THE DETERMINATION OF MODIFICATION FACTOR FOR OUTRIGGER BRACED STRUCTURES USING TIME HISTORY ANALYSIS

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According to developments in construction of high-rise buildings both in Iran and developing countries, more concentration and studies on seismic behavior of these types of structures are required. Due to a large variety of high-rise buildings, current research is carried out on a special type of above mentioned buildings, which is composed of a steel braced welded structure equipped with outrigger bracings both on roof and mid height levels. Outrigger braced high-rise structures are assumed to be a basic solution for overturning problem by out breaking the total outer structure of high-rise buildings. This system is much more effective than the conventional braced frame structures for buildings ranged from 40 to 60 stories high.

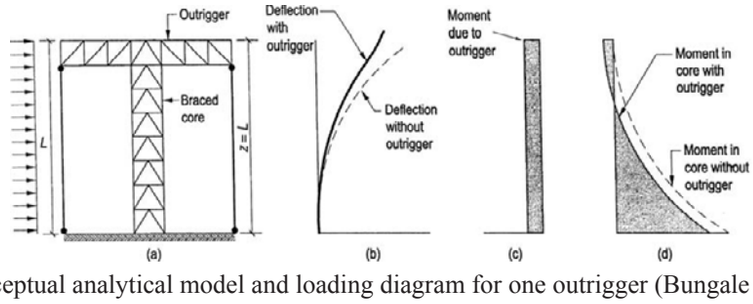

Figure 1. Conceptual analytical model and loading diagram for one outrigger (Bungale and Taranath, 2005)

First the computational method for modification factor and related effective parameters are briefly described in this research.

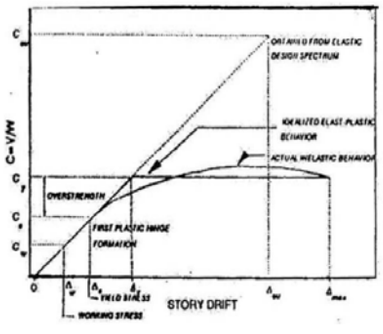

Figure 2. General seismic response of structures

$$R_{\mu} = C_{eu} / C_{y} \quad (1)$$

$$R_{s} = C_{y} / C_{s} \quad (2)$$

Then a total of 8 two dimensional frames (ranging from 20 to 60 stories high) equipped with outrigger bracings of various types both on roof and mid height levels are modeled. Then the assumed finite element models are analyzed and designed according to Iranian 2800 seismic code taking into account the site specifications and S_a=0.25g , 0.35g spectral acceleration levels. Afterwards, by using accelerograms recorded on soil types 1,2,3 & 4 (due to 2800 code), and after scaling them to S_a=0.25g & S_a=0.35g, a total of 1280 linear and nonlinear Time History analyses are carried out on the above mentioned 2D models, using Sap 2000 Ver 16.1.1 finite element software. By performing a "Modal Push-over Analysis" on each model and by using achieved results of above mentioned analyses, the ductility (1) and over strength reduction factors (2) are computed for each model and related records.

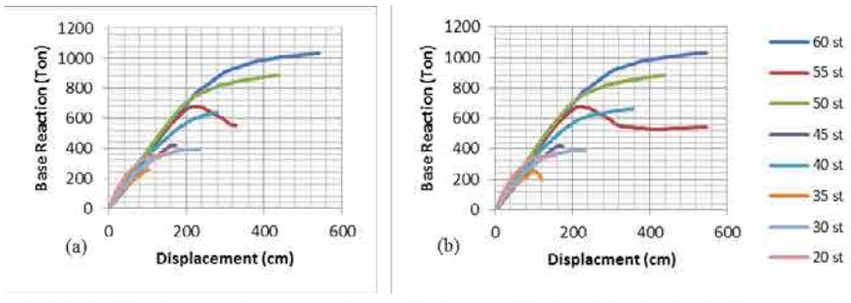

Figure 3. Modal Push-over diagrams for (a) Soil type III, S_a=.25g & (b) Soil type IV, S_a=.35g

Finally, the modification factors are calculated for both "Ultimate state" and "Working stress" design methods respectively, using the following equations:

$$R = R_{\mu} . R_{s} \quad (3)$$

$$R_{w} = R_{\mu} . R_{s} . Y \quad (4)$$

$$Y = C_{s} / C_{w} \quad (5)$$

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