

Vertical incremental dynamic analysis for assessing progressive collapse resistance and failure modes of structures

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Abstract

For unforeseen loads, although many design codes at present have recognized the importance of structural robustness for preventing progressive collapse, it has been still lack of guidelines and procedures since they don't give detailed specifications or design methods. As for strong earthquakes, although the present seismic design codes have particular requirements and analysis approaches for preventing progressive collapse, one can only get qualitative results, rather than quantitative ones.

To investigate the failure modes of vertical progressive collapse as well as progressive collapse resistance of structures, the vertical nonlinear dynamic analysis (NDA) is firstly utilized to intuitively observe the response of the area adjoined to initial damage of structures after some elements are removed, in which the removing time, removing duration and the element location are considered to be varied. After that, a vertical incremental dynamic analysis (IDA) method is further developed based on the vertical NDA to capture the ultimate bridging-over capacity and impact resistant ability of the areas upon and below the removed elements. The progressive collapse failure modes are analyzed, and the progressive collapse resistance of the structure is assessed by the proposed methods, respectively.

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