Civil Infrastructure Researches, Vol. 7, Issue.2, Winter 2022, pp. 21-31

Nonlinear Dynamic Behavior of Three-Dimensional Moment Steel Frames and Dual System under Vehicle Impact

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In this study, the potential of progressive collapse of a four-story steel structure due to the collision of an 8-ton truck with the ground floor columns was investigated. For this purpose, a 4-story steel structure (with intermediate steel moment frame system and special concentric steel bracing in the x-direction and intermediate steel moment frame system in the y-direction) was modeled and designed in ETABS software. ABAQUS finite element software was used to simulate the structure under collision scenarios. In this research, 6 scenarios of truck collision with adjacent columns of the structure have been considered by performing nonlinear dynamic analyzes. The vehicle speed is assumed to be 20 meters per second. The results showed that corner columns are more vulnerable to impact than perimeter columns. The presence of braces reduces the collapse and deformation in the desired scenario. The horizontal displacement in the impacted column in the direction of the moment frame was about 3 times that of in the direction of the dual system. this shows the positive effect of bracing system in reducing the structural responses to impact.

Keywords: Progressive Collapse, Impact, Truck Collision, Nonlinear Dynamic Analysis, ABAQUS.

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Received 21 August 2021, Revised 18 September 2021, Accepted 12 Octeber 2021.
DOI: 10.22091/cer.2021.7270.1287