Seismic Design of Reinforced Concrete Special Moment Frames:
A Guide for Practicing Engineers

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How to Cite This Publication

1. Introduction

Reinforced concrete special moment frames are used as part of the seismic force-resisting systems in buildings that are designed to resist earthquakes. Beams, columns, and beam-column joints in moment frames are proportioned and detailed to resist flexural, axial, and shearing actions that result as a building sways through multiple displacement cycles during strong earthquake ground shaking. Special proportioning and detailing requirements result in a frame capable of resisting strong earthquake shaking without significant loss of stiffness or strength. These moment-resisting frames are called “Special Moment Frames” because of these additional requirements, which improve the seismic resistance in comparison with less stringently detailed Intermediate and Ordinary Moment Frames.

The design requirements for special moment frames are presented in the American Concrete Institute (ACI) Committee 318 Building Code Requirements for Structural Concrete (ACI 318). The special requirements relate to inspection, materials, framing members (beams, columns, and beam-column joints), and construction procedures. In addition, requirements pertain to diaphragms, foundations, and framing members not designated as part of the seismic force-resisting system. The numerous interrelated requirements are covered in several sections of ACI 318, not necessarily arranged in a logical sequence, making their application challenging for all but the most experienced designers.

This guide was written for the practicing structural engineer to assist in the application of ACI 318 requirements for special moment frames. The material is presented in a sequence that practicing engineers have found useful. The guide is intended especially for the practicing structural engineer, though it will also be useful for building officials, educators, and students.

Most special moment frames use cast-in-place, normal-weight concrete having rectilinear cross sections without prestressing. Interested readers are referred to ACI 318 for specific requirements on the use of lightweight concrete, prestressed beams, for spiral-reinforced columns, and precast concrete, which are not covered in this guide.

This guide follows the requirements of the 2008 edition of ACI 318, along with the pertinent seismic load requirements specified in the American Society of Civil Engineers (ASCE) publication ASCE/SEI 7-05 Minimum Design Loads for Buildings and Other Structures (ASCE 2006). The International Building Code, or IBC, (ICC 2006), which is the code generally adopted throughout the United States, refers to ASCE 7 for the determination of seismic loads. The ACI Building Code classifies design requirements according to the Seismic Design Categories designated by the IBC and ASCE 7 and contains the latest information on design of special moment frames at the time of this writing. Because the 2008 edition of ACI 318 may not yet be adopted in many jurisdictions, not all of its provisions will necessarily apply.

This guide is organized in several sections, presented in a sequence that parallels the typical design sequence. The main body of text emphasizes code requirements and accepted approaches to their implementation. It includes background

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**Sidebars in the guide**

Sidebars are used in this guide to illustrate key points, to highlight construction issues, and to provide additional guidance on good practices and open issues in special moment frame design.