

2012 IBC[®]

SEAOC STRUCTURAL/SEISMIC DESIGN MANUAL

VOLUME 1

CODE APPLICATION EXAMPLES



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To advance the structural engineering profession; to provide the public with structures of dependable performance through the application of state-of-the-art structural engineering principles; to assist the public in obtaining professional structural engineering services; to promote natural hazard mitigation; to provide continuing education and encourage research; to provide structural engineers with the most current information and tools to improve their practice; and to maintain the honor and dignity of the profession.

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Errata Notification

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Preface to the 2012 IBC SEAOC Structural/Seismic Design Manual

The *IBC SEAOC Structural/Seismic Design Manual*, throughout its many editions, has served the purpose of illustrating good seismic design and the correct application of building-code provisions. The *Manual* has bridged the gap between the discursive treatment of topics in the SEAOC Blue Book (*Recommended Lateral Force Requirements and Commentary*) and real-world decisions that designers face in their practice.

The examples illustrate code-compliant designs engineered to achieve good performance under severe seismic loading. In some cases simply complying with building-code requirements does not ensure good seismic response. This *Manual* takes the approach of exceeding the minimum code requirements in such cases, with discussion of the reasons for doing so.

Recent editions of the *IBC SEAOC Structural/Seismic Design Manual* have consisted of updates of previous editions, modified to address changes in the building code and referenced standards. Many of the adopted standards did not change between the 2006 edition of the *International Building Code* and the 2009 edition. The 2012 edition, which is the one used in this set of manuals, represents an extensive change of adopted standards, with many substantial changes in methodology.

Additionally, this edition has been substantially revised. New examples have been included to address new code provisions and new systems, as well as to address areas in which the codes and standards provide insufficient guidance. Important examples such as the design of base-plate anchorages for steel systems and the design of diaphragms have been added.

This expanded edition comprises five volumes:

- Volume 1: Code Application Examples
- Volume 2: Examples for Light-Frame, Tilt-Up, and Masonry Buildings
- Volume 3: Examples for Reinforced Concrete Buildings
- Volume 4: Examples for Steel-Framed Buildings
- Volume 5: Examples for Seismically Isolated Buildings and Buildings with Supplemental Damping

Previous editions have been three volumes. This expanded edition contains more types of systems for concrete buildings and steel buildings. These are no longer contained in the same volume. Volumes 3 and 4 of the 2012 edition replace Volume 3 of the 2009 edition. Additionally, we have fulfilled the long-standing goal of including examples addressing seismic isolation and supplemental damping. These examples are presented in the new Volume 5.

In general, the provisions for developing the design base shear, distributing the base-shear-forces vertically and horizontally, checking for irregularities, etc., are illustrated in Volume 1. The other volumes contain more extensive design examples that address the requirements of the material standards (for example, ACI 318 and AISC 341) that are adopted by the IBC. Building design examples do not illustrate many of the items addressed in Volume 1 in order to permit the inclusion of less-redundant content.

Each volume has been produced by a small group of authors under the direction of a manager. The managers have assembled reviewers to ensure coordination with other SEAOC work and publications, most notably the Blue Book, as well as numerical accuracy.

This manual can serve as valuable tool for engineers seeking to design buildings for good seismic response.

Rafael Sabelli
Project Manager

Preface to Volume 1

Volume 1 of the 2012 *IBC SEAOC Structural/Seismic Design Manual* addresses the application and interpretation of the seismic provisions of the 2012 *International Building Code*. More specifically, Chapter 16 of the 2012 IBC requires compliance with the provisions of ASCE/SEI 7-10 “Minimum Design Loads for Buildings and Other Structures,” except for Chapter 14 of ASCE 7.

ASCE 7 generally prescribes the loading and methodology to be used in the analysis of a structure or an element. In order to determine strength to resist to the load demands from ASCE 7, the IBC adopts national material design standards (such as ACI, AISC, MSJC, and NDS) to be used for the design of an element of a particular material. The Volume 1 examples focus on the application of the provisions of ASCE 7, while the examples in Volumes 2, 3, and 4 focus more on the application of the material design standards. The *Manual* is not intended to serve as a building code or to be an exhaustive catalogue of all valid approaches.

Volume 1 presents 58 examples covering most of the key code provisions within ASCE 7 Chapters 11, 12, 13, and 15. Many of the examples are similar to those in previous editions but have been rewritten to more clearly present the material and have been updated to reflect changes to the code provisions and SEAOC recommendations. Additionally, new examples are included in this edition that specifically address provisions related to site-specific ground-motion procedures, combination framing detailing requirements, scaling design values in modal response spectrum analysis, and retaining walls subject to seismic earth pressures.

Whenever possible, the authors have incorporated lessons learned from actual projects into the examples. Readers are welcome to submit other conditions or provisions not addressed in this edition for consideration in future editions.

Ryan A. Kersting
Volume Manager

Acknowledgements

Volume 1 of the 2012 *IBC SEAOC Seismic Design Manual* was written and reviewed by a group of highly qualified structural engineers, chosen for their knowledge and experience with structural engineering practice and seismic design. The authors are:

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