PAPER 107: DESIGN LESSONS LEARNED FROM THE PERFORMANCE OF INSTRUMENTED HIGH-RISE BUILDINGS IN THE SAN FERNANDO EARTHQUAKE

by

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DISCUSSION by: Sigmund A. Freeman[I]

The author has related the results of the investigation of eleven high-rise buildings, instrumented with strong-motion accelerographs at the time of the San Fernando Earthquake, to potential weaknesses in current earthquake design procedures and to recommendations for code revisions. Being associated with a firm that was responsible for the investigation of five (Bldg. Nos. 27-31) of these buildings I feel qualified to make some supplementary comments to the author's paper.

Footnote III of Table 1 indicates that the lateral shear ratios (as defined by the author) of Buildings 29 and 30 may be too high because of nonlinear behavior. Actually, the data used to obtain the values in Table 1 did account for the nonlinear effect by using a softened model to correlate to the measured lengthening of structure periods during its response to the earthquake. If the structures had remained elastic throughout the earthquake, shear forces would have been higher.

If lateral displacement ratios were used in lieu of lateral shear ratios a better correlation with earthquake repair costs would be obtained. Buildings 28, 29, and 30 all had observed lengthening of periods during the response to the earthquake which will increase the earthquake/code design ratios. The other structures had little or no observed period change during the earthquake.

In Table 1, I believe the footnotes for Building 31 under lateral shear ratio should be IV instead of VI.

It may be unfair to state that in two cases, nonstructural damage was felt to be disproportionally high. The earthquake demand was substantially greater for these structures (Buildings 29 and 30) than for the other structures. If some of the other structures had been located at the Building 29 site there would have been substantially more damage to them. However, it is true that the seismic design code forces are substantially lower than the equivalent force resistance demanded by the earthquake.

I question whether a factor of "four times the distortions resulting from code required forces" is adequate in light of displacements observed in Buildings 27, 28, and 29, which were substantially greater than four times code. The question also arises as to how the lateral deflections are determined. In the case of reinforced concrete how are the section properties calculated (e.g., cracked vs. uncracked section)?

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