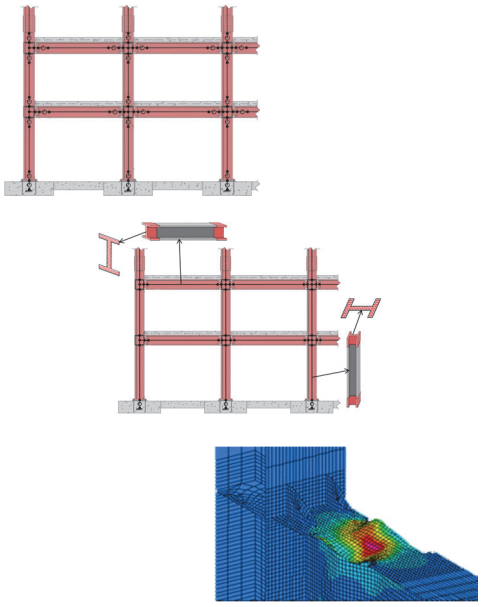
NIST GCR 17-917-46v2



Guidelines for Nonlinear Structural Analysis for Design of Buildings

Part IIa – Steel Moment Frames

Applied Technology Council

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National Institute of Standards and Technology
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Cover image – Three model idealizations (concentrated hinge, fiber hinge, and continuum finite element) of a typical steel moment frame system/connection.

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Part IIa – Steel Moment Frames

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Preface

In September 2014, the Applied Technology Council (ATC) commenced a task order project under National Institute of Standards and Technology (NIST) Contract SB1341-13-CQ-0009 to develop guidance for nonlinear dynamic analysis (ATC-114 Project). The need for such guidance is identified as high-priority research and development topic (Proposed Research Initiative 6) in NIST GCR 14-917-27 report, *Nonlinear Analysis Research and Development Program for Performance-Based Seismic Engineering* (NIST, 2013), which outlines a research and development program for addressing the gap between state-of-the-art academic research and state-of-practice engineering applications for nonlinear structural analysis, analytical structural modeling, and computer simulation in support of performance-based seismic engineering. In addition, the NIST GCR 09-917-2 report, *Research Required to Support Full Implementation of Performance-Based Seismic Design* (NIST, 2009), also identified the need to improve analytical models for buildings and their components in near-collapse seismic loading.

To help fill this gap, the ATC-114 Project developed a series of reports that provide general nonlinear modeling and nonlinear analysis guidance, as well as guidance specific to the following two structural systems: structural steel moment frames and reinforced concrete moment frames. This Part IIa report, referred to as *Guidelines* herein, provide practical guidance for nonlinear modeling and analysis specific to steel moment-resisting frames and their components. It is a companion to *Part I Guidelines* (NIST, 2017a) that provides general guidance on nonlinear analysis. Other Part II companion reports provide further details for selected system types.

These *Guidelines* were developed by the members of the ATC-114 *Steel Moment Frames* project team. ATC is indebted to the leadership of Greg Deierlein, who served as the Project Director. The Project Technical Committee, consisting of Stephen Bono, Jim Malley, Silvia Mazzoni, and Chia-Ming Uang, contributed to developing this report and guided the technical efforts of the Project Working Group, which included Gulen Ozkula and Zhi Zhou. The members of the Project Review Panel, who were charged with reviewing the report during the various stages of development and ensuring that technical results were accurate, are also gratefully acknowledged. These individuals consisted of Jerry Hajjar, Charles Roeder, Tom Sabol, Mark Saunders, and Kent Yu (ATC Board Contact). The names and affiliations of all who contributed to this report are provided in the list of Project Participants.

ATC also gratefully acknowledges Steven L. McCabe (Contracting Officer's Representative), Jay Harris, Siamak Sattar, Matthew Speicher, and Kevin Wong for their input and guidance throughout the project development process. Dimitrios Lignos and Amit Kanvinde contributed to the development of this report by providing source material, developing new equations, and helping with writing and reviewing the report. ATC staff members Veronica Cedillos and Carrie Perna provided project management support and report production services, respectively.

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Table of Contents