3/7/2018 BSSC PUC IT5/IT6 Joint Meeting
Issue Team 5 - Nonstructural Components
Issue Team 6 – Nonbuilding Structures
9:30 AM – 4:00 PM CST.

CB&I
21030 Research Forest Drive, The Woodlands, TX

Attendees (italicized via internet):

Peter Carrato
Travis Churpalo
John Gillengerten
Bret Lizundia
John Silva
Greg Soules
Chris Tokas
Hussain Bhatia
Phil Caldwell
Meaghan Halligan
Maryann Phipps
John Rolfes
Robert Simmons
Brian Weiss
PUC Chair: David Bonneville
BSSC Staff: Jiqiu Yuan

Agenda items and discussion. Action items in bold

Welcome, Introductions, Agenda Review

The participants were welcomed and there were brief introductions. The intent of the meeting was discussed—clarify the distinctions between nonbuilding structures and nonstructural components, and improve coordinate between Chapters 13 and 15 of ASCE 7.

The performance objectives for nonbuilding structures were discussed. Like buildings, nonbuilding structures are assigned to seismic risk categories based on their function and use.

Penthouses

Penthouses are currently design to the requirements of Chapter 13, as a nonstructural component. The nature of penthouse structures was discussed. These can vary from small enclosures at the top of stairs and elevators to large structures covering 30% of the roof area. It was agreed that the dynamic response of the penthouse will vary greatly depending on the size and nature of the penthouse structure. It was
also agreed that in many cases the penthouse lateral system selected might not be permitted as the primary lateral force-resisting system for a structure, such as an ordinary braced frame. Greg Soules pointed out that there are rules in Chapter 15 for the design of nonbuilding structures supported by other structures, including provisions for the use of some ordinary systems in SDC D and higher.

Different design approaches for penthouse structures were discussed. One option is to include the penthouse in the structural model of the building, and factor the forces in the penthouse structural elements for differences in the R value. Since the R value for the penthouse is often lower, the difficulty of determining how far into the structure the factored penthouse forces should be taken was discussed. Bret Lizundia pointed out that there are already provisions in Chapter 12 for vertical combinations of lateral force resisting systems, which should not be triggered by a penthouse.

There was a general desire to keep the requirements for small penthouses in Chapter 13 as a nonstructural component. For larger penthouse structures, the design coefficients—either R, Cd, and Ω or a system-specific value of Rp—should be selected based on the type of lateral force-resisting system, rather than using a single set of factors as is currently the case.

Maryann Phipps proposed that penthouses remain in Chapter 13. For small penthouses, a single conservative value for Rp could be used. For larger penthouses, appropriate factors based on the nature of the lateral force resisting-system should be obtained from Chapter 15. There was general support for this approach. Bret Lizundia noted the need to review the value of Rp for small penthouses, consider penthouse lateral system ductility limits based on hazard level, and restrict the use of nonductile lateral systems such as URM.

The discussion turned to size limits on penthouse structures. Peter Carrato pointed out that the current trigger for using Chapter 15 requirements for a penthouse is 25% of the total building weight. Bret Lizundia noted several tiers based on size could be used, for example:

- Small (stair enclosures, etc.)
- Up to 10% of building weight
- 10% to 20% of building weight
- Over 25% of building weight

In all cases, the engineer should retain the ability of including the penthouse in the main structural model of the building.

Greg Soules pointed out that Chapter 15 does not contain procedures for computing a design lateral force. The user is directed to Chapter 12 for the force computation using design coefficients obtained in Chapter 15, subject to additional detailed requirements for nonbuilding structures. Therefore, lateral force computations for nonstructural components should remain in Chapter 13, but Chapter 15 can be a source of design coefficients and detailed design requirements. Referencing Chapter 15 provisions for nonstructural components will require close coordination.

The final recommendations for penthouses were:

1. Retain penthouses in Chapter 13.
2. Develop Rp values for different penthouse lateral systems, based on Chapter 12 and 15 design coefficients.
3. Reference detailed design requirements for the penthouse lateral force-resisting system in Chapter 12 and 15
4. Retain the option of including the penthouse in the main structural model of the building.
5. Provide pointers to the Chapter 13 penthouse design provisions in Chapter 12 and 15

Distribution Systems

Distribution systems include piping, ducts, and electrical raceways. The design procedures for distributed systems were discussed. A question was posed, is the stiffness of the distribution system routinely considered in the analysis for locating the system’s lateral bracing? In many cases, the layout of bracing is governed by the capacity of the structure to sustain point loads. In some cases deflections are checked, but often general rules are applied for spacing between bracing. For example, the spacing of transverse/longitudinal braces is often 20 ft/40 ft for cast iron piping, and 40 ft/80 ft for copper piping. Robert Simmons noted that Chapter 13 assumes that the piping system does not affect the response of the supporting structure. For large bore piping this may not be the case. Meaghan Halligan noted that well designed piping systems are rugged. The high Rp values for some types of piping are never actually used for design since the minimum lateral force will govern.

The question of whether a piping system can have sufficient stiffness to be considered a nonbuilding structure and be including in the lateral analysis per Chapter 15 was discussed. Another alternative would be to direct the designer to ASME piping provisions for stress analysis if the piping stiffness exceeds a threshold value. A list of conditions where pipe stiffness and deflections should checked for distribution systems with Ip=1.0 and 1.5 was proposed. These include:

1. Risers
2. Pipe, duct and conduit drops to equipment. A challenge for this is determining who is responsible for checking deflection compatibility, the designer of the distribution system or the equipment supplier. In either case, one party may specify the displacement demand but the design responsibility is often delegated to other parties.
3. Displacement between supports, where interaction with other components or systems is possible. John Gillengerten will try to obtain a draft copy of an effort to develop prescriptive clearances for distribution systems in healthcare facilities. Not intended for Ip=1.0 systems or components.
4. Conditions where, due to changes in direction, pipe deflections impose loads at bracing points.

Provisions for duct systems in Chapter 13 are focused on systems constructed of light gage materials installed in residential, commercial, and institutional structures. Much larger air and gas duct systems are constructed in industrial facilities. It was noted that large ducts in industrial facilities are typically determinant systems with regular flex joints. Case studies were proposed to determine if the current provisions for ductwork in Chapter 13 are adequate for all applications.

The ramifications of failure of distribution systems were discussed. A common effect of failure in piping systems is flooding, Electrical distribution systems have similar performance issues but the consequences of damage may be less severe. Additional commentary is needed that discusses the impacts of system failure, potential for interaction between rigid distribution systems and the
supporting structure, and the importance of identifying who has design responsibility at interfaces between distribution systems and equipment. This commentary should be a joint effort of IT5 and IT6.

Conveyors are discussed only in Chapter 13, but the structures supporting many conveyors are designed as nonbuilding structures. The committee felt that the requirements in Chapter 13 should be limited to the attachment of the conveyors to the supporting structure. Users should be referred to Chapter 15 for the design of the conveyor supporting structure.

**Supports for Nonstructural Components**

Supports for nonstructural components are defined as:

“Those members, assemblies of members, or manufactured elements, including braces, frames, legs, lugs, snubbers, hangers, saddles, or struts, and associated fasteners, that transmit loads between nonstructural components and their attachments to the structure.”

The design of supports for nonstructural components was discussed. Currently, the supports use the same \( a_p \) and \( R_p \) factors as the component they support, regardless of the nature of the support system. There are no references to industry design standards for materials. John Gillengerten suggested that the design of certain types of supports such as platforms or support structures carrying multiple nonstructural components of significant size should be designed based on the structural properties of the support structure, rather than the items being carried. A similar approach could be used for the design of bracing for distributed systems. Chapter 15 could be referenced for detailed design requirements for different support structures.

While some committee members liked the idea of splitting component and support design in some cases, there were concerns that for many components, this might represent an unwarranted complication in design. Examples include small tanks on legs, and skid-mounted components. There was also concern that the anchor forces not be increased if the design of the component and the support is split. Bret Lizundia suggested that the committee would benefit from some illustrations that identify the component/support/attachments for different nonstructural components. These illustrations could be used to show existing and proposed criteria for design of nonstructural component supports. These illustrations could also be used to discuss size limits for nonstructural components. There is a point where nonstructural components are so large that they should be designed as nonbuilding structures. The illustrations can be arranged to identify the design force, what if any detailing provisions currently apply, and what portions of the component supports should be referred to Chapter 15 for detailed design.

During the meeting, the group was informally polled on types of nonstructural components that are sometimes constructed to sufficient size that it warrant analysis as a nonbuilding structure, and be subject to Chapter 15 requirements:

- Cooling towers – Yes, need to specify size criteria
- Generators – Perhaps
- Compressors – Perhaps
- Tanks and vessels - Yes, need to specify size criteria
- Bill boards – Yes. The group felt large billboards should be in Chapter 15.
25% Rule for Dynamic Interaction between Nonstructural Components and the Structure

The group discussed the origin of the rule that if the weight of a nonstructural component is greater than or equal to 25% of the weight of the combined component and supporting structure, an analysis combining the characteristics of both must be performed. Greg Soules traced the origins of the requirement, which seems to come from the nuclear industry. The group agreed that additional commentary is needed in Chapter 15, describing the basis of the exiting provisions. It was also noted that the method for analysis presented in Section 15.3.2.1 should be deleted, since no component of the size in view could have a period of 0.06 seconds. It was also noted that the 25% rule is intended to apply to discrete components, not distributed systems.

Action Items:

- Develop the concept of splitting the design of nonstructural components and supports (separate Rp values).
  - No increase in anchorage forces.
  - Prepare illustrations that identify the component/support/attachments for different representative nonstructural components. Assigned to John Gillengerten
- Prepare illustrations of nonstructural components approaching the size where they should be considered nonbuilding structures.
- Penthouse structures will remain in Chapter 13. Design coefficients will be expanded based on different lateral force resisting systems and references will be made to Chapters 12 and 15 for detailed design requirements. The option to include the penthouse in the model for the entire structure will be retained. The exceptions for vertical combinations of systems for rooftop structures in Section 12.2.3.1 will be reviewed.
- Billboards supported by structures will remain in Chapter 13. References will be made to Chapters 15 for detailed design requirements.
- Billboards supported at grade will remain in Chapter 15.
- Expand the coverage of design of distribution systems for displacements. Provide expanded discussion in the commentary on design of risers and drops. Gather data on empirical clearances to prevent interaction between distribution systems and other items.

The meeting was adjourned at 3:40 PM.