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INELASTIC STRUCTURAL DESIGN FOR TORNADO LOADS

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Conventional elastic structural design procedures do not take advantage of inherent material and system ductility and as a consequence are not cost-effective for reducing the risk of tornado damage. Although several performance-based frameworks have been proposed for wind engineering in general, specific application to tornado hazards is virtually nonexistent. Yet, inelastic procedures for structural design are essential because tornadoes (and other rare large-magnitude or long-duration windstorms) simply cannot be mitigated economically using elastic methods. Thus, there is a vital need to develop inelastic structural design procedures for tornado loads. Furthermore, continued growth of performance-based design will almost certainly necessitate inelastic design for all types of hazards, including tornados.

The hypothesis of the proposed approach is that a moderate degree of system ductility is sufficient to allow the main wind force resisting system to be designed using significantly reduced tornado design forces. This is analogous to what is current done in seismic design. The proposed approach is expected to provide a more economical design for structural systems that are controlled by strength, instead of drift, as is the case for a large portion of the building stock in tornado-prone regions. The proposed approach will also contribute to the broader effort in the structural engineering community to advance performance-based design.

The objectives of this presentation are (1) to provide clear rationale for inelastic tornado design, (2) to present a plan for developing inelastic structural design procedure for buildings and other structures subjected to wind loads, (3) to predict the benefits of the proposed methods using an example analysis of a steel-frame structure, and (3) to receive feedback from experts in wind science, colleagues in structural engineering, and others in tornado research.