A life-cycle cost assessment of seismic design strategies for steel moment frames with emphasis on failure mode control

Mostafa Fathi Sepahvand[1,*], **Akhrawat Lenwari**[1]

[1]Composite Structures Research Unit, Department of Civil Engineering, Faculty of Engineering, Chulalongkorn University, Bangkok 10330, Thailand

ABSTRACT

The objective of this study is to conduct a life-cycle cost analysis (LCA) of steel moment frames (SMF) designed with a focus on failure mode control. To implement failure mode control, the theory of plastic mechanism control (TPMC) is employed. TPMC is an energy-based method that utilizes the upper bound plastic theorem and balances the energy associated with the internal and external work done by the structure during the development of a plastic mechanism in a seismic event. This method ensures the achievement of a global mechanism, wherein all plastic hinges form in all beams and at the base of the columns on the first story of a moment frame. The seismic fragility of the SMFs designed according to current seismic provision codes and those designed by TPMC was evaluated using incremental dynamic analyses (IDA). The expected economic losses throughout the life cycle, were compared between the two moment frames. The results demonstrate that the SMF designed using TPMC, despite having higher initial costs, ultimately reduces the expected costs of the structure due to its superior seismic performance. Consequently, from an economic perspective within the realm of LCA, TPMC emerges as the more favorable choice for the seismic design of structures.

Keywords: Seismic design, moment frame, TPMC, life-cycle cost analysis, LCA, global mechanism

*__Corresponding author__: Mostafa Fathi Sepahvand (mostafa.f@chula.ac.th)