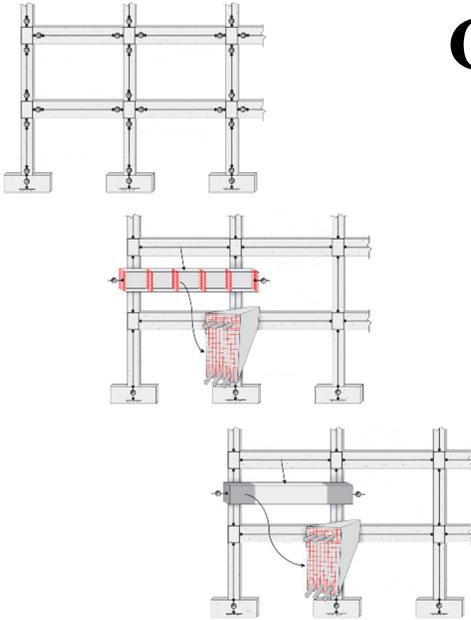


NIST GCR 17-917-46v3

# Guidelines for Nonlinear Structural Analysis for Design of Buildings

## Part IIb – Reinforced Concrete Moment Frames



*Applied Technology Council*

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Cover image – Three model idealizations (concentrated hinge, distributed plasticity, and fiber hinge) of a typical reinforced concrete moment-resisting frame system.

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## Part IIb – Reinforced Concrete Moment Frames

Prepared for  
*U.S. Department of Commerce  
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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 IIb report, referred to as *Guidelines* herein, provide practical guidance for nonlinear modeling and analysis specific to reinforced concrete moment-resisting frames and their components. It is a companion to *Part I Guidelines* (NIST, 2017) that provides general guidance on nonlinear analysis. Other Part II companion reports provide further details for selected system types.

This Part IIb document was developed by the members of the ATC-114 *Reinforced Concrete Moment Frames* project team. ATC is indebted to the leadership of Curt Haselton, who served as the Project Director, and to the members of the Project Technical Committee, consisting of Wassim Ghannoum, Mahmoud Hachem, John Hooper, and Santiago Pujol, for their contributions in developing this report and guiding the technical efforts of the Project Working Group, which included Dustin Cook, Ian McFarlane, and Hee Jae Yang. 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 Tony Ghodsi, Yuli Huang, Mike Mehrain, Farzad Naeim, John Wallace, 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. ATC staff members Veronica Cedillos and Carrie Perna provided project management support and report production services, respectively.

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# Table of Contents

<b>Preface .....</b>	<b>iii</b>
<b>List of Figures.....</b>	<b>ix</b>
<b>List of Tables .....</b>	<b>xiii</b>
<b>1. Introduction and Scope .....</b>	<b>1-1</b>
<b>2. Structural Behavior and Failure Modes .....</b>	<b>2-1</b>
2.1 Overview of Frame Behavior.....	2-1
2.2 Stiffness and Deformation of Components.....	2-3
2.2.1 Beams and Columns .....	2-5
2.2.2 Beam-Column Joints.....	2-7
2.2.3 Stiffness Differences for Various Loading Levels.....	2-8
2.3 Strength and Ductility of Components .....	2-8
2.3.1 Columns .....	2-8
2.3.2 Beams .....	2-11
2.3.3 Beam-Column Joints.....	2-12
2.4 Floor Diaphragms .....	2-13
2.4.1 Bending Behavior .....	2-13
2.4.2 In-Plane Behavior .....	2-14
<b>3. Nonlinear Modeling of Reinforced Concrete Frames and     Components.....</b>	<b>3-1</b>
3.1 Overview of Three Frame Model Idealizations .....	3-1
3.1.1 Concentrated Hinge Components Models .....	3-1
3.1.2 Fiber-Type Components Models .....	3-3
3.1.3 Continuum Finite Element Components Models.....	3-5
3.2 Column and Beam Modeling .....	3-5
3.3 Column Splices .....	3-5
3.4 Beam-Column Joint Panel Zones.....	3-5
3.5 Floor Diaphragms and Collectors .....	3-6
3.6 Secondary Gravity System Components .....	3-6
3.6.1 Gravity Columns, Beams, and Joints.....	3-7
3.6.2 Slab-Column Connections .....	3-7
3.7 Modeling of Damping.....	3-8
<b>4. Concentrated Hinge Component Models.....</b>	<b>4-1</b>
4.1 Overview of Concentrated Hinge Model.....	4-1
4.2 Modeling of Moment Frame Columns .....	4-3
4.2.1 Lateral Stiffness .....	4-3
4.2.2 Flexural Yield Strength ( $M_y$ ).....	4-7
4.2.3 Nonlinear Modeling Parameters .....	4-8

4.3	Modeling of Moment Frame Beams .....	4-16
4.4	Modeling of Beam-Column Joints .....	4-17
4.4.1	Stiffness Adjustment of Beam and Column Offsets .....	4-17
4.4.2	Rotational Hinge at the Beam-Column Intersection .....	4-18
4.5	Modeling of Gravity System Connections .....	4-18
4.5.1	Slab-Beam Strength .....	4-18
4.5.2	Slab-Beam Stiffness .....	4-19
4.5.3	Connection Plastic Rotation at Punching-Shear Strength Loss.....	4-20
<b>5.</b>	<b>Fiber-Type Component Models .....</b>	<b>5-1</b>
5.1	Overview .....	5-1
5.2	Fiber-Section Modeling.....	5-3
5.3	Fiber Material Modeling .....	5-5
5.3.1	Steel Reinforcement .....	5-5
5.3.2	Confined and Unconfined Concrete – Compressive Stresses.....	5-7
5.3.3	Confined and Unconfined Concrete – Tensile Stresses ...	5-11
5.3.4	Limitations of First-Principles Stress-Strain Modeling....	5-12
5.4	Modeling Shear and Bond-Slip Deformations .....	5-12
5.4.1	Bond-Slip Deformations .....	5-13
5.4.2	Shear Deformations.....	5-14
<b>6.</b>	<b>Continuum Finite Element Component Models.....</b>	<b>6-1</b>
	<b>Appendix A: Modeling Nonductile Reinforced Concrete Frames .....</b>	<b>A-1</b>
A.1	Overview .....	A-1
A.2	Modeling Columns.....	A-2
A.3	Modeling Beam-Column Joints .....	A-3
A.4	Modeling Slab-Column Connections .....	A-3
	<b>Appendix B: Reinforced Concrete Frame Example Building.....</b>	<b>B-1</b>
B.1	Introduction .....	B-1
B.2	Building Description .....	B-1
B.3	Linear Structural Analysis and Design of Building .....	B-5
B.3.1	Modeling Criteria .....	B-5
B.3.2	Fundamental Periods.....	B-5
B.3.3	Modal Analysis .....	B-5
B.3.4	Drift Check.....	B-6
B.3.5	Structural Design of Primary Moment-Resisting Members.....	B-8
B.3.6	Structural Design of Secondary Moment-Resisting Members.....	B-10
B.4	Nonlinear Modeling .....	B-11
B.4.1	Material Models for Fiber Hinges.....	B-11
B.4.2	Beam .....	B-12
B.4.3	Column.....	B-14
B.4.4	Beam-Column Panel Zone .....	B-16
B.4.5	Slab-Beam .....	B-16
B.4.6	Slab-Column Panel Zone .....	B-18
B.4.7	Damping.....	B-18

B.4.8	Ground Motions .....	B-19
B.5	Nonlinear Response History Analysis .....	B-21
B.5.1	Nonlinear Model Fundamental Periods .....	B-21
B.5.2	Story Drift Check.....	B-22
B.5.3	Story Shears and Overturning Moments.....	B-23
B.5.4	Deformation-Controlled Action.....	B-25
B.5.5	Force-Controlled Action.....	B-32
B.6	Conclusion .....	B-38
<b>References.....</b>		<b>C-1</b>
<b>Project Participants .....</b>		<b>D-1</b>