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Displacement Based Design of a Dual Structural System

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Abstract : The traditional seismic design is the methodology of Forced Based Design (FBD). The Displacement Based Design (DBD) is a seismic design that considers structural damage to achieve a failure mechanism of the structure before the collapse. It is easier to quantify damage of a structure with displacements rather than forces. Therefore, a structure to achieve an inelastic displacement design with good ductility, it is necessary to be damaged. The first part of this investigation is about differences between the methodologies of DBD and FBD with some DBD advantages. In the second part, there is a study case about a dual building 5-story, which is regular in plan and elevation. The building is located in a seismic zone, which acceleration in firm soil is 45% of the acceleration of gravity. Then it is applied both methodologies into the study case to compare its displacements, shear forces and overturning moments. In the third part, the Dynamic Time History Analysis (DTHA) is done, to compare displacements with DBD and FBD methodologies. Three accelerograms were used and the magnitude of the acceleration scaled to be spectrum compatible with design spectrum. Then, using ASCE 41-13 guidelines, the hinge plastics were assigned to structure. Finally, both methodologies results about study case are compared. It is important to take into account that the seismic performance level of the building for DBD is greater than FBD method. This is due to drifts of DBD are in the order of 2.0% and 2.5% comparing with FBD drifts of 0.7%. Therefore, displacements of DBD is greater than the FBD method. Shear forces of DBD result greater than FBD methodology. These strengths of DBD method ensures that structure achieves design inelastic displacements, because those strengths were obtained due to a displacement spectrum reduction factor which depends on damping and ductility of the dual system. Also, the displacements for the study case for DBD results to be greater than FBD and DTHA. In that way, it proves that the seismic performance level of the building for DBD is greater than FBD method. Due to drifts of DBD which are in the order of 2.0% and 2.5% compared with little FBD drifts of 0.7%.

Keywords : displacement-based design, displacement spectrum reduction factor, dynamic time history analysis, forced based design
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