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Beam element formulation and solution procedure for dynamic progressive collapse analysis

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Abstract: A beam element formulation and solution procedure for progressive collapse analysis of planar frame structures is presented. Unlike previous research, the current study addresses the significance of dynamic load redistribution following the failure of one or more elements. The developed beam-column element utilizes a multi-linear, lumped plasticity model, and it also accounts for the interaction of axial force and bending moment. Strength and stiffness degradation are included through use of a damage-dependent constitutive relationship. A damage index is used to determine the onset of member failure. Following the failure of an element, the analysis continues in an efficient manner through use of a modified member stiffness procedure. This approach does not require the introduction of any additional degrees-of-freedom or modification of the element connectivity definitions. Finally, a methodology for updating the state of a structure at the time of member failure is presented. Analysis results indicate that dynamic redistribution of loads is a significant feature of the progressive collapse problem and should be accounted for in order to avoid estimates of capacity that are not conservative. (C) 2004 Elsevier Ltd. All rights reserved.

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