Reliable Analysis of Structural Steel Frames

Proposed Presentation
NSF Workshop on Reliable Engineering Computing
September 15-17, 2004
Savannah, Georgia

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The design of steel frames comprising the skeletal structure of buildings contains many sources of uncertainty, which can make reliable analysis and design difficult, given the demands of balancing economy and safety. One can easily design a structure to resist collapse with very high reliability (approaching certainty), but the structure generated is probably uneconomical and therefore, impractical.

Examples of uncertainty arising in the design of building structures can be categorized into those related to the loading applied to the structure and those related to the properties that define the capacity of the structure to resist those loads. The structural engineering literature quantifies the statistical distribution of: (a) the loading applied to building structures (*e.g.,* wind load, gravity loading); (b) the properties that define the resistance of the frame components (*e.g.,* modulus of elasticity, cross-sectional properties, and connection properties). These statistical distributions allow the structural engineer to define *bounds* or *intervals* with varying levels of confidence on all important quantities related to the analysis of a structural steel frame.

The presentation will describe an element-by-element strategy for formulating the equations of equilibrium for structural frames suitable for object-oriented implementation and interval analysis. A discussion of interval solution techniques for determining structure response quantities will be provided. An interval-based structural analysis of a steel frame including loading uncertainty and resistance uncertainty will be discussed.

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