FEMA-NIBS BSSC PROVISIONS UPDATE COMMITTEE

Issue Team 6 - Nonbuilding Structures

Meeting #2, October 2, 2016
Conference Call
Prepared by Pete Carrato

Attendees:

Voting Members:
Pete Carrato, Bechtel Corporation, Chair of IT
Greg Soules, CB&I (PUC Member)
Bill Scott, AISC Industrial building committee
Eric Wey, Fluor

Corresponding Members:
Robert Simmons, Petra Seismic/ASHRAE
Harold Sprague, Parsons
John Rolfes, Computerized Structural Design

Guests:
Mark Thompson, Fluor (pipe stress engineer)

Discussion:

This meeting was focused on the interaction between large bore piping and connected components and structures. Eric Wey from Fluor led the discussion using the following outline:

I. DEFINITION OF SCOPE and GOALS: Define what do we hope to accomplish and by when.
II. Define: “Influential Large Bore Piping”
III. ORIGIN OF THE DISCUSSION: DISCIPLINE SILOS VS INTERACTION of pipe-equipment-structure
IV. VERY LARGE MODULES, LARGE BORE PIPE, HIGH SEISMIC RISK LOCATIONS
V. SIMILAR CONFIGURATIONS: FCCU REACTOR AND REGENERATOR
VI. DEFLECTION SENSITIVE STRUCTURES:
   A.) VIBRATION AND RESONANCE SENSITIVE PIPE AND EQUIPMENT
      1.) Reciprocating compressors and associated piping
      2.) Turbine driven elevated Centrifugal compressors and associated piping
      3.) Crude heaters with two-phase flow
   B.) EQUIPMENT AND PIPE WITH STRINGENT DEFLECTION CRITERIA
      1.) Sensitive nozzle loads (e.g.: fin-fan air coolers)
The discussion began with exploring the definition of large bore pipe. A more descriptive term “influential large bore pipe” was proposed. This would include large bore piping that has significant weight and/or stiffness such that it influences the seismic response of the system. J. Rolffes mentioned that large duct work such as that for steel mills can also effect the seismic interaction of connected components and structures. Both ASME and ANSI have defined small bore piping. The criteria is 1 inch in diameter or smaller for ASME Section III class 1 piping, 2 inches or smaller for classes 2 and 3, and 2 inches or smaller for ANSI B31.1 Jul 10, 1996. The seismic interaction of all piping larger than 2 inches is not practical.

G. Soule provided an account of a failure he observed in Chile that was exacerbated by large bore pipe interacting with vessels that were supported on separate foundations.

Two areas of detrimental seismic effects were identified; 1) the connecting large bore pipe having a negative impact on the connected components or structures, especially vibration sensitive equipment (turbines) or equipment with limited nozzle capacity (fin fan coolers) and 2) the connection of components and structures having a negative effect on the connecting pipe, especially if it leads to pipe rupture for high energy or toxic systems.

The balance of the discussion focused on identifying a “trigger” that requires additional analysis. It was pointed out that frangible connections have been used in many cases to mitigate piping interaction effects. If a detailed analysis is required then it should employ a systems approach that includes, structural design, piping stress analysis, pipe hanger considerations, and performance considerations such as sensitivity of connected equipment to seismic excitation and any hazard associated with the fluid carried by the piping.

It was generally agreed that for design category A and B no additional analysis was required. It was also generally agreed that for design category D and higher additional analysis is required. For design category C the trigger should consider mass and stiffness effects as well as the performance consideration discussed above. It was agreed that the mass effect would be the easy one to quantify using a rule such as “if the piping exceeds 25% of the mass of either connected component or structure then detailed analysis is required.” The other considerations, stiffness
and performance are more difficult to define. The chair will identify a smaller group of 2 to 3 who will develop a proposal for potential triggers for additional analysis of large bore pipe effects and present it to the IT for further discussion.

Action Items and Status:

Existing Action Items:

1) R. Simmons to contact fiber glass cooling tower vendors to gage their acceptance of an R value of 2.
   Status: The Cooling Technology Institute (CTI) has been contacted. They have a group that is working on R values. This group provided the following report: The R factor for FRP cooling towers is indeed in question within the ASCE group as well as CTI. Engineers within CTI are struggling with an R of 2.0 due to having used 3.5 for many years thus far. FRP towers are constructed identical to wood towers and member sizes are even similar thus the matching of the R factor to wood towers to date has been occurring. However, until more testing can be done on FRP cooling towers, it appears that a value of 2.0 will be used in the new ASCE Design Code when it comes out. CTI is working on getting some testing done but this will take time as well as funding so, until that occurs, we are not sure how accurate the 2.0 value will be.

2) G. Soules to contact B. Manley to determine if AISI has a position on corrugated metal structure and to see if there are contacts among the corrugated bin and tank vendors who would like to provide input to IT6.
   Status: B. Manley was contacted. She has colleagues in the corrugated metal structure industry and is working on providing G. Soules with contact information.

New Action Item:

3) E. Wey will provide a copy of a paper he presented at the ASCE Structures Congress on the large bore piping issue for distribution to the IT.

4) P. Carrato to establish a group to develop potential trigger mechanisms for detailed analysis of large bore pipe effects.
   Status: E. Wey and G. Soules will prepare a proposal for triggering detailed analysis. This should be ready for the Team to discuss by December.