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1: Trends Toward Advanced Analysis

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1.1 Introduction

Since the publication of the two-volume book on *Theory of Beam-Columns* (Chen and Atsuta, 1976 and 1977), and the subsequent books and monograph related to *Stability Design of Frames* (Chen and Lui, 1986 and 1991; SSRC, 1992), our understanding of certain aspects of the behavior and design of steel members and frames has increased considerably and many extensions and advancements have been made during the past 10 years.

The advent of limit-states specifications has resulted in more explicit and more rational consideration of the combined effects of inelasticity and stability at maximum strength levels. Since limit-states design is based directly on factored loads and limits of resistance, it is expected that structural systems and their members will behave nonlinearly before their capacity is reached. Of course, the most direct approach for structural design is to model all the significant nonlinear effects in the analysis. However, until recently, rigorous consideration of system as well as member strength and stability in the analysis of large-scale structural system were not feasible and practical. As a result, contemporary specification provisions have been based primarily on simpler methods of analysis and member interaction equations which account approximately for the interaction of strength and stability between the member and structural system.

Recently, the advancement in computer hardware, particularly in the computing and graphics performance of personal computers and workstations, is making advanced methods of analysis more and more feasible for design use. This advancement has made it possible for the engineer to adopt the limit-states design philosophy in a wider perspective. Advanced analysis techniques hold the promise of more realistic prediction of load effects and overall structural performance, and therefore in certain cases, yield greater economic and more uniform safety. The two task groups in the U.S. — the American Institute of Steel Construction (AISC) Technical Committee 117 on *Inelastic Analysis and Design* and the Structural Stability Research Council (SSRC) Task Group 29 on *Second-Order Inelastic Analysis for Frame Design* — are

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