
**Program on Improved Seismic Safety Provisions**

*Of the National Institute of Building Sciences*

**2000 Edition**

# NEHRP RECOMMENDED PROVISIONS FOR SEISMIC REGULATIONS FOR NEW BUILDINGS AND OTHER STRUCTURES

## Part 1: Provisions (FEMA 368)

The **Building Seismic Safety Council** (BSSC) was established in 1979 under the auspices of the National Institute of Building Sciences as an entirely new type of instrument for dealing with the complex regulatory, technical, social, and economic issues involved in developing and promulgating building earthquake hazard mitigation regulatory provisions that are national in scope. By bringing together in the BSSC all of the needed expertise and all relevant public and private interests, it was believed that issues related to the seismic safety of the built environment could be resolved and jurisdictional problems overcome through authoritative guidance and assistance backed by a broad consensus.

The BSSC is an independent, voluntary membership body representing a wide variety of building community interests. Its fundamental purpose is to enhance public safety by providing a national forum that fosters improved seismic safety provisions for use by the building community in the planning, design, construction, regulation, and utilization of buildings.

To fulfill its purpose, the BSSC: (1) promotes the development of seismic safety provisions suitable for use throughout the United States; (2) recommends, encourages, and promotes the adoption of appropriate seismic safety provisions in voluntary standards and model codes; (3) assesses progress in the implementation of such provisions by federal, state, and local regulatory and construction agencies; (4) identifies opportunities for improving seismic safety regulations and practices and encourages public and private organizations to effect such improvements; (5) promotes the development of training and educational courses and materials for use by design professionals, builders, building regulatory officials, elected officials, industry representatives, other members of the building community, and the public; (6) advises government bodies on their programs of research, development, and implementation; and (7) periodically reviews and evaluates research findings, practices, and experience and makes recommendations for incorporation into seismic design practices.

See the back of the *Commentary* volume for a full description of BSSC activities.

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**(National Earthquake Hazards Reduction Program)**

# FOR SEISMIC REGULATIONS

# FOR NEW BUILDINGS AND

# OTHER STRUCTURES

## 2000 EDITION

## Part 1: PROVISIONS
## (FEMA 368)

**Prepared by the**
**Building Seismic Safety Council**
**for the**
**Federal Emergency Management Agency**

**BUILDING SEISMIC SAFETY COUNCIL**
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Building Seismic Safety Council activities and products are described at the end of this report. For further information, contact the Building Seismic Safety Council, 1090 Vermont, Avenue, N.W., Suite 700, Washington, D.C. 20005; phone 202-289-7800; fax 202-289-1092; e-mail bssc@nibs.org.

Copies of this report may be obtained by contacting the FEMA Publication Distribution Facility at 1-800-480-2520.

The National Institute of Building Sciences and its Building Seismic Safety Council caution users of these *Provisions* documents to be alert to patent and copyright concerns especially when applying prescriptive requirements.

# PREFACE

One of the primary goals of the Federal Emergency Management Agency (FEMA) and the National Earthquake Hazards Reduction Program (NEHRP) is to encourage design and building practices that address the earthquake hazard and minimize the resulting damage. Publication of the 2000 *NEHRP Recommended Provisions for Seismic Regulation of New Buildings and Other Structures* reaffirms the continuing FEMA-sponsored effort to improve the seismic safety of new structures in this country. Its publication marks the fifth in a planned updating of both the *Provisions* documents and several complementary publications. As in the case of the earlier editions of the *Provisions* (1985, 1988, 1991, 1994, and 1997), FEMA is proud to sponsor this Building Seismic Safety Council project and encourages widespread dissemination and voluntary use of this state-of-the-art consensus resource document.

In contrast with the 1997 Provisions update, this update does not make significant changes to the hazard maps or design procedures. Rather, the 2000 *Provisions* contains new material in select areas that keep the document at the cutting edge of seismic design practices. An example of this new material is the addition of a comprehensive procedure for the design of structures with energy dissipating devices. As this new technology gains further acceptance in practice, the design guidance within the *Provisions* will enjoy widespread use. Another example is the inclusion of material on anchorage to concrete. A special anchorage subcommittee was assembled to integrate this much-needed new material into the *Provisions*. A third example is the comprehensive treatment of design of steel moment frame structures based on the research results of a FEMA-funded project started after the 1994 Northridge earthquake. Finally, some new material in the areas of 'pushover' design and simplified design procedures was developed. Further refinement of these two areas is expected during the next update cycle.

The above changes are but a few of the nearly 170 that were balloted by the BSSC member organizations. The number of changes continues to grow over the numbers of earlier update efforts and is testament to the increased attention being paid to the *Provisions.* This is due in large part to the decision to use the NEHRP *Provisions* as the basis for the seismic requirements in both the *International Building Code* and *NFPA 5000 Code*. FEMA welcomes this increased scrutiny and the chance to work with these code organizations.

Looking ahead, FEMA has already contracted with BSSC for and work already has begun on the update process that will lead to the 2003 *Provisions*. The update effort will continue to capture the state of the art, continue work on simplified methods, and seek to improve the treatment of non-building structures within the *Provisions.*

Finally, FEMA wishes to express its deepest gratitude for the yeoman efforts of a large number of volunteer experts and the BSSC Board of Directors and staff who made possible the 2000 *Provisions* documents. It is truly their efforts that make the *Provisions* a reality. Americans unfortunate enough to experience the earthquakes that will inevitably occur in this country in the future will owe much, perhaps even their very lives, to the contributions and dedication of these individuals to the seismic safety of buildings. Without the dedication and hard work of these men and women, this document and all it represents with respect to earthquake risk mitigation would not have been possible.

*Federal Emergency Management Agency*

# INTRODUCTION and ACKNOWLEDGEMENTS

The 2000 Edition of the *NEHRP Recommended Provisions for Seismic Regulations for New Buildings and Other Structures* is the sixth edition of the document and, like the 1985, 1988, 1991, 1994, and 1997 Editions that preceded it, has the consensus approval of the Building Seismic Safety Council membership. It represents a major product of the Council's multiyear, multitask Program on Improved Seismic Safety Provisions and is intended to continue to serve as a source document for use by any interested members of the building community. (For readers unfamiliar with the program, a detailed description of the BSSC's purpose and activities concludes the *Commentary* volume.)

In September 1997, NIBS entered into a contract with FEMA for initiation of the BSSC 2000 *Provisions* update effort. Late in 1997, the BSSC member organization representatives and alternate representatives and the BSSC Board of Direction were asked to identify individuals to serve on the 2000 Provisions Update Committee (PUC) and its Technical Subcommittees (TSs).

The 2000 PUC was constituted early in 1998, and 12 PUC Technical Subcommittees were established to address design criteria and analysis, foundations and geotechnical considerations, cast-in-place/precast concrete structures, masonry structures, steel structures, wood structures, mechanical-electrical systems and building equipment and architectural elements, quality assurance, composite steel and concrete structures, energy dissipation and base isolation, and nonbuilding structures.

More than 200 individuals have participated in the 2000 update effort, and 169 substantive proposals for change were developed. A series of editorial/organizational changes also have been made. All draft TS and PUC proposals for change were finalized in late January 2000. The PUC Chairman presented to the BSSC Board of Direction the PUC's recommendations concerning proposals for change to be submitted to the BSSC member organizations for balloting, and the Board accepted these recommendations.

The first round of balloting concluded in early June 2000. There were 147 items on the official ballot, and a large majority passed; however, many comments were submitted with "no" and "yes with reservations" votes. These comments were compiled for distribution to the PUC, which met in mid-July to review the comments, receive TS responses to the comments and recommendations for change, and formulate its recommendations concerning what items should be submitted to the BSSC member organizations for a second ballot. The PUC directed several of the proposals from the first ballot to be revised requiring them to be reballoted. The PUC deliberations resulted in the decision to recommend to the BSSC Board that 17 items be included in the second ballot. The PUC Chairman subsequently presented the PUC's recommendations to the Board, which accepted those recommendations.

The second round of balloting was completed in early October 2000. Of the 17 proposals, all passed except for one. This had to be revised because of a duplication error. There were also three other proposals developed by the PUC to clarify last minute concerns. The PUC met on the last two days of October to formulate its recommendations to the Board, and the Board subsequently accepted those recommendations.

During the review of the first ballot, there was a request to table the proposals from TS 6 regarding Chapter 8 on Steel. The American Institute of Steel Construction (AISC) was in the process of updating their supplement to AISC Seismic and the PUC expected publication of Supplement No. 2

during the second ballot voting period. If the supplement was published in time for the TS and PUC to review the changes and incorporate the most current information available, it would be beneficial to all. AISC Seismic Supplement No. 2 was published in November 2000. Since the second ballot was already on the street, this drove the necessity to have a third ballot. A fifth proposal for the third ballot was prepared to allow AISC Seismic Supplement No. 2 to be incorporated.

The third ballot was developed to include 5 proposals and all ballots were received by early February 2001. The comments and responses were prepared in time for the PUC Executive Committee to review and accept all proposals in early March 2001. One of the proposals accepted AISC Seismic Supplement No. 2 as a reference document that overrode the necessity for several proposals initially balloted for the Chapter 8 on Steel. The PUC Chair once again presented the recommendations to the BSSC Board of Direction and they were approved. The final versions of the *Provisions* and *Commentary* volumes were developed and the *Provisions* includes, as Appendix A, a summary of the differences between the 1997 and 2000 Editions. Once the documents were edited and supporting information was prepared they were transmitted to FEMA for publication.

In presenting this 2000 Edition of the *Provisions*, the BSSC wishes to acknowledge the accomplishments of the many individuals and organizations involved over the years. The BSSC program resulting in the first four editions of the *Provisions*, the 2000 update effort, and the information development/dissemination activities conducted to stimulate use of the *Provisions* has benefitted from the expertise of hundreds of specialists, many of whom have given freely of their time over many years.

With so many volunteers participating, it is difficult to single out a given number or group for special recognition without inadvertently omitting others without whose assistance the BSSC program could not have succeeded; nevertheless, the 2000 Edition of the *Provisions* would not be complete without at least recognizing the following individuals to whom I, acting on behalf of the BSSC Board of Direction, heartily express sincerest appreciation:

- The members of the BSSC Provisions Update Committee, especially Chairman William Holmes;
- The members of the 12 PUC Technical Subcommittees, the Simplified Design Task Group, and the Anchorage Task Group; and
- Timothy Sheckler, the FEMA Project Officer.

Appreciation also is due to the BSSC staff members, all of whose talents and experience were crucial to conduct of the program.

At this point I, as Chairman, would like to express my personal gratitude to the members of the BSSC Board of Direction and to all those who provided advice, counsel, and encouragement during conduct of the update effort or who otherwise participated in the BSSC program that resulted in the 2000 *NEHRP Recommended Provisions*.

*William Stewart, Chairman, BSSC Board of Direction*

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