they are specifically designed to be rigid. This flexibility may amplify the ground motions such that equipment supported on the floor may experience significantly high displacements and forces. The high displacements also may cause connection failures that could precipitate a significant collapse of the floor. Existing floors can be rehabilitated by securing the pedestals to the subfloor with expansion anchors, or by adding diagonal bracing to pedestals in a regular pattern (Figure 5.8b in FEMA 172). Rehabilitated floors should be designed and tested to meet both a stiffness and a strength criterion.

9-4. Rehabilitation of Nonstructural Mechanical and Electrical Components

a. General. Nonstructural mechanical and electrical components are often vulnerable to seismic damage in moderate to large earthquakes. Damage to mechanical and electrical components can impair essential building functions or threaten life safety. This section presents common techniques for mitigating seismic damages of the following typical mechanical and electrical components:

- Mechanical and electrical equipment
- Ductwork and piping
- Elevators
- Emergency power systems
- Hazardous material storage systems
- Communication systems
- Computer equipment.

b. Mechanical and electrical equipment. Large equipment that is unanchored or inadequately anchored can slide during an earthquake and damage utility connections. Tall, narrow units may also be vulnerable to overturning. Positive mechanical anchorages (Figures 6.1a in FEMA 172) will prevent seismic damage.

(1) Electrical equipment frequently is tall and narrow, and may overturn and slide, causing damage to internal instruments and utility connections. This type of equipment can be secured against sliding or rocking in many ways depending on the location of the units relative to adjacent walls, ceiling, and floors (Figure 6.1b in FEMA 172). In all cases, the capacity of the wall to resist the seismic loads imposed by the connected equipment must be verified.

(2) Mechanical or electrical equipment located on vibration isolators may be particularly vulnerable to being shaken off the isolator supports. Rehabilitation to mitigate the potential for damage involves either replacing the vibration isolation units or installing rigid stops. Vibration isolation units that can also provide lateral seismic resistance are available from isolator manufacturers, and these units (Figure 6.1c in FEMA 172) can be installed in place of the existing isolators. Alternatively, rigid stops designed to prevent excessive lateral movement of the equipment can be installed on the existing foundation (Figure 6.1d and 6.1e in FEMA 172). A sufficient gap needs to be provided between the stop and the equipment to prevent the transmission of vibrations through the stops. Where equipment is tall relative to its width, stops in the vertical direction are required to prevent overturning. The equipment itself, its attachments to the isolators or support rails, and the rails themselves can be points of weakness that need to be assessed and strengthened where required.

c. Ductwork and piping. Seismic retrofit of ductwork and piping primarily consists of providing lateral sway braces. The Sheet Metal and Air-Conditioning Contractors National Association (SMACNA) has published guidelines for the design and seismic restraints of new mechanical systems and plumbing piping systems (September 1982) that can also be used for rehabilitation of existing systems. These guidelines were developed for use in areas of relatively high seismicity, and engineering judgment should be used in their application elsewhere.

(1) The SMACNA guidelines for seismic bracing of ductwork recommend that:

(a) All rectangular ducts 6 square feet in area and greater, and round ducts 28 inches in diameter and larger should be seismically braced.

(b) Transverse braces should be installed at a maximum of 30 feet on center, at each duct turn, and at each end of a duct run.

(c) Longitudinal braces should be installed at a maximum of 60 feet on center.

(d) No bracing is required if the top of a duct is suspended 12 inches or less from the supporting structural member, and the suspension straps are attached to the top of the duct.

(e) Flexibility should be provided where pipes pass through seismic or expansion joints.

(2) The SMACNA guidelines for seismic bracing of piping recommend that:

(a) Braces for all pipes 2½ inches in diameter and larger (and also for smaller piping used for fuel gas, oil, medical gas, and compressed air, and smaller piping located in boiler rooms, mechanical equipment rooms, and refrigeration machinery rooms).

(b) Transverse braces should be installed at a maximum of 40 feet on center.

(c) Longitudinal braces should be installed at a maximum of 80 feet on center.

(d) Thermal expansion and contraction forces, where present, must be considered in the layout of transverse and longitudinal braces.

Figures 6.2a through 6.2c in FEMA 172 show typical seismic brace details for ducting. Duct diffusers also should be positively attached with mechanical anchors to rigid ducts or secured with wires to the floor above when connected to flexible ducts. Figures 6.2d through 6.2g in FEMA 172 show typical details for installing seismic braces for piping.

d. Sprinkler Systems. National Fire Protection Association (NFPA) 13 is the accepted standard for the installation of wet and dry sprinkler systems for fire protection of buildings. Existing sprinkler systems in buildings governed by this document shall be evaluated for compliance with the support and bracing provisions of NFPA 13. Identified deficiencies shall be documented for final assessment and considered for rehabilitation in accordance with paragraph 6.2.

e. Elevators. Elevator machinery and controller units should be anchored like other mechanical and electrical equipment to prevent the units from sliding or toppling. Rope retainer guards should be provided on sheaves to inhibit displacement of wire ropes. Snag points created by rail brackets should be provided with guards so that compensating ropes or chains, governor ropes, suspension ropes, and traveling cables will not snag. Retainer plates should be added to the top and bottom of the cars and counterweights to prevent them from becoming dislodged from the rails. Seismic switches should be installed to provide an electronic alert or command for the safe automatic emergency operation of the elevator system, and to detect lateral motion of the counterweight. For more information on the requirements for elevator seismic safety, refer to ANSI 17.1, *Safety Codes for Elevators and Escalators.*

f. Emergency power systems. Although emergency power systems typically containing batteries, motor generators, fuel tanks, transformers, switchgear, and control panels are designed to be activated in the event of an emergency, many are inadequately protected from earthquake forces.

(1) Batteries are frequently stored in racks as shown in Figure 6.4a in FEMA 172, and structural supports should be installed to restrain the batteries to the racks; the racks should be braced; and adequate anchorages should be provided to carry the lateral loads. Foam spacers also should be fitted snugly between the batteries to prevent them from impacting each other.

(2) Motor generators typically are mounted on vibration isolators, and these units should have seismic stops installed as shown in Figures 6.1d or 6.1e in FEMA 172. Fuel tanks frequently are mounted on legs to facilitate gravity feed of the fuel, and these tanks should be braced as shown in Figure 6.4b in FEMA 172, and provided with adequate anchorage. Flexible fuel piping with adequate loops also should be installed both at the fuel tank and at

the motor generator; transformers, switchgear, and control panels should be anchored as shown in Figure 6.1b in FEMA 172.

g. Hazardous materials storage systems. Seismic-activated shutoff valves should be installed on hazardous materials supply lines. These lines also should be adequately braced as shown in Figures 6.2e and 6.2f in FEMA 172, and should be provided with flexible connections at storage tanks. Bottles of laboratory chemicals should be prevented from falling by using elastic straps or shelf lips as shown in Figure 6.5a in FEMA 172. Liquid oxygen and similar pressurized tanks also should be restrained as indicated in Figure 6.5b in FEMA 172.

h. Communications systems. The operation of communication systems following an earthquake is of vital importance to individuals, communities, federal agencies and private businesses that depend on them to aid in assessing damage and responding to problems.

(1) Telephone communications equipment consists of input and output data processing units, disk drives, central computers, and remote regional and central switching units, much of which is located on raised access floors; this computer-type equipment is discussed in paragraph 9-3i. Remote switching units not located on raised floors should be secured like other mechanical and electrical equipment as discussed in paragraph 9-4b.

(2) Essential facilities such as hospitals and fire and police stations that must have communications capabilities in the event of an earthquake should have backup external and internal communications systems. Radio equipment should be secured to prevent sliding or toppling. Desktop equipment should also be secured or tethered to prevent falling.

i. Computer equipment. Computer equipment vulnerable to seismic damage includes electronic data processing equipment such as mainframes, peripherals, telecommunications cabinets, and tape and disk storage units. Seismic rehabilitation to protect computer equipment is different from that required for other mechanical and electrical equipment for several reasons: (1) computer equipment typically is located on raised access floors that complicate traditional anchorage techniques and may amplify seismic loads; (2) computer equipment design is rapidly evolving and advancing, and units frequently are replaced or rearranged; and (3) some computer equipment may be sensitive to high-frequency vibrations such as those that may be caused by ground shaking.

(1) Electronic data processing (EDP) equipment typically is located on raised access floors; hence, the traditional techniques of anchoring electrical equipment to the floor are complicated by the fact that the anchorage needs to pass through the access floor to the subfloor. This reduces the access to the space beneath the raised floor, and greatly reduces the flexibility to rearrange and replace equipment. Some dynamic tests of EDP equipment also have shown that certain vibration-sensitive equipment may be more prone to seismic damage if it is rigidly anchored to the building and is subjected to high-frequency seismic ground motions than if the equipment is free to slide on the access floor. If EDP units are unrestrained, however, they may slide into

structural walls or adjacent equipment, or their support feet may slide into an access floor penetration, and the unit will topple. Two general solutions may be used to reduce the potential for seismic damage of EDP equipment: (1) rigidly restraining the equipment, or (2) allowing the equipment to slide. Rigid restraints (Figure 6.7a in FEMA 172) may be appropriate for equipment that is not vibration-sensitive, is not likely to be relocated, or is tall and narrow (and, hence, susceptible to toppling). Air-handling units, modem cabinets, and power distribution units fall into this category. Tall, flexible equipment such as modem cabinets may require stiffening or bracing near the top. If anchored only at the base, the seismic motions at the top of the units may be significantly amplified and may result in equipment damage. Figure 6.7b in FEMA 172 shows a detail that will prevent toppling, but does not transmit high-frequency ground shaking to the unit.

(2) Equipment that is vibration sensitive or is likely to require frequent relocations can be isolated to reduce the potential for seismic damage. Some of the considerations necessary for isolating equipment include protecting the equipment from sliding to prevent a supporting foot or caster from falling into an opening in the access floor (provided for cable penetrations). This can be prevented by tethering the equipment to the subfloor (Figure 6.7c of FEMA 172) so that the equipment cannot slide far enough to impact other equipment or walls, or to fall into a penetration. Precautions should be considered for tall equipment restrained with a tether to prevent the equipment from reaching the end of the tether, which may cause the equipment to overturn. Floor penetrations also can be provided with guards (Figure 6.7c in FEMA 172) that will prevent the equipment feet from entering. Adjacent equipment should either be separated by about 1 foot to prevent potential pounding, or should be strapped together (Figure 6.7d in FEMA 172) so that the separate pieces move as a unit.

CHAPTER 10
QUALITY ASSURANCE/QUALITY CONTROL

10-1. General

This chapter prescribes special quality control provisions related to both the seismic evaluation and the seismic rehabilitation design and construction of certain military buildings, as identified herein. These provisions are in addition to those QA/QC processes normally prescribed for evaluation and design, and for the engineering services normally provided during construction of these military buildings. The term Special Independent Technical Review (SITR) is used herein to describe a separate in-depth structural review of the seismic design performed by a qualified reviewer.

10-2. Applicability

The quality requirements given in this chapter shall be applied only to the evaluations, designs, and construction of existing buildings in Seismic Design Categories B, C, D, E, and F that require rehabilitation because of deficiencies in deep foundation systems, intermediate or special moment frames, or special concentric braced frames. Buildings requiring rehabilitation as a result of Tier 2 deficiencies-only evaluations are exempt from this requirement. Additionally, SITRs shall be done for all buildings when the rehabilitation includes seismic isolation or energy-dissipation systems, and for any other building designated by the agency headquarters proponent. All site-specific ground motion studies, whether done for individual buildings or as installation-wide studies, shall be given a SITR.

10-3. Special Independent Technical Review (SITR)

a. Reviewer qualifications. When SITRs are required herein, they shall be performed by one or more structural engineer design professionals, who have been approved by the Government as having recognized expertise in the seismic evaluation and design of buildings.

b. Review scope. A full SITR quality control review of a seismic evaluation or rehabilitation design includes, at a minimum, verification of the validity of all assumptions made during the evaluation or the rehabilitation design processes, and verification of the applicability and theoretical adequacy of the numerical calculations. The SITR will also verify the validity of the selected rehabilitation concepts and their estimated costs. For rehabilitation designs, a SITR will include the determinations both that the design drawings and specifications implement the assumptions made during the rehabilitation design, and that the construction documents are adequate for construction. Based on the stage of the review, evaluation, or rehabilitation design, and on the type and complexity of the structural system involved, the scope of the SITR review will be defined in writing by the cognizant design authority following the guidance discussed below.

c. Review meeting. After completing the SITR, the reviewer or review team will meet with the structural engineer evaluator or designer, as appropriate, to discuss the review results and resolve any differences concerning the evaluation or design that may exist.

d. Review report. Following the review meeting, the reviewer or review team will develop and submit a report summarizing the scope and limitations of the review, the discussions and conclusions from the review meeting, and the final recommendations from the review.

10-4. Evaluation

SITRs will be performed for the seismic evaluations of all buildings meeting the applicability requirements given herein.

10-5. Rehabilitation Design

If, after completion of the evaluation report, a seismic rehabilitation project has been funded, the following SITR activities will be performed during the rehabilitation design process.

a. Review process. A SITR of the rehabilitation designs of all buildings meeting the applicability requirements given herein will be performed as given below.

(1) Concept design review. For seismic rehabilitation projects, both the *"structural rehabilitation strategy"* (Step 2 in Table 6-1) and the *"structural rehabilitation concept"* (Step 3 in Table 6-1) parts of the completed evaluation report, along with both the *"supplementary analysis of existing building (if necessary)"* (Step 3 in Table 7-1) and *"rehabilitation concept selection"* (Step 4 in Table 7-1) parts of the preliminary rehabilitation design shall be given a SITR before the *"rehabilitation design"*(Step 5 in Table 7-1) is begun.

(2) Final design review. Following the completion of the rehabilitation design (Steps 5 & 6 in Table 7-1), during the period when the construction documents are being completed (Step 7 in Table 7-1), a SITR of the final design of the project will be done.

b. Contract specifications. Following the completion of the final design analysis, the structural designer shall edit and include in the contract specifications the guide specification, CEGS-01452, SPECIAL INSPECTION AND TESTING FOR BUILDING SEISMIC-RESISTING SYSTEMS. The editing shall provide the special inspection and testing provisions required for the types of systems constructed in the project.

10-6. Construction

During the construction of seismic-force-resisting structural systems, the structural designer or the SITR reviewer shall provide the following quality assurance services:

a. Review the qualifications of the special inspector.

b. Review the construction quality assurance plan, done in accordance with the requirements in CEGS-01452.

c. Review the special inspector's reports concerning observations and testing.

d. Perform *"Structural Observations"* as described in Chapter 3 of FEMA 302.

e. Review drafts of as-built drawings to confirm the final constructed conditions of the structural lateral-force-resisting system(s) are accurately detailed.