MSJC Masonry Design Provisions for 2005

What's New for Structural Engineers?

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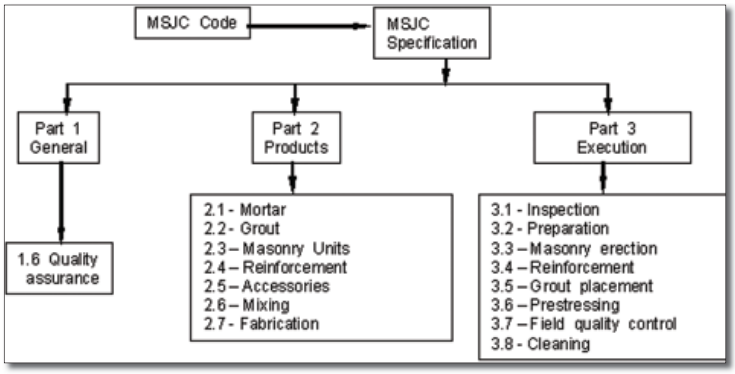
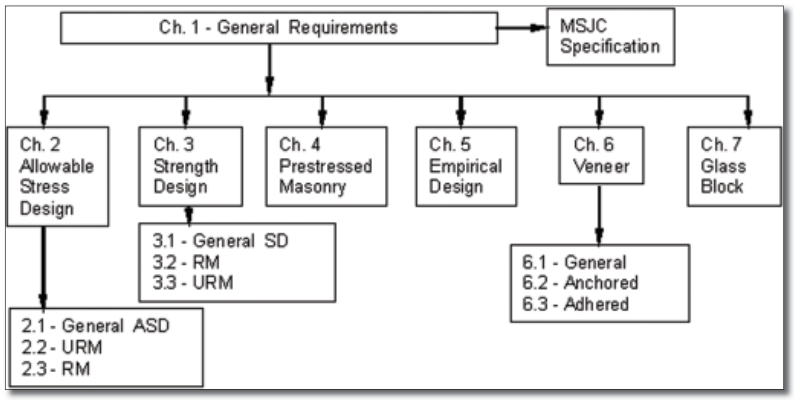
The Masonry Standards Joint Committee (MSJC) is the consensus organization accredited by ANSI to develop general design provisions for masonry, and its "Code and Specification" is referenced essentially verbatim by model-code agencies. In this article, the activities of the MSJC during the current 2005 code cycle are summarized, with emphasis on draft changes that will be particularly important to structural engineers. The structural engineering community is encouraged to become more involved with the MSJC and the development of its provisions.

About The Masonry Standards Joint Committee (MSJC)

Because the MSJC is the only source for ANSI-accredited masonry design provisions in the US, and because it has an unequalled technical understanding of masonry behavior and design, it is fundamental to the development of code provisions for masonry. Because both harmonized US model building codes reference the MSJC *Code and Specification* essentially verbatim, that document is the de facto basis for US building-code provisions for masonry.



Top - Figure 2: Organization of the 2002 MSJC Specification



Left - Figure 1: Organization of the 2002 MSJC Code

Organization of the MSJC Code and Specification

The organization of the MSJC *Code* is shown in *Figure 1*. The Code's general provisions are spelled out in Chapter 1. Its design provisions are given in Chapter 2 (Allowable Stress Design), Chapter 3 (Strength Design), Chapter 4 (Prestressed Masonry), Chapter 5 (Empirical Design), Chapter 6 (Veneer), and Chapter 7 (Glass Block). Its Sections 1.2.4 and 1.14 require a Quality Assurance program in accordance with the MSJC *Specification*, and its Section 1.4 invokes that Specification by reference.

The MSJC *Specification*, whose organization is shown in *Figure 2*, is part of the MSJC *Code* by reference and contains requirements intended to protect life safety.

Most Important Proposed Changes to 2002 MSJC Standards

During the 2005 cycle, the MSJC has completely re-organized under three sponsoring societies and one set of rules; it has essentially resolved maximum reinforcement issue for strength design; it has updated empirical design as needed; it has developed a new mandatory-language appendix on autoclaved aerated concrete (AAC) masonry; it has made many improvements to the *Specification*; and it has been harmonized and cleaned up throughout. Some of the most important of those changes include:

Chapter 1 (General Requirements):

MSJC Code Section 1.14 (Seismic Design Requirements) has been updated to clarify definitions of wall types, and to insert seismic design requirements for AAC masonry shear walls to correspond to the design provisions for AAC masonry in the new Appendix A8.

References to ASCE 7 have been updated to ASCE 7-02 with one exception, where a reference to ASCE 7-93 has been maintained to preserve the 1/3 stress increase for allowable-stress design in a limited number of jurisdictions.

Chapter 2 (Allowable Stress Design):

- Allowable stresses for in-plane bending as well as out-of-plane bending are now given by Table 2.2.3.2. Although more work still needs to be done in this area, it is more reasonable to have allowable stresses for in-plane bending be given by Table 2.2.3.2, than be zero.

Chapter 3 (Strength Design) has been extensively updated, including:

- In Section 3.2.3.5, provisions governing the maximum area of flexural tensile reinforcement have been extensively revised. The provisions of this section are still based on a critical strain gradient, similar to the approach of ACI 318-02. The maximum reinforcement provisions of the 2002 MSJC Code were relatively severe, and led to

constructability problems in some circumstances. For the 2005 MSJC Code, the provisions are applied only to elements intended to be ductile. The maximum steel strain in the critical gradient was somewhat relaxed, and is tied directly to wall type (special, intermediate or ordinary). Stress in tensile reinforcement need now be taken no higher than 1.0 fy. Stress in compressive reinforcement can be included in calculating axial equilibrium even though that steel is not laterally supported by transverse reinforcement.

- The new Section 3.2.6.5 presents an alternative to the maximum flexural tensile reinforcement of Section 3.2.3.5 – the use of confined boundary elements to increase the strain capacity of the compressive stress block. While requirements for these elements are not yet defined, procedures for defining them are presented. The use of confined boundary elements is an option for reinforced concrete, and it should in principle be an option for reinforced masonry as well.

Chapter 4 (Prestressed Masonry) has been extensively updated:

- While the 2002 Code was based on allowable-stress design with nominal strength checks, the 2005 Code offers the designer the option of strength design. Provisions have been harmonized with those of Chapters 1, 2, and 3.

Chapter 5 (Empirical Design) was amended to clarify its restrictions:

- In Section 5.1.2.1, gravity loads on walls and foundation piers are required to act within the kern (no net tension).
- In Section 5.1.2.3, wind speeds are given as the basic wind speed of ASCE 7-02.

Chapter 6 (Veneer):

- In Section 6.2.2.11, prescriptive requirements, with appropriate modifications, have been extended to areas of high winds.

Chapter 7 (Glass Unit Masonry):

- In Section 7.3.2, glass unit masonry is permitted to be supported by wood, with strict limitations on weight.

Appendix Chapter A8:

- Appendix Chapter A8 is a completely new, mandatory-language Appendix dealing with the strength design of autoclaved aerated concrete masonry.

The MSJC Specification:

- Article 1.1B clarifies the relationship between the Code and the Specification, and removes the requirement that the contractor follow the provisions of the contract documents. This requirement was legally inappropriate because the Specification, being referenced by the Code, becomes a law. It is inappropriate for a law to require somebody to follow a civil contract. The contract itself requires certain actions.

- Article 1.4B adds provisions for determination of the compressive strength of AAC masonry.
- Article 2.1C adds material construction provisions for AAC masonry.
- Article 3.3 adds masonry erection provisions for AAC masonry.
- Article 3.5D permits grout lifts of up to 12.67 ft in height, under closely controlled conditions.
- Article 3.5G adds grouting provisions for AAC masonry.

MSJC Plans for the 2008 Cycle

Easy Issues for the 2008 Cycle

Examples of relatively easy issues for the 2008 cycle include:

- Continue to harmonize design by strength, allowable-stress and empirical approaches.
- Make strength design simpler (for example, by eliminating the requirement to check the moment magnifier for out-of-plane bending if walls are not very slender).
- Clean up the logic on our prescriptive seismic requirements.
- Continue to improve the Specification
- Update the Commentaries.

Tough Issues for the 2008 Cycle

Examples of relatively tough issues for the 2008 cycle include the following:

- Maximum reinforcement provisions. Masonry is much harder to confine than concrete, maximum reinforcement limitations must be more severe for unconfined masonry than for unconfined concrete, to avoid toe crushing. Possible solutions include more walls, increased compressive strength of masonry, practical confined boundary elements for masonry, and decreased ϕ-factors rather than prohibition for compression-controlled cross-sections
- Prescriptive seismic requirements. How can we make prescriptive seismic reinforcement more convenient to use?
- The 1/3 stress increase. As explained in detail in Chapter 8 of the Masonry Designer's Guide, the 1/3 stress increase is permitted by alternative allowable-stress loading combinations in some load documents, and expressly prohibited in others. It can significantly affect final designs under some conditions, particularly unreinforced masonry in high wind areas. To the best of my knowledge, no formal test data support it, and it is increasingly restricted by loading documents. The MSJC's options for addressing this issue include routinely reinforcing more masonry, or attempting to generate the data required to justify the 1/3 stress increase.
- The future of empirical design. Inside and outside the masonry technical community, empirical design is distrusted by many. Inside the community, it is popular with some designers and may contractors, who believe, rightly or wrongly, that it results in more cost-effective designs. Recent model-code hearings have involved increased pressure by NCSEA and CRSC to take exception to empirical design. In my personal opinion, the MSJC should continue to defend empirical design for as long as it has potential users, while keeping it restricted and reasonably consistent with allowable-stress and strength design. At the same time, the MSJC is working to develop "simplified design," a rational subset similar to the ACI / ISO simplified design publication for reinforced concrete. Ultimately, the design marketplacwill decide the fate of empirical design.

How the Masonry Community Can Help

The masonry community, including structural engineers, can help in this effort by staying involved with the MSJC, by helping to identify areas where the MSJC Code and Specification can be improved, and by helping to act as a resource for the MSJC process in addressing difficult issues.

The most direct way for masonry designers to stay in touch with the building-code process is to follow the MSJC. That committee meets twice a year, in conjunction with The Masonry Society, at different locations in the US and Canada. Information on MSJC activities and meeting dates is posted on the MSJC web site (**www.masonrystandards.org**), and meetings are open to the public. Although membership on the MSJC is generally stable over each 6-year major cycle, those interested in working more closely with the MSJC are encouraged to inquire, either through the MSJC web site or directly to this author.

Finally, although MSJC members are selected for their individual expertise rather than institutional representation, several individual MSJC members hold leadership positions in state structural engineering associations or the NCSEA. Masonry designers can also contact their state associations or the NCSEA for further information.▪

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For More Information

MSJC Code and Specification: ACI 530-02 / ASCE 5-02 / TMS 402-02 (*Building Code Requirements for Masonry Structures*) and ACI 530.1-02 / ASCE 6-02 / TMS 602-02 (*Specifications for Masonry Structures*), American Concrete Institute, Farmington Hills, Michigan; American Society of Civil Engineers, Reston, Virginia; and The Masonry Society, Boulder, Colorado, 2002.

Masonry Designers' Guide, 4th ed., Phillip J. Samblanet, ed., The Masonry Society, Boulder, Colorado, 2003.

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