ASSESSMENT OF SEISMIC RESPONSE PARAMETERS OF TALL BUILDINGS WITH TUBE IN TUBE STRUCTURAL SKELETON

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In this research, the basic response parameters of the nonlinear dynamic behavior of steel tall buildings with tube in tube structural skeleton consisted of two systems of exterior braced-tube and interior framed-tube was studied. Pulse- like ground motions are utilized in a separate study to gain further insight into the effects of high-amplitude free field pulses on structural demands. It is noticeable that there are powerful forward directivity effects in the time history of the selected earthquake records.

As shown in Figure 1, the studied model is a 30-story steel tube in tube structure which has been designed according to the Iranian civil engineering standards. Yet, the base shear coefficient related to the seismic lateral load has been calculated according to the Iranian seismic design code 2800. The sections of members and the connection zones of the studied model have been designed based on the Iranian national building code (steel structures - part 10). A number of diagonal girders are considered in the skeleton of the studied structure to connect efficiently the exterior braced tube to the interior rigid framed tube. The redesigned building performs significantly better than the ordinary existing buildings with tall buildings with tube in tube structural skeleton.

Analytical assessments of other researches results indicate that the structural seismic response parameters are obviously affected by those strong earthquake records which contain pulse type features as well as surpassing forward directivity effects. Furthermore, it was observed many times that specified design provisions for regular low-rise and even mid-rise buildings are not adequate to prevent serious damages in the structure of tall buildings (Movahed et al., 2014).

The studied outputs of the analyzed model include the maximum acceleration, the maximum velocity and both of the maximum displacement and drift of each story. These results are related to the three dimensional nonlinear dynamic behavior of the studied model. The drift parameters for the 30-story model are illustrated in Figure 2. Based on the analytical assessment of the results, the total behavior of steel tube in tube tall building structures would extremely be affected by strong earthquake records. As a general conclusion, it is important to pay attention carefully to control the lateral displacement and drift of tall buildings structures. In modeling process of structure, non-linear damage analyses of the structure was performed using the program SAP2000 version 14.2.2. SAP2000 utilizes Newmark and Hilber-hughes - Taylor time integration schemes to solve the nonlinear equations of motion at each time step.

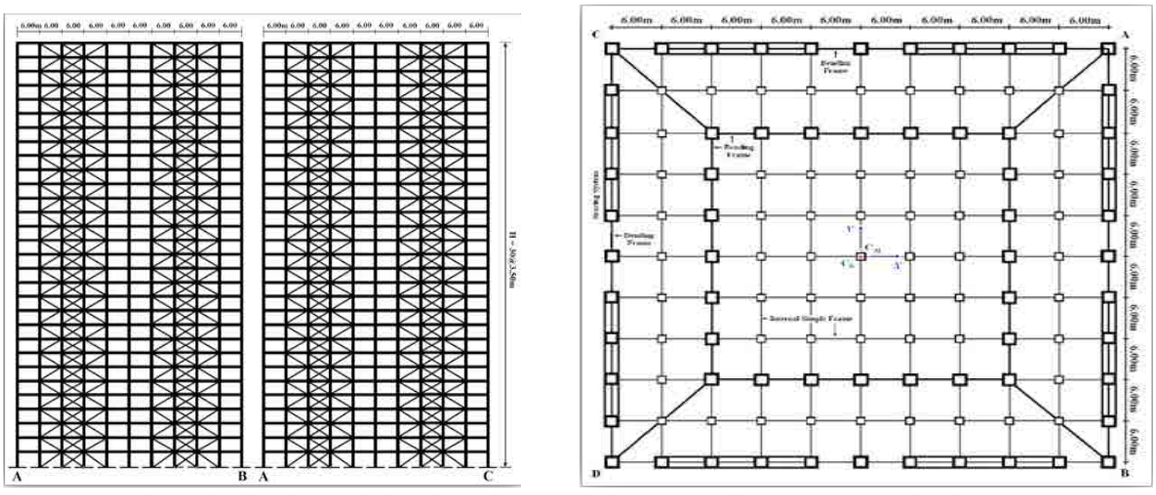
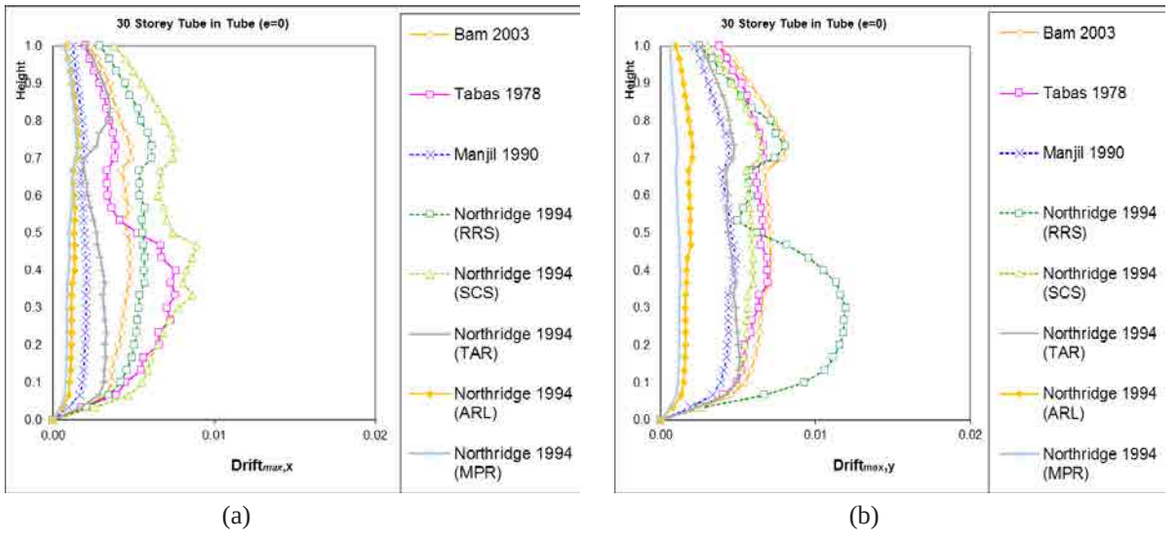


Figure 1. The plan and elevation of the studied structure, C_M: mass center, C_S: shear center



(a) (b)

Figure 2. The maximum seismic displacement of stories; (a) x direction of plan; (b) y direction of plan

REFERENCES

FEMA 356 (1998) Federal Emergency Management Agency

Iranian National Building Code (2005) Steel Structures-Part 10, Tehran, Iran

Movahed H, Meshkat-Dini A and Tehranizadeh M (2014) Seismic Evaluation of Steel Special Moment Resisting Frames Affected by Pulse Type Ground Motions, *Asian Journal of Civil Engineering (BHRC)*, 15(4): 575-585

Standard No. 2800-84 (2005) Iranian Code of Practice for Seismic Resistant Design of Buildings, 3rd Edition, Tehran, Iran