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PERFORMANCE ASSESSMENT OF DIFFERENT TABULAR SYSTEMS FOR TALL BUILDINGS AGAINST DYNAMIC WIND AND EARTHQUAKE EFFECTS

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Structural system selection for tall buildings against lateral wind and earthquake loads is of great importance in view of minimum material use and structural weight. Structural systems, for tall buildings, have been classified into four main groups, namely rigid frames, shear walls, combined wall-frame structures and tube systems (Kheyroddin et al., 2012). In the tube system category, Tube in Tube (TiT), Braced Bundled Tube (BBT) and Bundled Tube (BT) are the most popular structural configurations in order to reduce the shear lag in tall buildings (Taranath, 2010). Number of studies has been conducted to compare various lateral-resisting systems in tall buildings against wind and earthquake effects (Kakde et al., 2017; Mulla & Srinivas, 2015). The comparative study of the mentioned tube system categories has not been addressed in previous studies. Furthermore, in previous studies, the dynamic effects of wind load are neglected. The main originalities of this paper are to compare the behavior, assess the performance and evaluate the optimality, in view of structural weight, of the mentioned configurations against dynamic effects of wind and earthquake loads. As a case study, the existing 58-story building in Dalas, USA is modeled applying the three mentioned systems. The wind load is affected by equivalent static and time history dynamic methods, separately. The earthquake load is affected applying the spectrum method based on UBC-94 design spectrum. For the mentioned structural configurations, Shear Lag Index (SLI) and Displacement Index (DI) are compared.

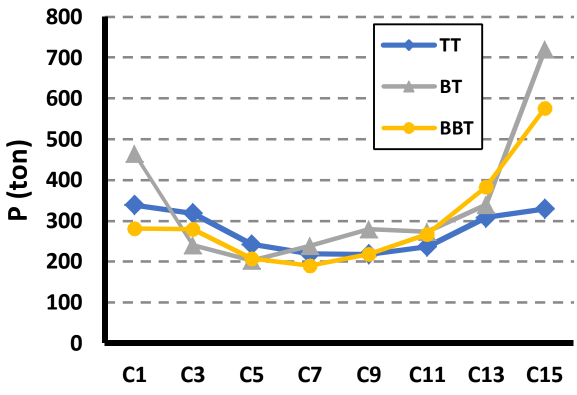

Figure 1. Shear lag in columns of flange frame induce (WDX).

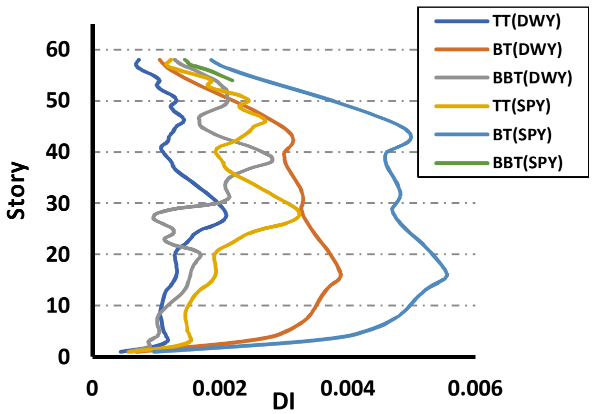

Figure 2. Displacement index induce wind dynamic loading and earthquake semi-dynamic (Y).

According to the achieved results for computed displacement capacity and convenience index the Braced Tube (BT) system gained the minimum margin of safety in accordance with the relevant capacities in Iranian national code. In view of shear lag and achieved structural weight, 45% decrease in displacement and 71% decrease in structural weight are achieved for BBT system comparing with BT system. Furthermore, remaining the braces, after the tube cross section decrease, has the adverse effects on structural behavior and displacement index, especially for the higher floors. Finally, BBT system is the most effective structural system to reduce the consumed structural material and to enhance the structural behavior. Adding the braces in BT system makes the distribution of axial force in flange and web panel columns to be uniform, consequently, makes the reduction of shear lag.

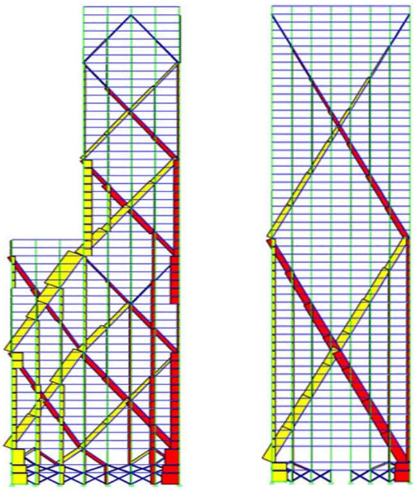

Figure 3. Uniform distribution of axial force in dynamic loading of wind (DWX) in flange frame (a), in web frame (b).

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