DEVELOPMENT OF OUTRIGGER CONCEPT IN SPECIAL PLATE SHEAR WALLS STRUCTURAL SYSTEMS FOR TALL BUILDINGS

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The primary objective of this study is to develop outrigger concept in structural systems for tall buildings by utilizing the special plate shear walls as the primary lateral force resisting systems. The high overturning forces expected in SPSWs can be mitigated by the use of special configurations to distribute the overturning over the multiple bays by placement of additional web plates at certain levels acting as outriggers to deliver overturning forces to outer columns as shown in Figure 1.

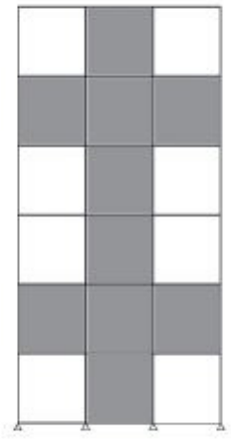

Figure 1. Configurations that reduce overturning by means of web-plate location

When the building increases in height, the stiffness of the structures becomes more important and controlling the lateral displacement and drift will become an issue. When horizontal loading acts on the building, the column-restrained outriggers resist the rotation of the core, causing the lateral deflection and moments in the core to be smaller than if the free standing core alone resisted the loading. The result is to increase the effective depth of the structures when it flexes as a vertical cantilever by inducing tension in the windward columns and compression in the leeward columns.

In this paper the performance-based evaluation of a 40 story residential building with two different lateral load resisting system including Special Plate Shear Walls (SPSW) and Buckling Restrained Braced Frames (BRBF) with 3 levels of outriggers in 20th, 30th and 40th story level is carried out. Several nonlinear time history analyses are carried out and seismic performance of the two structural systems are compared to each other. The seismic performance is evaluated based on lateral displacements, inter story drifts, residual displacements, and floor accelerations. The seismic performances of both structural systems are within the acceptable limits. However, the system with buckling restrained braced frames requires

very high strength BRB elements with relatively large sizes for acceptable seismic performance. The SPSW structural system requires nominal plate thickness for acceptable seismic performance and is a suitable and economical alternative to the BRBF structural system.

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