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ABOUT THE MDG AND THE MASONRY CODE AND SPECIFICATION

1.1 INTRODUCTION

Masonry consists of hand-placed units, typically bonded together with mortar. Masonry can be reinforced or unreinforced. Masonry units may be of stone, adobe, fired clay (brick or tile), concrete, glass, or autoclaved aerated concrete. Masonry is one of society's oldest forms of building construction.

Modern masonry codes have existed for about 80 years. Some of the key milestones leading up to the current masonry code and specification, TMS 402/602, are given in the following. Further information on the development of masonry codes in the U.S. is in Borchelt (1999) and Samblanet (2017).

- 1944: *American Standard Building Code Requirements for Masonry*, (ASA/ANSI A 41.1)
- 1966: *Building Code Requirements for Engineered Brick Masonry*, published by the Structural Clay Products Institute, 1966, and the Brick Institute of America, 1969 (currently the Brick Industry Association)
- 1970: *Specification for the Design and Construction of Load Bearing Concrete Masonry*, National Concrete Masonry Association.
- 1979: *Building Code Requirements for Concrete Masonry Structures and Commentary,* ACI 531-79, American Concrete Institute.
- 1981: *Standard Building Code Requirements for Masonry Construction*, TMS 401, The Masonry Society.

A brief history the current Building Code Requirements for Masonry Structures (TMS 402) and Specification for Masonry Structures (TMS 602) is given in the following.

- 1988: First edition under a joint committee of ACI and ASCE.
- 1992: TMS became a joint sponsor and code developed by the Masonry Standards Joint Committee (MSJC).
- 1995: Seismic requirements moved from appendix to main body of code; chapters on veneers and glass block added.
- 1998: Major reorganization of code; prestressed masonry chapter added.
- 2002: Strength design chapter added; code moved to a three year revision cycle.
- 2005: Added AAC masonry in appendix.
- 2008: Major reorganization of seismic requirements; TMS became the lead sponsor.
- 2011: Eliminated one-third stress increase and recalibrated allowable stresses; AAC moved from appendix to main body of code; added infill provisions in appendix.
- 2013: Major reorganization of code; moved empirical design to appendix and added a partitions chapter; added limit states appendix.
- 2016: TMS became the sole sponsor; code moved to a six year revision cycle.

- 2022: Empirical design deleted; infills moved from appendix to main body of code; appendix added on glass-fiber reinforced polymer reinforcement in masonry.

This MDG 2022 is the result of 9 past successful Masonry Designers Guides. The first, developed in 1993 in response to the need for a handbook that addressed the requirements of the early masonry Code, was developed by TMS with support of the masonry industry and ACI. That first edition of the MDG was very popular and of great value to designers, and as such, TMS has developed new editions of the MDG following the completion of each new masonry Code/Specification. The last edition, the MDG 2016, was based on the 2016 TMS 402/602 provisions. This Guide, which is the 10th edition, is designated as the MDG 2022 in response to requests from users who requested quick identification of the basis for the design guide. As such this MDG 2022 is so named because it is based on 2022 TMS 402/602, Figure 1.1-1.

In recognition of past efforts from volunteer leaders of the MDG, the three design examples are named after three individuals. The REK Shopping center is named in honor of Richard E. Klingner who led efforts on this example for many years. The JHM Retail Center is named in honor of John H. Matthys who served as leader for the MDG for the first 3 editions. The RCJ Hotel is named in honor of Rochelle C. Jaffe because of her past efforts on the hotel building as well as her many contributions to the MDG. The efforts of these three individuals, and the efforts of all the other volunteers who assisted in developing, reviewing, and revising the MDG are greatly appreciated.

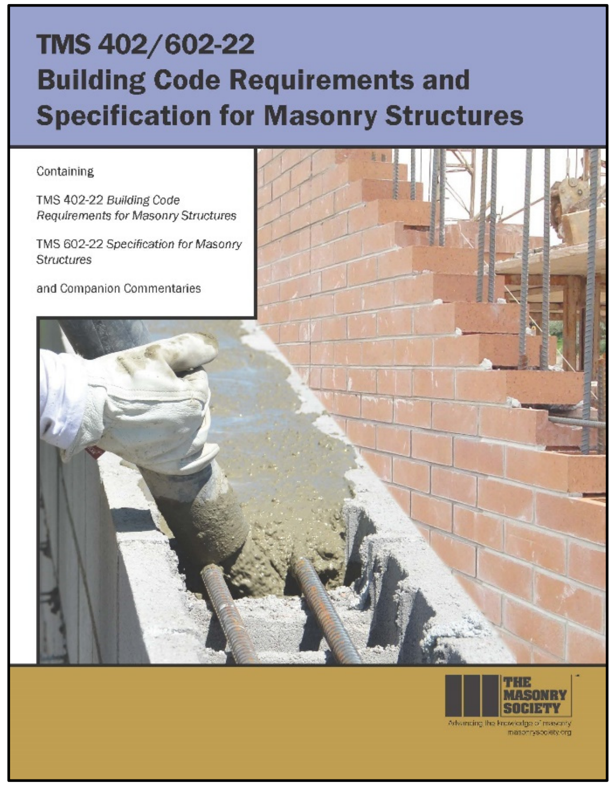

Figure 1.1-1: 2022 TMS 402/602 Building Code Requirements & Specification for Masonry Structures

MDG Tip: For those working on existing buildings, most past editions of TMS 402/602 are available from The Masonry Society at masonrysociety.org.

MDG Tip: While rare, errata to standards and publications are sometimes needed. Visit masonrysociety.org/errata/ to check for errata on the MDG and TMS 402/602.

1.2 OVERVIEW OF THE 2022 TMS 402/602

1.2.1 General Overview of the 2022 Edition of TMS 402/602

As with past editions of the TMS 402/TMS 602 Code and Specification, both documents, along with their commentaries, are contained in one bound book for the 2022 edition (Figure 1.1-1). The commentary is displayed to the right of the applicable Code and Specification provisions in a side-by-side Code/Commentary and Specification/Commentary format.

For those not familiar with the provisions, TMS 402 is written in mandatory language, and it addresses the design and construction of masonry structures. As noted in TMS 402 Section 1.1.1, the Code provides minimum requirements for the structural design and construction of masonry elements consisting of masonry laid in mortar. It does not address non-structural issues, (such as fire resistance, energy efficiency, water penetration resistance, etc.) nor does it address dry-stack surface bonded masonry or dimension stone supported by structural framing rather than mortar.

TMS 402 is divided into five parts, with a total of fifteen chapters and two mandatory-language Appendices. These are listed in MDG Table 1.2.1. Table 1.2.1 also gives TMS 402 page numbers, and supplemental comments by MDG authors, shown in italics to highlight specific requirements to help users of the MDG.

The TMS 602 Specification addresses minimum life safety-related construction requirements for those masonry structures and includes minimum quality assurance requirements paralleling those of the Code. The commentaries to TMS 402/602, written in non-mandatory language, are for information only, and discuss some of the historical background and supporting research for the Code and Specification requirements.

The TMS 602 Specification is a reference specification, intended for inclusion in its entirety by reference in contract documents, together with supplementary requirements applicable to the specific project. It is not a guide specification from which the specifier is permitted to pick and choose. The Specification is required by the Code, with the objective of ensuring that the masonry elements are constructed consistently with the intent of the designer. Thus, the Specification addresses minimum life safety-related construction requirements for masonry elements. Included are general provisions, including safety-related quality assurance requirements; requirements for the materials used in the work; and requirements for the execution of the work. The requirements of the Specification may be augmented in contract documents but are not to be relaxed.

As described in Table 1.2.2, the Specification consists of three main Parts (General, Products, and Execution), plus the Preface and the Specification Checklists. The checklists themselves are not mandatory. The Mandatory Requirements Checklist, in spite of the fact that the word “mandatory” appears in its name, is simply a list of those specification decisions that the specifier must make, because no default requirements exist. The Optional Requirements Checklist is simply a list of those specification decisions that the specifier may or may not make, and which, if not made, automatically invoke the default requirements. These main Parts, along with their major articles, are shown in Table 1.2.2 in outline form for reference by the reader. To help the user of the MDG, that same Table 1.2.2 also gives Specification page numbers and supplemental comments by MDG authors, shown in italics to highlight specific requirements.

1.2.2 Significant Changes in the 2022 Edition of TMS 402

There were numerous changes made in the 2022 edition of TMS 402. The list provided below is not comprehensive but provides an overview of many of the major changes. This list should be particularly useful to those familiar with the 2016 edition of TMS 402 and who are interested in what has changed.

Net Shear Area: TMS 402 Table 4.4.5 was added which defines and clarifies the net shear area for masonry members. In particular, the depth for the net shear area for beams is specified to be d, whereas in previous editions it was unclear whether the depth should be d, the depth to the centroid of the reinforcement, or d_v, the depth of the member.

Wall Intersections: TMS 402 Section 5.2 was added to clarify wall intersection provisions. There are three cases given.

- Independent walls: designed and detailed for no shear transfer.
- Lateral support for walls with composite action at the intersection: designed and detailed so only out-of-plane forces are transferred at the intersection.
- Wall intersections designed for composite action: Requirements similar to previous codes for effective flange width and design for shear transfer at the intersection.

Beam Shear: Provisions for using shear at $d/2$ from the face of support in beam design were moved from TMS 402 Chapter 8 (Allowable Stress Design) to TMS 402 Chapter 5 (Structural Members) so they apply to all beams, irrespective of the design method.

Deformed Wire Reinforcement: Although deformed wire had been mentioned in previous editions, there were no requirements for deformed wire. Requirements were added for deformed wire reinforcement to TMS 402 Chapter 6, including yield strength limits, maximum size, requirements for deformed wire in both mortar and grout, and development and splice lengths.

Size of Reinforcement in Grout: The differing requirements for reinforcement size in allowable stress and strength design were harmonized and moved to Chapter 6. The reinforcement size is limited to:

- one-eighth the least nominal member dimension.
- one-third the least dimension of the gross grout space.
- 4% of the gross grout space for clay and concrete masonry except 8% at laps.

The gross grout space is the area within the continuous grouted cell, core, bond beam course, or collar joint, considering the effect of unit offset in adjacent courses but neglecting possible mortar protrusions and the presence of perpendicular reinforcement, if any. Tables are given in the commentary for maximum bar size for most common masonry configurations.

Hooks for Shear Reinforcement: The requirement for hooks at the end of shear reinforcement in shear walls was deleted for all except special reinforced masonry shear walls, where hooks are still required. It was also clarified as to whether the hook requirement applies to prescriptive seismic reinforcement with hooks only being required if $V/(F_{vm}A_{vn}) > 0.4$ in allowable stress design and if $V_u/\phi V_n > 0.4$ for strength design in special reinforced masonry shear walls.

Non-participating Elements Isolation: An exception was added to the requirement that non-participating elements be isolated. Non-participating elements do not need to be isolated if they can accommodate the inelastic story drift, can support gravity loads acting simultaneously with the inelastic displacement, and have a ductility compatible with the ductility of the seismic-force-resisting system.

Non-participating Elements Prescriptive Reinforcement: The Code clarified the prescriptive seismic reinforcement in non-participating elements must be in the direction of the span.

Anchor Bolt Steel Strength: The tensile and shear steel strength of anchor bolts is now based on f_u instead of f_y. The Code also clarified that effective area of the bolt is to be used, including the threads. This results in the steel strength being the same as in ACI and AISC.

Allowable Compressive Force: The allowable axial compressive force from masonry was increased from $0.25f'_mA_n$ to $0.30f'_mA_n$ for reinforced masonry.

Partially Grouted Shear Wall Factor: The partially grouted shear wall factor, γ_g, was decreased from 0.75 to 0.70.

Allowable Shear Friction Stress: The allowable shear friction strength for $M/(Vd_v) > 1$ was increased by changing the term $0.6A_{sp}F_s$ to $0.75A_{sp}F_s$.

Compression-controlled Sections in Strength Design: Compression-controlled sections were added to strength design with a strength-reduction factor of 0.65. As a result of this change the maximum reinforcement provisions in strength design were deleted except for beams and for intermediate and special reinforced shear walls under in-plane loads.

Shear Friction Nominal Strength: The nominal shear friction strength for $M_u/(V_ud_v)$ was changed from being based on A_{nc}, which can be difficult to calculate, to being based on $A_{sp}f_y$ and P_u, similar in format to allowable stress design.

Prestressed Masonry Beams: Provisions were added for prestressed masonry beams.

Veneer: The veneer chapter was changed from Chapter 12 to Chapter 13 and was completely rewritten. Prescriptive provisions for anchored veneer were simplified. A tributary area method was added for engineered design of anchored veneer as well as guidance for modeling anchored veneer in a full engineered design. Both the prescriptive and engineered provisions for adhered veneer were enhanced.

Thin Unit Glass Masonry: The requirements for thin unit glass masonry were added to the strength level wind pressure chart, which clarifies the provisions and makes them easier to use.

Infills: The infill provisions were moved from Appendix B to Chapter 12.

Empirical Design: Appendix A on empirical design was deleted.

Glass Fiber Reinforced Polymer (GFRP) Reinforced Masonry: Appendix D was added on the design of GFRP reinforced masonry. The provisions of Appendix D are currently limited to non-participating elements in Seismic Design Category C or less.

1.2.2 Significant Changes in the 2022 Edition of TMS 602

The changes made in the 2022 edition of TMS 602 were far fewer than the changes to TMS 402. The list provided below is not comprehensive but provides an overview of many of the major changes. This list should be particularly useful to those familiar with the 2016 edition of TMS 602 and who are interested in what has changed.

Mortar Materials: ASTM C1714 was added as an acceptable mortar in addition to ASTM C270. ASTM C1714 mortars have materials and design requirements governed by ASTM C270 but are preblended in a factory instead of produced from individual raw materials delivered to the jobsite.

Adhered Veneer: The setting bed mortar for adhered veneer is now required to meet the requirements of ANSI A118.4 or A118.15. These are polymer modified mortars that have increased bond strength.

Glass Fiber Reinforced Polymer (GFRP) Reinforcement: With the addition of GFRP reinforcement to TMS 402, requirements were added to TMS 602 including requirements on delivery, handling and storage (Article 1.7 F), GFRP bars conform to ASTM D7957/D7957M (Article 2.4 C), requirements for hooks (Article 2.7 B), and field cutting of GFRP bars (Article 3.4 B.10).

Veneer Wire Reinforcement: A new term has been added, with veneer wire reinforcement being either a single wire that conforms to the longitudinal wire requirements of joint reinforcement or deformed wire reinforcement. This was to distinguish it from joint reinforcement, which is required by ASTM A951 to have two wires.

Anchor Bolts: ASTM F1554 was added as an acceptable anchor bolt for both headed and bent-bar anchor bolts.

Adhered Veneer: Requirements were added for lath, cementitious backer units, lath fasteners, and weep screeds for use with adhered veneer.

Installation of Adhered Veneer: The requirements for installation of adhered veneer were updated to conform to current practice.

Veneer Tie Fasteners: Fasteners for veneer ties need to conform to AWC NDS for fasteners to wood, AISI S240 for fasteners to cold-formed metal, and ACI 318 for fasteners to concrete.

Veneer Tolerances: A tolerance of ± 1 in. (25.4 mm) was added for placement of veneer ties. A tolerance of ± 0.25 in. (6.4 mm) was added for placement of adhered veneer assembly fasteners.

Deformed Wire: Hook and bend requirements were added for deformed wire.

Mechanical Splices: Requirements were added for the cover and clear distance between mechanical splices that are the same as for reinforcing bars.

Grout Pour and Lift Heights: A figure was added to the commentary to clarify grout pour and lift heights.

Table 1.2.1: Summary of 2022 TMS 402 Code Requirements

Table 1.2.1: Summary of 2022 TMS 402 Code Requirements *(Continued)*

Table 1.2.1: Summary of 2022 TMS 402 Code Requirements *(Continued)*

Table 1.2.1: Summary of 2022 TMS 402 Code Requirements *(Continued)*

Table 1.2.2: Summary of 2022 TMS 602 Specification Requirements

1.3 PREVIEW OF THE MDG 2022

1.3.1 Introduction to the MDG

As with past editions, the 2022 MDG continues to be divided into five main parts.

Part I, General, is administrative and applies to all other parts. Background information on development of the MDG, including author and reviewer contributions, is given in the Foreword. Chapter 1 discusses the development of this Guide, its basis, and major changes to it as well as to the Codes and Standards upon which it is based. Chapter 2 (Notation, Definitions, and Abbreviations) presents TMS 402/602 notation and definitions with additions and abbreviations used in the MDG. Where appropriate, notation is identified within the MDG text.

Part II, Materials, primarily addresses the TMS 602 Specification provisions as related to materials and testing. Chapter 3 (Materials) examines the provisions for clay or shale masonry units, concrete masonry units, AAC masonry units, glass masonry units, stone masonry units, mortar, grout, masonry assemblages, reinforcement, and connectors.

Part III, Construction and Quality Assurance, addresses these topics as well as quality control and hot and cold weather construction. Quality assurance (QA) includes the administrative policies and requirements related to quality control measures that are instituted to achieve the owner's quality objectives. Quality control is the systematic performance of construction, testing, and inspection. It consists of the operations of the contractor at the construction site to obtain compliance with the contract documents.

Chapter 4 (Construction) discusses basic masonry construction, especially in relation to the quality assurance and quality control provisions in the Specification, including the following: storage and protection of materials; placement of materials including units, mortar, grout, reinforcement, and connectors; and tolerances. Chapter 4 is not intended to teach someone how to be a mason, but rather to address critical construction issues related to Specification requirements. Likewise, Chapter 5 (Cold and Hot Weather Construction) addresses precautions that should be taken during hot and cold weather conditions. Chapter 6 (Quality Control and Quality Assurance) addresses the items comprising quality assurance and quality control, including organizational responsibilities, materials control, inspection, testing and evaluating, noncomplying conditions, and records. MDG Tables 6.5.1 and 6.5.2 present a checklist of items addressed by the Specification, and shows which items are mandatory and which are optional. The extent of any quality assurance and quality control program, above and beyond the minimum life safety-related requirements of the Specification, often varies with the size and nature of the project. To give examples of this possible variation, specific possible applications of the Specification QA/QC provisions to the three common prototypical masonry buildings of this Guide (the REK Shopping Center of Chapter 19, the JHM Retail Store of Chapter 20 and the RCJ Hotel of Chapter 21) are presented in MDG Table 6.5.3.

Part IV, Design, covers the application of the Code provisions to the structural design of masonry members (beams, walls, columns, pilasters) for different types of construction (multiwythe composite and noncomposite, single-wythe, unreinforced and reinforced). Chapter 7 (Design Philosophy and Methodology) gives an overview of masonry, and its characteristics, and provides background on material strengths, loads, load combinations, masonry construction, and performance that underlie the philosophy of masonry structural design. Global building design issues, including building configurations, building types, and building performance, are reviewed. Typical loads on masonry buildings are discussed, as well as applicable load combinations for design. The chapter then addresses global distribution of gravity and lateral loads to major building members. The chapter concludes with a discussion of the structural behavior of various types of masonry members, including walls, beams, beam-columns, and pilasters. Chapter 8 (Movements) addresses the nature, causes, possible consequences of movements, and differential movement in masonry construction. Methods for determining the magnitude of specific movements are presented, as are ways of accommodating those movements. These include determination of the required location and width of control joints and expansion joints.

Chapter 9 (Reinforcement and Anchor Bolts) addresses requirements for reinforcement and anchor bolts. This includes reinforcement details and development and splice lengths. Anchor bolt strengths under tension, shear, and combined tension and shear are covered.

Chapter 10 (Requirements for Seismic Design) describes how earthquake-resistant design of masonry buildings requires provisions for connectivity and ductility not generally required for wind or other lateral loads. It reviews the requirements in TMS 402 Chapter 7, which are intended to provide a minimum level of performance of masonry structures subjected to earthquakes. MDG Chapter 10 also reviews Limit Design that was added to the 2013 TMS 402 Appendix C.

Chapters 11, 12, 13, 14, and 15 discuss TMS 402 provisions for Allowable-Stress Design, Strength Design, Prestressed Masonry Design, AAC Masonry Design, and Infills respectively. Concepts related to axial force, flexure, and shear are examined, and simple examples are provided showing how to use each design approach to design masonry members subjected to those forces. Chapter 15 includes guidance on the design of masonry infill based on Chapter 12 of TMS 402. Chapter 15 also include partitions and glass unit masonry, which are both a form of non-participating infills.

Chapter 16 (Veneer) discusses TMS 402 provisions for anchored veneer and adhered veneer, as given in TMS 402 Chapter 13. TMS 402 Chapter 13 was entirely rewritten in the 2022 edition and thus this chapter has been rewritten. Both prescriptive and engineered design of anchored and adhered veneer are presented, with examples illustrating the code requirements.

Chapter 17 is a new chapter that addresses TMS 402 Appendix D, which is a new Appendix on glass fiber reinforced polymer (GFRP) reinforced masonry. The scope of this chapter is limited to non-participating elements, and these are the first provisions for the use of nonmetallic reinforcement in masonry.

Chapter 18, on Using TMS 402/602 with Model Building Codes, which has been very popular with users of previous editions of the MDG, is included once more in this MDG. The chapter is now primarily based on the 2024 International Building Code (IBC).

Part V – Building Design presents a variety of more complex design examples based on three masonry buildings: the REK Shopping Center (Chapter 19), the JHM Retail Store (Chapter 20), and the RCJ Hotel (Chapter 21). These examples are similar to those used in the MDG 2016.

The design examples for each building have been substantially revised and updated based on new design provisions in the TMS 402 Code. Comments related to the IBC are included as appropriate. For each building, plans and elevations are presented, followed by calculations of gravity and lateral design loads, and of the resulting design loading combinations. For those combinations, the design examples proceed to address the structural design of typical members of each building. In addition, several miscellaneous design examples are presented, for different design loading combinations, to provide additional insight into different design approaches.

To assist the reader in finding information on various design methods, "Bleed Tabs" are shown on the outside edges of many pages. These bleed tabs are presented vertically down the page according to the order of those topics in the TMS 402 Code (that is the bleed tab for Allowable-Stress Design is shown near the top of the page as it is covered in TMS 402 Chapter 8, and the bleed tabs progress down the pages with each subsequent chapter of the TMS 402). As such, a reader interested in a particular design method can easily thumb to discussion on that topic.

1.3.2 MDG Website

Companion files for the MDG-2022 including Excel Spreadsheets used in several of the design examples and additional supplemental information are available at the link below.

masonrysociety.org/mdg2022/

1.3.3 Units of Measurement

As with past editions, the MDG is written in inch-pound units. Chapters 1 through 19 typically include approximate SI equivalents in parentheses, except in design examples, and occasionally in figures. For clarity and conciseness, Chapters 19, 20, and 21 do not include SI equivalents. Conversion factors for SI units are provided in Appendix B. Readers should also be aware that the TMS 402 and TMS 602 are written in inch-pound units, and that SI units and equations are not an official part of the Code (Code Section 1.1.3).

1.3.4 Significant Figures

ASTM Standard, E29, *Standard Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications*, provides a helpful discussion of significant figures. Although various forms of the significant figure rules were developed hundreds of years ago, they were only emphasized in the last 40-50 years when calculators replaced slide rules (Carter, 2013). Carter (2013) states "we have lost the emphasis that the significant figure rules were designed to calculate an approximate (not exact) precision." Significant figure rules are an approximation to the multivariable calculus that is required for error analysis.

From an engineering standpoint, Dr. Mete Sozen, distinguished professor at the University of Illinois and then Purdue University, provided a good overview of significant figures. He would tell his students that they should know the answer of an engineering problem to one significant figure before doing any calculations. Engineering calculations are performed to determine the second significant figure. And if you think you know anything in engineering to three significant figures you are kidding yourself. Although this may be a bit of an overstatement there is a lot of truth in what Professor Sozen taught his students.

Over the years the MDG team has had numerous discussions and debates on significant figures. For example, should the thickness of a nominal 8 inch block be expressed as 7.625 in., 7.62 in., or 7.63 in. It really does not matter, although as shown later there is a slight argument for using 7.625 in. to avoid propagation of roundoff error.

In this Guide there are three aspects related to significant figures that will be emphasized. The first is Professor Sozen's first rule – know the answer to one significant figure. Engineers are encouraged to do quick back-of-the-envelope calculations to get approximate answers. This is particularly important with finite element analyses where slightly wrong input or modeling may result in very wrong output. There is no substitute for engineering design experience, but the Guide will provide various rules of thumb to aid in design.

The second aspect of significant figures that is important is to carry extra significant figures in calculations to avoid propagation of error. For example, when two numbers are subtracted there is a loss of precision. This is particularly true when the numbers are close to each other. For example, 5.64 – 5.28 = 0.36, or a significant figure has been lost. There is also a problem when there is an order of magnitude change in a number. There is not much difference between 0.999 and 1.001. The former has three significant figures and a change of the last digit by one results in about a 0.1% change in the value. Using three significant figures with the latter, 1.001, would be written as 1.00 and a change in the last digit by one results in about a 1% change. Some people suggest that if the first digit of a number is "1" then four significant figures should be used to partially mitigate this issue.

The final aspect is related to the second and is to only round the final answer. Consider the design of a masonry bearing wall. There are many calculations that are needed in this design. First there is the determination of the loads, which involves numerous calculations. Some of the loads are dependent on other calculations; for example, the site class used in determining seismic loads may be based on a geotechnical report which has many calculations. After determination of the loads there is structural analysis. If this is the finite element analysis of a perforated wall for limit design there are numerous calculations. Finally, there is the design of the masonry cross-section. If this is an interaction diagram there are again numerous calculations. The point is that there are many calculations along the way and rounding should be done only at the end to avoid propagation of errors. Best practice is to carry an extra significant figure or two along the way. With the use of computer programs and spreadsheets, usually about 15 digits are carried, which is far more than sufficient. For calculators the best practice is to store intermediate numbers in the calculator.

Since the Masonry Designer's Guide is written by multiple authors there may be cases where there is inconsistent use of significant figures. Going back to an earlier example, the thickness of a nominal 8 inch masonry unit will typically be written as 7.63 in. but there may be other values used. Intermediate calculations will generally be given to three significant figures although often more significant figures are used in the calculations. The reason for reporting intermediate results to three significant figures is to give the user a feel for the numbers and also not to imply that there is a greater precision. This does mean that if the rounded intermediate numbers are plugged into a calculator by a user of the Guide, they may get slightly different results than reported.

To put this discussion into perspective, consider the design of a masonry bearing wall. From experience and/or rules of thumb it is determined that 8 inch masonry units will be used. The calculations, perhaps one hundred or more, are simply to determine whether No. 5 bars will be placed at 32 in., 40 in., or 48 in. As long as the engineer is not excessively sloppy in intermediate calculations and rounding the final design is safe.

1.3.5 MDG Tips

Due to the popularity of Good Structural Design Tips in *Strength Design of Masonry* published by TMS, Masonry Designer's Guide Tips (MDG Tips) were added to this edition of the Masonry Designer's Guide. These are callouts with suggestions from the authors of the Guide. An example is shown below. Look for these tips throughout the Guide.

> **MDG Tip:** Masonry is an excellent construction material, providing many benefits to the owner that include economy, strength, durability and fire resistance.

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TMS 602: *Specification for Masonry Structures* (formerly TMS 602/ACI 530.1/ASCE 6), multiple editions, The Masonry Society, Longmont, Colorado.

Model Codes

UBC: *Uniform Building Code*, multiple editions, International Conference of Building Officials, Whittier, California.

IBC, *International Building Code®*, multiple editions, International Code Council, Washington, DC.