Building Code Requirements and Specification for Masonry Structures

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Building Code Requirements for Masonry Structures
(TMS 402-08/ACI 530-08/ASCE 5-08)

Specification for Masonry Structures
(TMS 602-08/ACI 530.1-08/ASCE 6-08)

and Companion Commentaries

Reported by the Masonry Standards Joint Committee (MSJC)

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Advancing the knowledge of masonry

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ABSTRACT

Building Code Requirements and Specification for Masonry Structures contains four parts: Building Code Requirements for Masonry Structures (TMS 402-08/ACI 530-08/ASCE 5-08); Specification for Masonry Structures (TMS 602-08/ACI 530.1-08/ASCE 6-08); Commentary on Building Code Requirements for Masonry Structures (TMS 402-08/ACI 530-08/ASCE 5-08); and Commentary on Specification for Masonry Structures (TMS 602-08/ACI 530.1-08/ASCE 6-08). These standards are produced through the joint efforts of The Masonry Society (TMS), the American Concrete Institute (ACI), and the Structural Engineering Institute of the American Society of Civil Engineers (SEI/ASCE) through the Masonry Standards Joint Committee (MSJC). The Code covers the design and construction of masonry structures while the Specification is concerned with minimum construction requirements for masonry in structures. Some of the topics covered in the Code are: definitions, contract documents; quality assurance; materials; placement of embedded items; analysis and design; strength and serviceability; flexural and axial loads; shear; details and development of reinforcement; walls; columns; pilasters; beams and lintels; seismic design requirements; glass unit masonry; veneers; and autoclaved aerated concrete masonry. An empirical design method and a prescriptive method applicable to buildings meeting specific location and construction criteria are also included. The Specification covers subjects such as quality assurance requirements for materials; the placing, bonding and anchoring of masonry; and the placement of grout and of reinforcement. This Specification is meant to be modified and referenced in the Project Manual. Since the Code is written as a legal document and the Specification as a master specification required by the Code, the two commentaries present background details, committee considerations, and research data used to develop the Code and Specification.

The designation of these standards has been modified from past editions to recognize the lead sponsorship role by The Masonry Society.

The Masonry Standards Joint Committee, which is sponsored by The Masonry Society, the American Concrete Institute, and the Structural Engineering Institute of the American Society of Civil Engineers, is responsible for these standards and strives to avoid ambiguities, omissions, and errors in these documents. In spite of these efforts, the users of these documents occasionally find information or requirements that may be subject to more than one interpretation or may be incomplete or incorrect. Users who have suggestions for the improvement of these documents are requested to contact TMS.

These documents are intended for the use of individuals who are competent to evaluate the significance and limitations of its content and recommendations and who will accept responsibility for the application of the material it contains. Individuals who use this publication in any way assume all risk and accept total responsibility for the application and use of this information.

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Reported by the Masonry Standards Joint Committee

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About the MSJC and its Sponsors

Masonry Standards Joint Committee

The Masonry Standards Joint Committee (MSJC) is, as its name suggests, a joint committee sponsored by The Masonry Society (TMS), the American Concrete Institute (ACI), and the Structural Engineering Institute of the American Society of Civil Engineers (SEI/ASCE). Its mission is to develop and maintain design and construction standards for masonry for reference by or incorporation into model building codes regulating masonry construction. In practice, the MSJC is responsible for the maintenance of the *Building Code Requirements for Masonry Structures* (TMS 402/ACI 530/ASCE 5), *Specification for Masonry Structures* (TMS 602/ACI 530.1/ASCE 6) and their companion *Commentaries*. Committee membership is open to all qualified individuals, within the constraints of balance requirements, balloting schedules and particular needs for technical expertise. Committee meetings are open to the public.

Committee Activities include:

1. Evaluate and ballot proposed changes to existing standards of the committee.
2. Develop and ballot new standards for masonry.
3. Resolve Negative votes from ballot items.
4. Provide interpretation of existing standards of the Committee.
5. Identify areas of needed research.
6. Sponsor educational seminars and symposia.
7. Monitor international standards.

Additional details of the Committee, its work, and its meeting schedule are posted at www.masonrysociety.org and can be obtained from The Masonry Society.

THE MASONRY SOCIETY

Advancing the knowledge of masonry

The Masonry Society (TMS) was formed in 1977 as a not-for-profit professional, technical, and educational association dedicated to the advancement of knowledge on masonry. Today TMS is an international gathering of people interested in the art and science of masonry, and its members include design engineers, architects, builders, researchers, educators, building officials, material suppliers, manufacturers, and others who want to contribute to and benefit from the global pool of knowledge on masonry.

TMS gathers and disseminates technical information through its committees, publications, codes and standards, newsletter, refereed journal, educational programs, workshops, scholarships, disaster investigation team, and conferences. The work of TMS is conducted by individual TMS members and through the volunteer committees composed of both members and non-members. The Masonry Society serves as the lead Society for the support of the MSJC, and as such, meetings of the committee are held at TMS meetings and activities of the Committee are managed by TMS.

For more information about TMS, contact The Masonry Society, 3970 Broadway, Suite 201-D, Boulder, CO 80304-1135, U.S.A; Phone: 303-939-9700; Fax:303-541-9215; E-mail: info@masonrysociety.org; Website: www.masonrysociety.org

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ACI was founded in 1904 as a nonprofit membership organization dedicated to public service and representing the user interest in the field of concrete. ACI gathers and distributes information on the improvement of design, construction, and maintenance of concrete products and structures. The work of ACI is conducted by individual ACI members and through volunteer committees composed of both members and non-members.

The committees, as well as ACI as a whole, operate under a consensus format, which assures all participants the right to have their views considered. Committee activities include the development of building codes requirements and specifications, analysis of research and development results, presentation of construction and repair techniques, and education.

Individuals interested in the activities of ACI are encouraged to become members. There are no educational or employment requirements. ACI's membership is composed of engineers, architects, scientists, contractors, educators, and representatives from a variety of companies and organizations. Members are encouraged to participate in committee activities that relate to their specific areas of interest.

For more information about ACI, contact the American Concrete Institute, 38800 Country Club Drive, Farmington Hills, MI 48331 U.S.A; Phone: 248-848-3700; Fax: 248-848-3701; Website: www.concrete.org

SEI
Structural Engineering Institute
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The Structural Engineering Institute (SEI) is a 22,000 plus member organization within the American Society of Civil Engineers (ASCE). SEI is organized into four Divisions. The Business and Professional Activities Division (BPAD), promotes needed change in business and professional development issues unique to the structural engineering profession. The Codes and Standards Activities Division (CSAD) develops and maintains leading design standards that are used worldwide. The Local Activities Division (LAD) provides technical, educational, and professional program support to the local structural technical groups within ASCE's sections and branches. The Technical Activities Division (TAD) advances the profession with the dedicated work of its 70 plus technical committees that produce technical papers and publications and produce the *Journal of Structural Engineers,* the *Journal of Bridge Engineers*, and the *Practice Periodical on Structural Design and Construction*.

Through its four divisions, SEI advances the profession in many ways including developing standards such as ASCE 7, encouraging discussion about licensure issues, enriching local Structural Technical Group programs, leading coordination efforts with other standards organizations, conducting an annual Structures Congress, offering cutting edge presentations, offering specialty conferences on topics of interest to the Structural Engineering community, coordinating efforts with other structural engineering organizations, responding to the community's need for help in crisis, and providing low-cost seminars and webinars to the Structural Engineering community

For more information about SEI, contact the Structural Engineering Institute, 1801 Alexander Bell Drive, Reston, VA 20191; Phone: 703-295-6196; E-mail: jrossberg@asce.org; Website: www.seinstitute.org

Revision Formatting for the 2008 Building Code Requirements and Specification for Masonry Structures

At the request of users of these standards, the Code and Specification portions of this edition include revision bars, deletion arrows and text boxes to designate places where major changes have occurred since the 2005 edition of these standards. These marks are for information only and designate major revisions. Editorial revisions, minor changes in section numbering, and similar other minor modifications are not designated with revision formatting. The following describes the basic purpose of each type of revision formatting along with other formatting conventions.

Revision Bars

Where major substantive modifications to a 2005 provision were made, a revision bar (line) is shown in margin adjacent to revised text. The revision bar is located in the left margin for text in the left column and in the right margin for text in a right column. An example of this revision bar is shown to the left.

Deletion Arrows

Where substantive requirements from the 2005 provisions have been deleted and not replaced or moved, a deletion arrow, as shown to the left, is located in the margin where that requirement formerly appeared.

Movement Boxes

Where large portions of text, or very specific requirements, have been moved from one place in the 2005 provisions to a new spot in the 2008 provisions, a small box has been inserted in the margin to indicate where the 2005 provisions were moved. The number in the box is the new section or new article where the requirements now appear. As an example, the movement box to the left indicates that requirements have been moved to section 0.0.0. In a few cases, the new section reference is so long that it would not appear in the box within the space provided. As such, the major section is shown to aide the user in finding the approximate location of the text.

Other Formatting Conventions

The user is again reminded that these revision designations above only highlight significant revisions that have occurred between the 2005 and the 2008 editions of these standards. These revision designations are intended to facilitate the use of these standards and should not be relied upon as the sole means of reviewing and understanding the entire context and impact of changes introduced into the 2008 edition.

To also aide users of these standards, "bleed tabs" have been added to the outside edges of most pages so that the user will quickly be able to determine which portion (Code, Specification, Code Commentary, Specification Commentary, or Index) they are reviewing.

Also be advised that a number of pages are intentionally left blank in the standards and commentaries so that the beginning of each Chapter starts on a right hand page.

Building Code Requirements for Masonry Structures (TMS 402-08/ACI 530-08/ASCE 5-08)

Reported by the Masonry Standards Joint Committee (MSJC)

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SYNOPSIS

This Code covers the design and construction of masonry structures. It is written in such form that it may be adopted by reference in a legally adopted building code.

Among the subjects covered are: definitions; contract documents; quality assurance; materials; placement of embedded items; analysis and design; strength and serviceability; flexural and axial loads; shear; details and development of reinforcement; walls; columns; pilasters; beams and lintels; seismic design requirements; glass unit masonry; and veneers. An empirical design method applicable to buildings meeting specific location and construction criteria are also included.

The quality, inspection, testing, and placement of materials used in construction are covered by reference to TMS 602-08/ACI 530.1-08/ASCE 6-08 Specification for Masonry Structures and other standards.

Keywords: AAC, masonry, allowable stress design, anchors (fasteners); anchorage (structural); autoclaved aerated concrete masonry, beams; building codes; cements; clay brick; clay tile; columns; compressive strength; concrete block; concrete brick; construction; detailing; empirical design; flexural strength; glass units; grout; grouting; joints; loads (forces); masonry; masonry cements; masonry load bearing walls; masonry mortars; masonry walls; modulus of elasticity; mortars; pilasters; prestressed masonry, quality assurance; reinforced masonry; reinforcing steel; seismic requirements; shear strength; specifications; splicing; stresses; strength design, structural analysis; structural design; ties; unreinforced masonry; veneers; walls.

[1] Main Committee Members participate in Subcommittee and Main Committee activities, including correspondence and voting.
[2] Subcommittee Members participate in Committee activities, vote on Subcommittee Ballots, and can comment on Main Committee ballots.
[3] Associate and Consulting Members participate in Committee activities.
+Deceased.

Adopted as a standard of the American Concrete Institute (December 21, 2007), the Structural Engineering Institute of the American Society of Civil Engineers January 28, 2008, and The Masonry Society (January 18, 2008) to supersede the 2005 edition in accordance with each organization's standardization procedures. The standard was originally adopted by the American Concrete Institute in November, 1988, the American Society of Civil Engineers in August, 1989, and The Masonry Society in July, 1992.

SI equivalents shown in this document are calculated conversions. Equations are based on U.S. Customary (inch-pound) Units; SI equivalents for equations are listed at the end of the Code.

CHAPTER 1 — GENERAL DESIGN REQUIREMENTS FOR MASONRY, pg. C-9

CHAPTER 1
GENERAL DESIGN REQUIREMENTS FOR MASONRY

1.1 — Scope

1.1.1 *Minimum requirements*

This Code provides minimum requirements for the structural design and construction of masonry elements consisting of masonry units bedded in mortar.

1.1.2 *Governing building code*

This Code supplements the legally adopted building code and shall govern in matters pertaining to structural design and construction of masonry elements, except where this Code is in conflict with requirements in the legally adopted building code. In areas without a legally adopted building code, this Code defines the minimum acceptable standards of design and construction practice.

1.1.3 *Design procedures*

Masonry structures and their component members shall be designed in accordance with the provisions of this Chapter and one of the following:

(a) Allowable Stress Design of Masonry: Chapter 2.

(b) Strength Design of Masonry: Chapter 3.

(c) Prestressed Masonry: Chapter 4.

(d) Empirical Design of Masonry: Chapter 5.

(e) Veneer: Chapter 6.

(f) Glass Unit Masonry: Chapter 7.

(g) Strength Design of Autoclaved Aerated Concrete (AAC) Masonry: Appendix A.

1.1.4 *SI equivalents*

SI values shown in parentheses are not part of this Code. The equations in this document are for use with the specified inch-pound units only. The equivalent equations for use with SI units are provided in Conversion of Units on Page C-73.

1.2 — Contract documents and calculations

1.2.1 Project drawings and project specifications for masonry structures shall identify the individual responsible for their preparation.

1.2.2 Show all Code-required drawing items on the project drawings, including:

(a) Name and date of issue of code and supplement to which the design conforms.

(b) Loads used in the design of masonry.

(c) Specified compressive strength of masonry at stated ages or stages of construction for which masonry is designed, except where specifically exempted by Code provisions.

(d) Size and location of structural elements.

(e) Details of anchorage of masonry to structural members, frames, and other construction, including the type, size, and location of connectors.

(f) Details of reinforcement, including the size, grade, type, and location of reinforcement.

(g) Reinforcing bars to be welded and welding requirements.

(h) Provision for dimensional changes resulting from elastic deformation, creep, shrinkage, temperature, and moisture.

(i) Size and location of conduits, pipes, and sleeves.

1.2.3 The contract documents shall be consistent with design assumptions.

1.2.4 Contract documents shall specify the minimum level of quality assurance as defined in Section 1.18, or shall include an itemized quality assurance program that equals or exceeds the requirements of Section 1.18.

1.3 — Approval of special systems of design or construction

Sponsors of any system of design or construction within the scope of this Code, the adequacy of which has been shown by successful use or by analysis or test, but that does not conform to or is not covered by this Code, shall have the right to present the data on which their design is based to a board of examiners appointed by the building official. The board shall be composed of licensed design professionals and shall have authority to investigate the data so submitted, require tests, and formulate rules governing design and construction of such systems to meet the intent of this Code. The rules, when approved and promulgated by the building official, shall be of the same force and effect as the provisions of this Code.

1.4 — Standards cited in this Code

Standards of the American Concrete Institute, the American Society of Civil Engineers, ASTM International, the American Welding Society, and The Masonry Society cited in this Code are listed below with their serial designations, including year of adoption or revision, and are declared to be part of this Code as if fully set forth in this document.

TMS 602-08/ACI 530.1-08/ ASCE 6-08 — Specification for Masonry Structures

ASCE 7-05 — Minimum Design Loads for Buildings and Other Structures