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ALL WEATHER MASONRY CONSTRUCTION: *ABRIDGED*

OCTOBER 21, 2020

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Director of Industry Development and Technical Services

OUR SERVICES FOR YOU

Plan and spec review

Detailing

Job site troubleshooting

Continuing education

Hands-on material workshops

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LEARNING OBJECTIVES

- Become familiar with the **TMS 402 / TMS 602 requirements for masonry construction including cold and hot weather conditions**.
- Gain an understanding of both the **construction and protection requirements for specific temperature ranges**, and the associated terminology related to various temperature measurements.
- Gain an understanding of the various **requirements for mixing and installing grout and mortar** in various weather conditions.
- Become familiar with **typical methods of dealing with material storage issues, in all weather conditions**.

EFFECT ON MATERIALS – COLD WEATHER

Cold weather procedures are needed because hydration (of cement) and proper strength development of mortar only occur above freezing temperatures

Possible spalling from water freezing internally

Freezing of mortar reduces bond and compressive strength – reduces life

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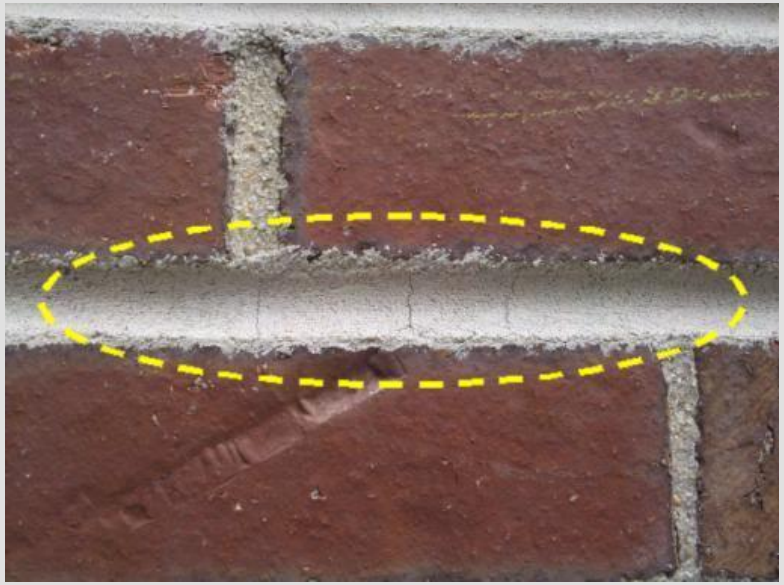
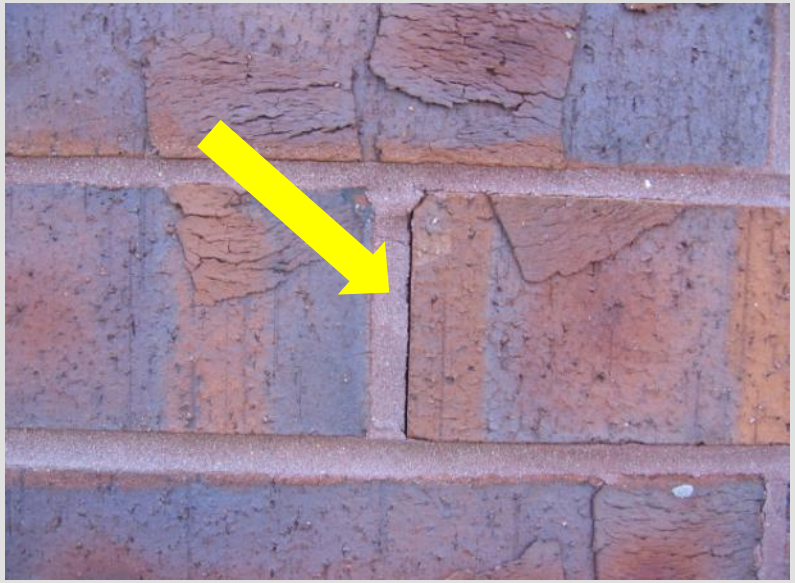
CEMENT HYDRATION

"The most critical factor is ensuring that mortar and grout maintain adequate heat for cement hydration. Without sufficient heat, hydration slows and may stop completely, arresting the development of the masonry's compressive and bond strengths."





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EFFECT ON MATERIALS – HOT WEATHER

Hot weather procedures are needed because mortar dries out too quickly not allowing proper hydration (of cement) and proper strength development of mortar

Result is retarded strength development and weak masonry

Mortar bond may not occur – reduces life

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NORMAL TEMPERATURES FOR CONSTRUCTION

Normal temperature range not requiring special precautions:

- Between 40 °F and 90 °F
- Wind has an effect as well

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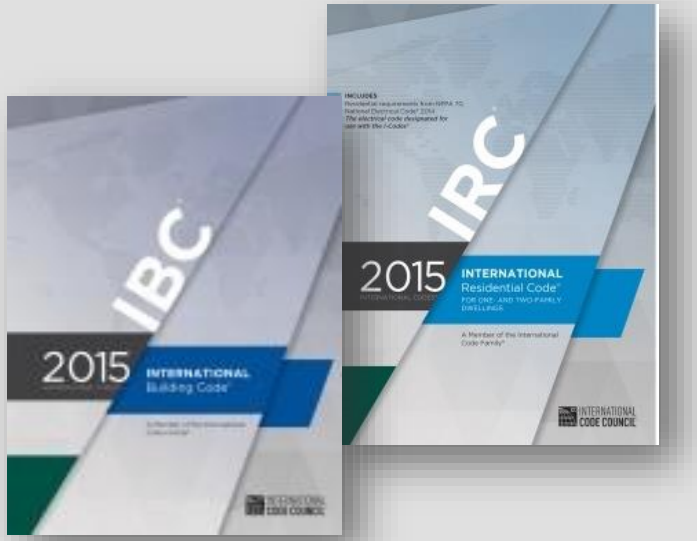
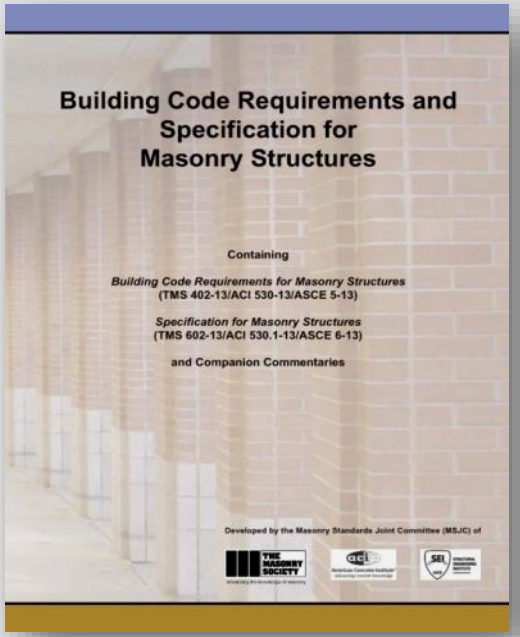
IBC & TMS CODES – HOW DO THEY RELATE?

IBC & IRC: Model code, legally adopted with or without local amendments

TMS 402/602: Reference document for masonry

ASTM: Standards referenced in both IBC and TMS





Designation: C1384 – 18$^{\varepsilon 1}$

Standard Specification for Admixtures for Masonry Mortars[1]

This standard is issued under the fixed designation C1384; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

ε^1 NOTE—Annex reference corrections for Test Method C780 were editorially made in December 2018.

1. Scope*

1.1 This specification pertains to admixtures for masonry mortars. Admixtures are substances other than Specification C270 prescribed materials of water, aggregate, and cementitious materials that are used to improve one or more of the recognized desirable properties of conventional masonry mortar.

1.2 This specification does not cover coloring pigments.

NOTE 1—Information on coloring pigments can be found in Specification C979/C979M.

1.3 This specification does not cover additives that are added to the cementitious materials during the manufacture of the cementitious materials.

1.4 Acceptance of an admixture is based on its performance in an admixed mortar. Acceptance of the admixed masonry mortar is based on attainment of performance either equivalent

2. Referenced Documents

2.1 *ASTM Standards:*[2]

C144 Specification for Aggregate for Masonry Mortar
C270 Specification for Mortar for Unit Masonry
C305 Practice for Mechanical Mixing of Hydraulic Cement Pastes and Mortars of Plastic Consistency
C403/C403M Test Method for Time of Setting of Concrete Mixtures by Penetration Resistance
C723 Practice for Chemical-Resistant Resin Grouts for Brick or Tile
C780 Test Method for Preconstruction and Construction Evaluation of Mortars for Plain and Reinforced Unit Masonry
C979/C979M Specification for Pigments for Integrally Colored Concrete
C1072 Test Methods for Measurement of Masonry Flexural Bond Strength
C1093 Practice for Accreditation of Testing Agencies for

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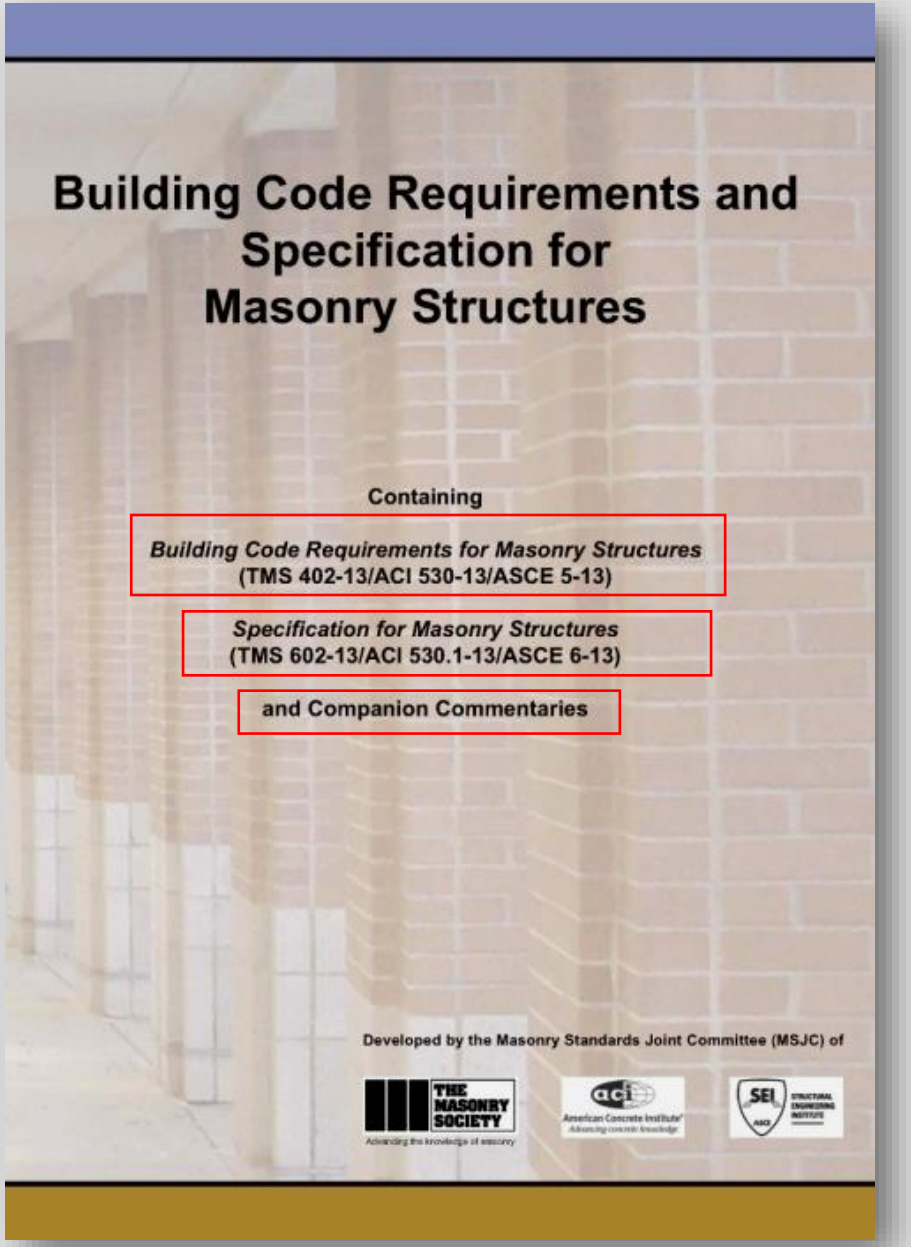
TMS CODE AND SPECIFICATION

TMS 402 Code contains primarily structural design provisions, but also a few Construction Requirements – Designer oriented

Construction provisions are primarily found in the **TMS 602 Specification** – Contractor & Inspector oriented

Companion **Commentary** to each – Non-mandatory



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INTERNATIONAL BUILDING CODE

Since 2009, the IBC does NOT have hot/cold weather provisions for masonry construction. The TMS 602 provisions are referenced.

2104.1 Masonry construction. Masonry construction shall comply with the requirements of… TMS 602/ACI530.1/ASCE 6.

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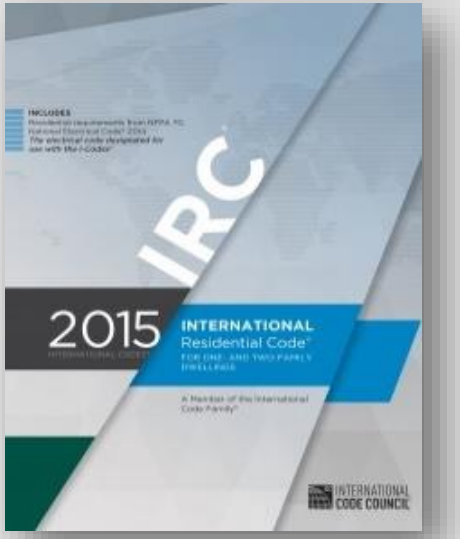
INTERNATIONAL RESIDENTIAL CODE

No cold/hot weather provisions specifically mandated for masonry construction, but reference is made to TMS 402.

Check for local amendments to residential codes as some include cold and/or hot weather masonry requirements.

Can be included in project specifications.



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FULL HEAD JOINTS

Apprentices are taught to fill joints

100 % full

85 % full

ALL-WEATHER CONSTRUCTION PRACTICES

Tooling Mortar Joints

Good Practice:

- Joints should be tooled when the mortar is thumbprint hard
- Concave, V and grapevine joints are best

Benefits:

- Mortar near surface is compressed, providing a watertight joint

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KEEPING WEEPS OPEN

ALL-WEATHER CONSTRUCTION PRACTICES

Covering unfinished brickwork:

- Cover tops of walls at end of day
- Extend cover 2 ft. down wall

Benefits

- Eliminates additional moisture in wall which contributes to efflorescence later

ALL-WEATHER CONSTRUCTION PRACTICES

(Not) Covering Walls and Efflorescence

- Efflorescence due to water in wall during construction
- May need a season (or two) to dry out
- Only temporary, usually
- May be removed by normal weathering
- Dry brush small isolated areas

ALL-WEATHER CONSTRUCTION PRACTICES

Mortar mixing and use

- Allow mortar to be retempered by mason
- Use mortar within 2 1/2 hours

Benefits

- Proper bonding to the brick and proper curing of cement (i.e. less water penetration)

Cold Weather Masonry - General

EFFECT OF HOT AND COLD WEATHER

What effect does weather have on masonry?

Mortar and grout

- Affects set time
- Affects early age strength
- Changes water demand

Masonry Units

- Affects absorption
- Affects shrinkage
- Affects unit placement

COLD - WEATHER PROVISIONS - HOT

40°F to 32°F

Below 32°F to 25°F

Below 25°F to 20°F

Below 20°F

Normal Construction Procedures between

40°F – 100°F

(or 90°F w/wind)

Greater than:

100°F (or 90°F w/wind) to 115°F (or 105°F w/wind)

Greater than: 115°F or 105°F w/wind

COLD AND HOT WEATHER PROVISIONS

During very cold (below 40°) or very hot (above 90°) weather, three categories of requirements may apply:

- Preparation
- Construction requirements (while wall is being built)
  - **Ambient conditions**
- Protection requirements (after wall is built)
  - For ungrouted masonry, protection requirements are based on "**anticipated mean daily temperature**"
  - For grouted masonry, protection requirements based on "**anticipated minimum daily temperature**"

TEMPERATURE EXAMPLES

Ambient Temperature
Current outdoor temp. at the time considered
Considered for construction

Anticipated Daily Minimum
Lowest temp forecast for the upcoming 24 hrs
Considered for protection, grouted masonry

Mean Daily Temperature
Average of the projected maximum and minimum daily temperature, midnight to midnight
Considered for protection, ungrouted masonry

54º + 36º / 2 = **45º**

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Cold Weather Masonry – Provisions

COLD WEATHER PROVISIONS

1. **General** Provisions
   Apply at all temperatures
2. **Construction** Provisions
   Options available for how to meet targets based on job site conditions
3. **Protection** Provisions
   Care for the masonry during and after construction

COLD WEATHER CONSTRUCTION PROVISIONS – SUMMARY

40°F to 32°F	**Heating of mortar materials is required, but not for grout.**	Greater than: 100°F (or 90°F w/wind) to 115°F (or 105°F w/wind)
Below 32°F to 25°F	**Heat grout aggregates & water to produce grout between 70F & 120F; Grout must be above 70F when placed**	
Below 25°F to 20°F	**Plus: Heat masonry to 40F before placing grout**	Greater than: 115°F or 105°F w/wind
Below 20°F	**Plus: Provide enclosure & heat to maintain air above 32F**	

Cold Weather Masonry - Protection

PROTECTION PROVISIONS

Masonry protection - Cover top of unfinished masonry work to protect it from moisture intrusion. *(TMS Specification Section 1.8 B.)*

Note: This provision applies regardless of temperature.

PROTECTION PROVISIONS

Temperatures for Protection Requirements

"anticipated **minimum** daily" temperatures for grouted masonry.
"anticipated **mean** daily" temperatures for ungrouted masonry.

PROTECTION PROVISIONS

40˚F to 25°F

Below 25°F to 20°F

Below 20°F

Normal Construction Procedures between 40°F – 100°F (or 90°F w/wind)

Greater than: 100°F (or 90°F w/wind) to 115°F (or 105°F w/wind)

Greater than: 115°F or 105°F w/wind

WHY DOES TYPE III HELP?

Type III portland achieves high strength while curing more quickly.

This helps us in two ways:

- It reduces the need for longer periods of protection because it has achieved the necessary strength more quickly, and
- It generates more “heat of hydration” during curing which helps to protect the mortar or grout for the first 24 hours.

Adds to the cost of the grout mix, but potential savings in the cost of not having to provide temporary heat.

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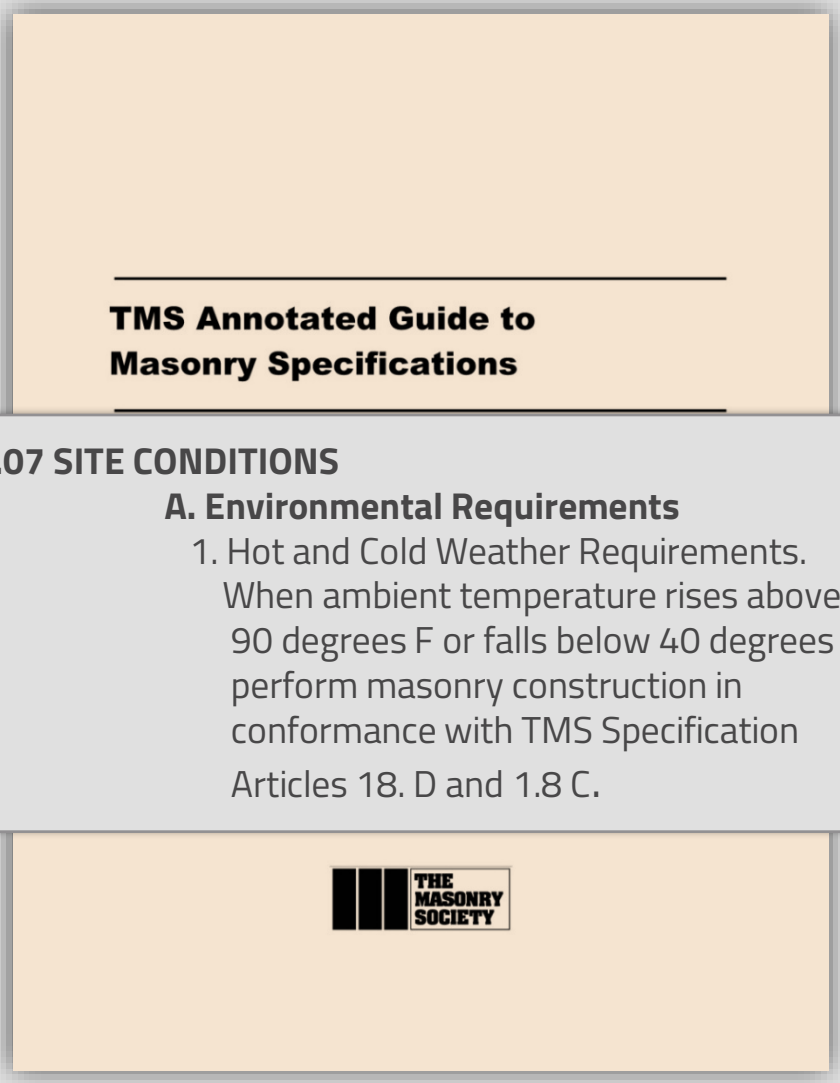
COLD WEATHER **PROTECTION** PROVISIONS – SUMMARY

40˚F to 25°F	**Cover with weather resistive membrane for 24 hrs**	Greater than: 100°F (or 90°F w/wind) to 115°F (or 105°F w/wind)
Below 25°F to 20°F	**Cover with weather resistive membrane for 24 hrs, 48 for grouted masonry unless Type III cement was used**	Greater than: 115°F or 105°F w/wind
Below 20°F	**Provide enclosure & heat to maintain air above 32F for 48 hrs for grouted masonry, unless Type III cement was used**	

Cold Weather Masonry - Specifications & Submittals

SPECIFYING COLD WEATHER CONSTRUCTION REQUIREMENTS



1.07 SITE CONDITIONS

A. Environmental Requirements

1. Hot and Cold Weather Requirements. When ambient temperature rises above 90 degrees F or falls below 40 degrees F, perform masonry construction in conformance with TMS Specification Articles 18. D and 1.8 C.

The TMS Specification includes requirements for preparation prior to construction, requirements during construction, and requirements for protection of constructed masonry. Precautions during environmental extremes, as specified in MSJC, are required for proper performance of masonry.

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TMS 602 SPECIFICATION

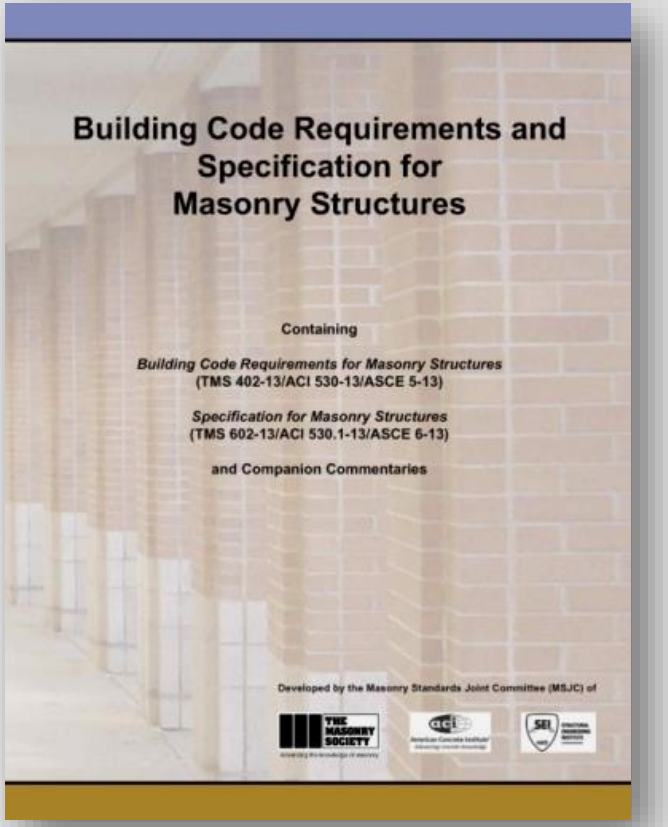
1.5 Submittals

1.5 B. Submit the following:

3. Construction procedures

a. Cold weather construction procedures

b. Hot weather construction procedures



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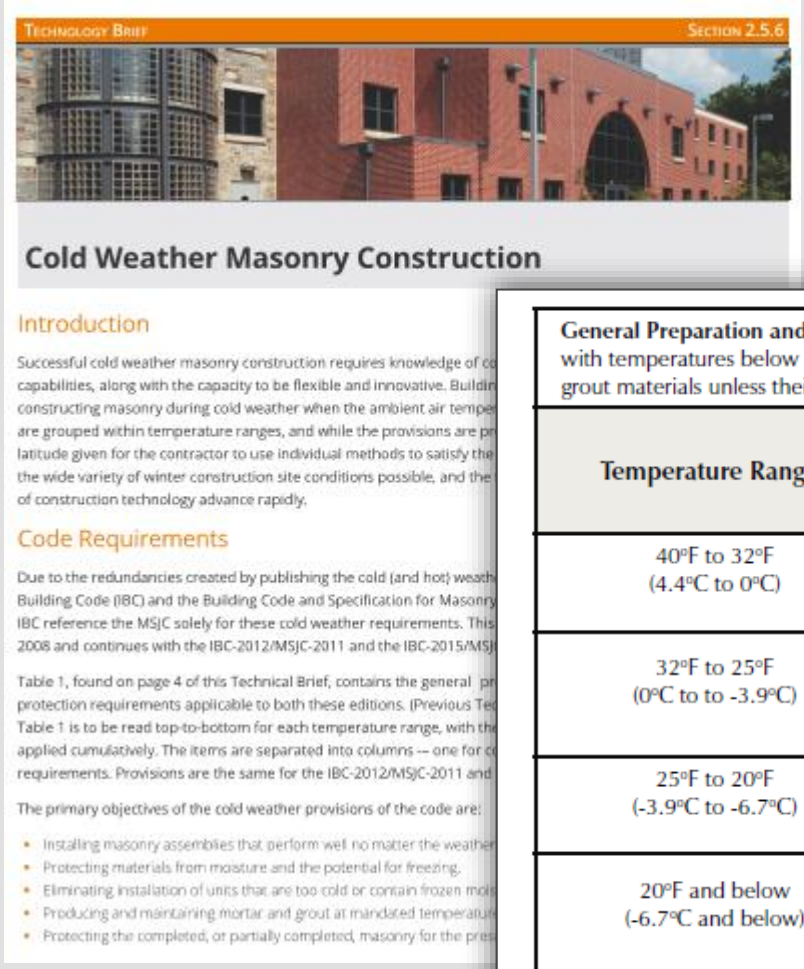
COLD WEATHER PLAN SUBMITTAL



TECHNOLOGY BRIEF SECTION 2.5.6

Cold Weather Masonry Construction

Introduction

Successful cold weather masonry construction requires knowledge of c
capabilities, along with the capacity to be flexible and innovative. Buildin
constructing masonry during cold weather when the ambient air tempe
are grouped within temperature ranges, and while the provisions are pr
latitude given for the contractor to use individual methods to satisfy the
the wide variety of winter construction site conditions possible, and the
of construction technology advance rapidly.

Code Requirements

Due to the redundancies created by publishing the cold (and hot) weath
Building Code (IBC) and the Building Code and Specification for Masonry
IBC reference the MSJC solely for these cold weather requirements. This
2008 and continues with the IBC-2012/MSJC-2011 and the IBC-2015/MSJ

Table 1, found on page 4 of this Technical Brief, contains the general pr
protection requirements applicable to both these editions. (Previous Tec
Table 1 is to be read top-to-bottom for each temperature range, with the
applied cumulatively. The items are separated into columns -- one for c
requirements. Provisions are the same for the IBC-2012/MSJC-2011 and

The primary objectives of the cold weather provisions of the code are:

- Installing masonry assemblies that perform well no matter the weather
- Protecting materials from moisture and the potential for freezing.
- Eliminating installation of units that are too cold or contain frozen mois
- Producing and maintaining mortar and grout at mandated temperatur
- Protecting the completed, or partially completed, masonry for the pres

General Preparation and Construction Requirements: Store units and other materials in dry conditions off the ground. Do not lay frozen units (those with temperatures below 20°F (6.7°C) or those with visible ice or snow. Do not heat water or aggregates above 140°F (60°C). It's not necessary to heat grout materials unless their temperatures are below 32°F (0°C).

Temperature Ranges	Construction Requirements Ambient Temperatures (Temperatures during construction)	Protection Requirements (Based on mean daily temperatures for ungrouted masonry and anticipated daily minimums for grouted masonry for period following construction)
40°F to 32°F (4.4°C to 0°C)	Do not lay glass units in temperatures below 40°F (4.4°C). Heat sand **or** water to achieve mortar temperatures of 40°F (4.4°C) to 120°F (49°C) at time of mixing.	Maintain glass unit masonry above 40°F (4.4°C) for 48 hrs. Protect newly laid masonry with weather-resistant membrane for 24 hours.
32°F to 25°F (0°C to -3.9°C)	Heat sand **and** water to achieve mortar temperatures of 40°F (4.4°C) to 120°F (49°C) at time of mixing. Maintain materials above 32°F (0°C) until used. Heat grout aggregates and water, keeping grout above 70°F (21°C).	Protect newly laid masonry with weather-resistant membrane for 24 hours.
25°F to 20°F (-3.9°C to -6.7°C)	Add windbreaks or enclosures when wind exceeds 15 mph (24.1 km/h). Heat masonry to 40°F (4.4°C) prior to grouting.	Cover new masonry completely with insulating blankets, or equal, for 24 hours. Increase to 48 hours for grouted masonry unless Type III cement only is used.
20°F and below (-6.7°C and below)	Add auxiliary heat to enclosures. Keep enclosed area above 32°F (0°C).	Maintain new masonry temperature above 32°F (0°C) for 24 hours with heated enclosures, lamps, etc. Increase to 48 hours for grouted masonry unless Type III cement only is used.

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https://www.imiweb.org/cold-weather-masonry-construction/

Cold Weather Masonry - Materials & Good Construction Practices

MASONRY UNITS

Good jobsite practice:

Covered and stored off the ground

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MASONRY UNITS

Initial Rate of Absorption

Using a high IRA brick reduces the risk of freezing by more rapidly absorbing water from the mortar or grout, often called “winter brick”

If a low IRA brick is used, water content of the mortar should be the minimum necessary for workability or consider changing mortar type, if allowed

MORTAR

Mortar must be at least 40°F at time of mixing

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MORTAR ENCLOSURE

Silos partially enclosed, heat provided in mixing area

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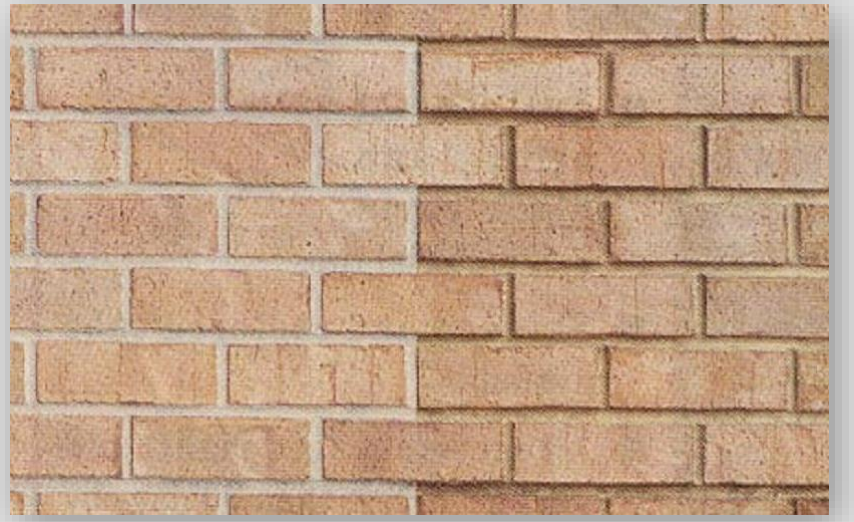
MORTAR

Avoid scorching the sand or overheating the water, which can lead to discolored mortar and **flash setting**.

Avoid wide variations in mortar temps, causing variations in tooling times and possible variations in mortar color.



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GROUT

Heat of Hydration occurs when water is mixed with portland cement

- Heat of Hydration is about 70 degrees

The heat is generated as a result of the chemical reaction between the portland cement and the water

Using the heat generated by hydration plus aggregate and water at or near 40°F, grout can achieve temperatures between 70°F & 120°F

GROUT

Material options for cold weather construction:

- Type III portland cement
- Self-consolidating grout
- Fly Ash as an additive

Be careful not to tread on means and methods of contractor

GROUT

Self-consolidating Grout may provide the desired fluidity with less water.

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ADMIXTURES IN MORTAR & GROUT

Set accelerators are admixtures used to speed the setting time of mortar and grout.

- If approved, non-chloride, non-corrosive accelerators are preferred.

'Antifreeze' – does not depress the freezing point sufficiently, and it often reduces compressive and bond strength of mortar.

Using calcium chloride is **not recommended** as it causes corrosion to metal accessories

Cold Weather Masonry - Good Jobsite Practices

KEEP WALLS COVERED TO PROTECT MASONRY

Insulating blankets cover top of walls

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ENCLOSURES

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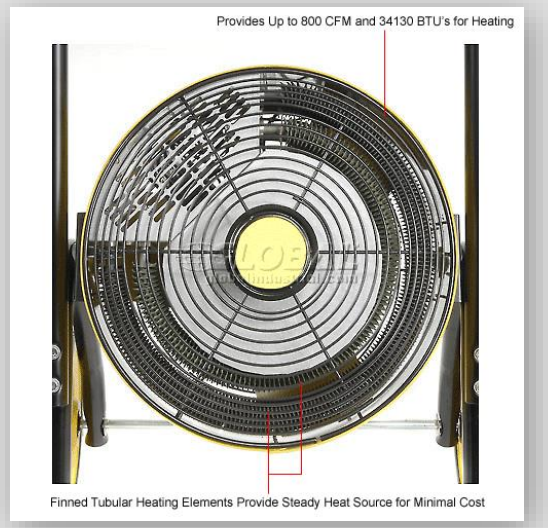
HEATING OPTIONS FOR ENCLOSURES

Remote forced air – gas or oil fired



Electric Radiant Systems

Electric wall heaters

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ENCLOSURES

What's good for the masonry is also good for the mason.

Productivity and safety are improved with enclosures

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ONSITE MASONRY/ TRADE CREWS: GUIDELINES

- Regardless of mortar or Building Code regulations, there are other considerations to cold weather/winter working.
- Significant differences between mandates of Union vs. Non-Union subcontractors / crews.
- Union (Local 3 MA/RI/NH/ME): Any/all work done outdoors between Nov. 15 – March 15 must be done in a heated tent/space.
- Non-Union: There are no set rules on "how cold it can be" to still work outdoors. This can lead to several issues.
- *Note for following sheet: 20°F = 30°F with a 15 MPH wind*

(ACGIH = American Conference of Governmental Industrial Hygienists)

SOME GENERAL GUIDELINES - COLD WEATHER CONSTRUCTION

CCOHS
Canadian Centre for Occupational Health and Safety

For example, ACGIH (2018) suggests a work-warming regimen when work is done continuously in the cold when the wind chill temperature is -7°C (19.4°F), heated warming shelters (tents, cabins, rest rooms, etc) should be made available nearby. Workers should be encouraged to use these shelters, depending on the severity of the exposure. If signs of cold stress are noticed, return to the shelter immediately. For work at or below -12°C (10.4°F), work should include:

- constant observation (supervisor or buddy system),
- adjusting the pace or rate of work so that it is not too high and cause heavy sweating that will result in wet clothing
- time for new employees to become accustomed to the conditions
- adjusted to include the weight and bulkiness of the clothing when estimating work performance and weights to be lifted by the worker
- arranged in such a way that sitting and standing for long periods is minimized
- instructions in safe work practices, re-warming procedures, proper clothing practices, proper eating and drinking habits, recognition of cold stress/frostbite, and signs and symptoms of hypothermia or excessive cooling of the body (including when shivering does not occur)

FROM THE CCOHS (CON'T)

What should be done when it is very cold or windy outside?

Employers have a duty to take every reasonable precaution to make sure the workplace is safe for the worker. This duty includes taking effective measures to protect workers from cold stress disorders if it is not reasonably practicable to control indoor conditions adequately, or when the work is done outdoors.

General recommendations include to:

- Dress in layers of warm clothing, with an outer layer that is wind-resistant.
- Cover all exposed skin.
- Wear a hat, mittens or insulated gloves, a scarf, neck tube or face mask, and insulated, waterproof footwear.
- Stay dry (including taking steps to prevent excess sweating).
- Keep active.
- Maintain a work/break schedule. Breaks should be taken in a warm area, with protection from drafts.
- When very cold, consider cancelling outdoor activities.

Hot Weather Masonry Construction

HOT WEATHER CONSTRUCTION REQUIREMENTS

Above 100 °F, or 90 °F with a wind velocity > 8 mph (ambient temp.):

- Maintain sand piles in a damp loose condition
- Keep mortar and grout at temps below 120°F

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HOT WEATHER CONSTRUCTION REQUIREMENTS

Above 100 °F, or 90 °F with a wind velocity > 8 mph (ambient temp.) con't:

- Flush mixer, mortar transport container, and mortar boards with cool water before they come into contact with mortar ingredients or mortar
- Maintain mortar consistency by retempering with cool water
- Use mortar within 2 hr of initial mixing (not the usual 2 ½ hrs)

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HOT WEATHER PROTECTION REQUIREMENTS

Above 100 °F, or 90 °F with a wind velocity > 8 mph (mean daily temp.)

- Fog spray newly constructed masonry until damp, at least three times a day, until masonry is three days old

HOT WEATHER CONSTRUCTION TECHNIQUES

Shade masonry construction

Do not spread mortar too far ahead of masonry being placed

Cool mortar boards down with cool water

Damp-cure masonry

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ALL Weather Masonry - **Summary**

ALL-WEATHER CONSTRUCTION PRACTICES

Inspect / observe work

- May be required for some types of structures according to the building code (i.e. essential facilities)

Consider commissioning of the building envelope

Benefits

- Avoid problems (i.e. leaks, cracks, efflorscence…)

FOR BEST RESULTS...

Code provisions

+ Planning

+ Skilled Execution

= Successful all weather masonry construction

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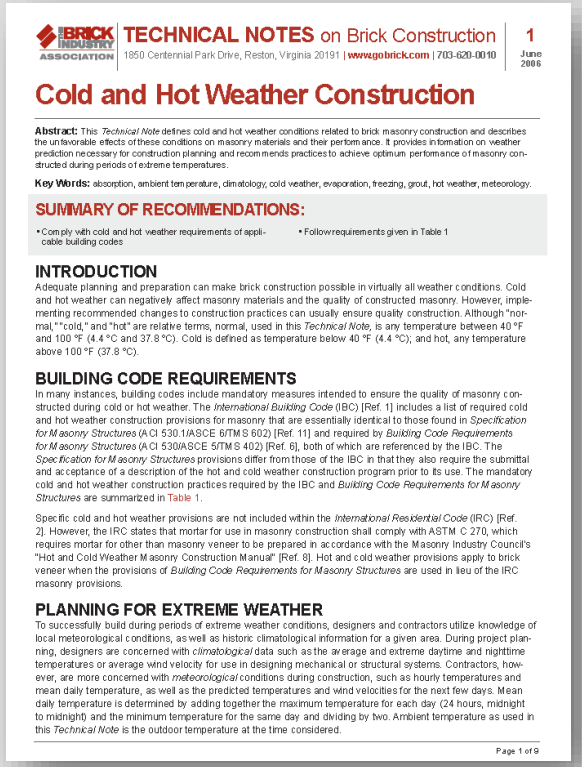
RESOURCES



BRICK INDUSTRY ASSOCIATION | TECHNICAL NOTES on Brick Construction | 1

1850 Centennial Park Drive, Reston, Virginia 20191 | www.gobrick.com | 703-620-0010 | June 2006

Cold and Hot Weather Construction

Abstract: This *Technical Note* defines cold and hot weather conditions related to brick masonry construction and describes the unfavorable effects of these conditions on masonry materials and their performance. It provides information on weather prediction necessary for construction planning and recommends practices to achieve optimum performance of masonry constructed during periods of extreme temperatures.

Key Words: absorption, ambient temperature, climatology, cold weather, evaporation, freezing, grout, hot weather, meteorology.

SUMMARY OF RECOMMENDATIONS:

- Comply with cold and hot weather requirements of applicable building codes
- Follow requirements given in Table 1

INTRODUCTION

Adequate planning and preparation can make brick construction possible in virtually all weather conditions. Cold and hot weather can negatively affect masonry materials and the quality of constructed masonry. However, implementing recommended changes to construction practices can usually ensure quality construction. Although "normal," "cold," and "hot" are relative terms, normal, used in this *Technical Note*, is any temperature between 40 °F and 100 °F (4.4 °C and 37.8 °C). Cold is defined as temperature below 40 °F (4.4 °C); and hot, any temperature above 100 °F (37.8 °C).

BUILDING CODE REQUIREMENTS

In many instances, building codes include mandatory measures intended to ensure the quality of masonry constructed during cold or hot weather. The *International Building Code* (IBC) [Ref. 1] includes a list of required cold and hot weather construction provisions for masonry that are essentially identical to those found in *Specification for Masonry Structures* (ACI 530.1/ASCE 6/TMS 602) [Ref. 11] and required by *Building Code Requirements for Masonry Structures* (ACI 530/ASCE 5/TMS 402) [Ref. 6], both of which are referenced by the IBC. The *Specification for Masonry Structures* provisions differ from those of the IBC in that they also require the submittal and acceptance of a description of the hot and cold weather construction program prior to its use. The mandatory cold and hot weather construction practices required by the IBC and *Building Code Requirements for Masonry Structures* are summarized in Table 1.

Specific cold and hot weather provisions are not included within the *International Residential Code* (IRC) [Ref. 2]. However, the IRC states that mortar for use in masonry construction shall comply with ASTM C 270, which requires mortar for other than masonry veneer to be prepared in accordance with the Masonry Industry Council's "Hot and Cold Weather Masonry Construction Manual" [Ref. 8]. Hot and cold weather provisions apply to brick veneer when the provisions of *Building Code Requirements for Masonry Structures* are used in lieu of the IRC masonry provisions.

PLANNING FOR EXTREME WEATHER

To successfully build during periods of extreme weather conditions, designers and contractors utilize knowledge of local meteorological conditions, as well as historic climatological information for a given area. During project planning, designers are concerned with *climatological* data such as the average and extreme daytime and nighttime temperatures or average wind velocity for use in designing mechanical or structural systems. Contractors, however, are more concerned with *meteorological* conditions during construction, such as hourly temperatures and mean daily temperature, as well as the predicted temperatures and wind velocities for the next few days. Mean daily temperature is determined by adding together the maximum temperature for each day (24 hours, midnight to midnight) and the minimum temperature for the same day and dividing by two. Ambient temperature as used in this *Technical Note* is the outdoor temperature at the time considered.

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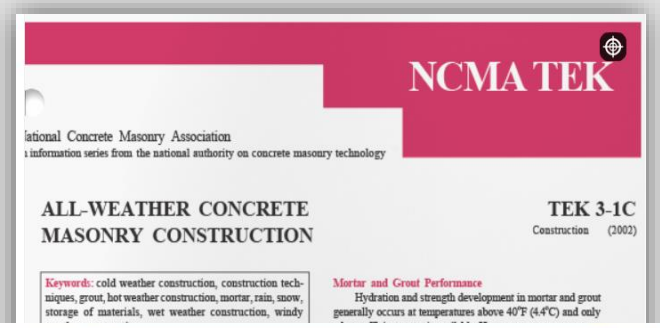


NCMA TEK

National Concrete Masonry Association

an information series from the national authority on concrete masonry technology

ALL-WEATHER CONCRETE MASONRY CONSTRUCTION

TEK 3-1C

Construction (2002)

Keywords: cold weather construction, construction techniques, grout, hot weather construction, mortar, rain, snow, storage of materials, wet weather construction, windy

Mortar and Grout Performance

Hydration and strength development in mortar and grout generally occurs at temperatures above 40°F (4.4°C) and only

TECHNOLOGY BRIEF | SECTION 2.5.6

Cold Weather Masonry Construction

Introduction

Successful cold weather masonry construction requires knowledge of code requirements, workforce and planning capabilities, along with the capacity to be flexible and innovative. Building codes mandate certain procedures when constructing masonry during cold weather when the ambient air temperature is 40°F and below. The requirements are grouped within temperature ranges, and while the provisions are prescriptive in nature, there is considerable latitude given for the contractor to use individual methods to satisfy the code requirements. This is in recognition of the wide variety of winter construction site conditions possible, and the fact that material, equipment and methods of construction technology advance rapidly.

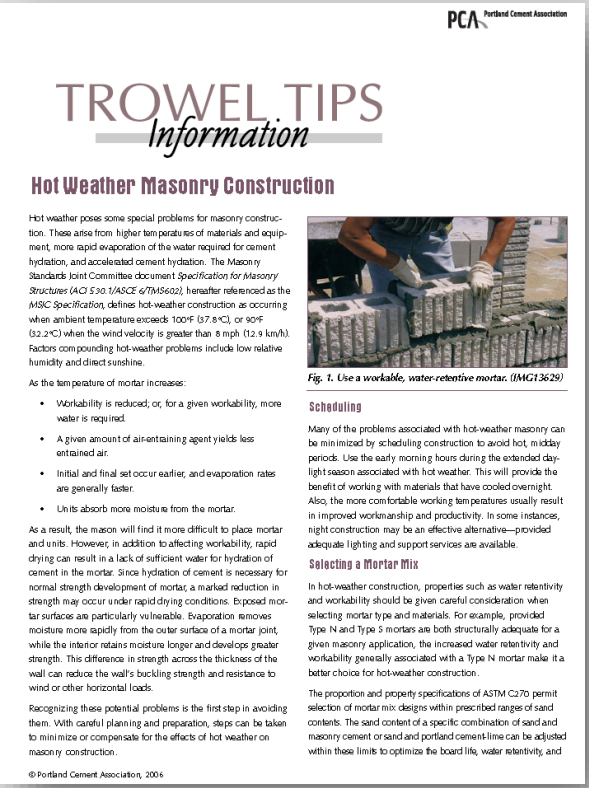
Code Requirements

Due to the redundancies created by publishing the cold (and hot) weather requirements in both the International Building Code (IBC) and the Building Code and Specification for Masonry Structures (MSJC[1]), recent editions of the IBC reference the MSJC solely for these cold weather requirements. This practice began with the IBC-2009/MSJC-2008 and continues with the IBC-2012/MSJC-2011 and the IBC-2015/MSJC-2013.

Table 1, found on page 4 of this Technical Brief, contains the general provisions, construction requirements and protection requirements applicable to both these editions. (Previous Technical Briefs cover past IBC/MSJC editions.) Table 1 is to be read top-to-bottom for each temperature range, with the requirements in each range downward applied cumulatively. The items are separated into columns -- one for construction and one for protection requirements. Provisions are the same for the IBC-2012/MSJC-2011 and the IBC-2015/MSJC-2013.

The primary objectives of the cold weather provisions of the code are:

- Installing masonry assemblies that perform well no matter the weather during construction.
- Protecting materials from moisture and the potential for freezing.
- Eliminating installation of units that are too cold or contain frozen moisture, ice or snow.
- Producing and maintaining mortar and grout at mandated temperatures.
- Protecting the completed, or partially completed, masonry for the prescribed period of time.



PCA Portland Cement Association

TROWEL TIPS *Information*

Hot Weather Masonry Construction

Hot weather poses some special problems for masonry construction. These arise from higher temperatures of materials and equipment, more rapid evaporation of the water required for cement hydration, and accelerated cement hydration. The Masonry Standards Joint Committee document *Specification for Masonry Structures (ACI 530.1/ASCE 6/TMS602)*, hereafter referenced as the *MSJC Specification*, defines hot-weather construction as occurring when ambient temperature exceeds 100°F (37.8°C), or 90°F (32.2°C) when the wind velocity is greater than 8 mph (12.9 km/h). Factors compounding hot-weather problems include low relative humidity and direct sunshine.

As the temperature of mortar increases:

- Workability is reduced; or, for a given workability, more water is required.
- A given amount of air-entraining agent yields less entrained air.
- Initial and final set occur earlier, and evaporation rates are generally faster.
- Units absorb more moisture from the mortar.

As a result, the mason will find it more difficult to place mortar and units. However, in addition to affecting workability, rapid drying can result in a lack of sufficient water for hydration of cement in the mortar. Since hydration of cement is necessary for normal strength development of mortar, a marked reduction in strength may occur under rapid drying conditions. Exposed mortar surfaces are particularly vulnerable. Evaporation removes moisture more rapidly from the outer surface of a mortar joint, while the interior retains moisture longer and develops greater strength. This difference in strength across the thickness of the wall can reduce the wall's buckling strength and resistance to wind or other horizontal loads.

Recognizing these potential problems is the first step in avoiding them. With careful planning and preparation, steps can be taken to minimize or compensate for the effects of hot weather on masonry construction.

Fig. 1. Use a workable, water-retentive mortar. (IMG13629)

Scheduling

Many of the problems associated with hot-weather masonry can be minimized by scheduling construction to avoid hot, midday periods. Use the early morning hours during the extended daylight season associated with hot weather. This will provide the benefit of working with materials that have cooled overnight. Also, the more comfortable working temperatures usually result in improved workmanship and productivity. In some instances, night construction may be an effective alternative—provided adequate lighting and support services are available.

Selecting a Mortar Mix

In hot-weather construction, properties such as water retentivity and workability should be given careful consideration when selecting mortar type and materials. For example, provided Type N and Type S mortars are both structurally adequate for a given masonry application, the increased water retentivity and workability generally associated with a Type N mortar make it a better choice for hot-weather construction.

The proportion and property specifications of ASTM C270 permit selection of mortar mix designs within prescribed ranges of sand contents. The sand content of a specific combination of sand and masonry cement or sand and portland cement-lime can be adjusted within these limits to optimize the board life, water retentivity, and

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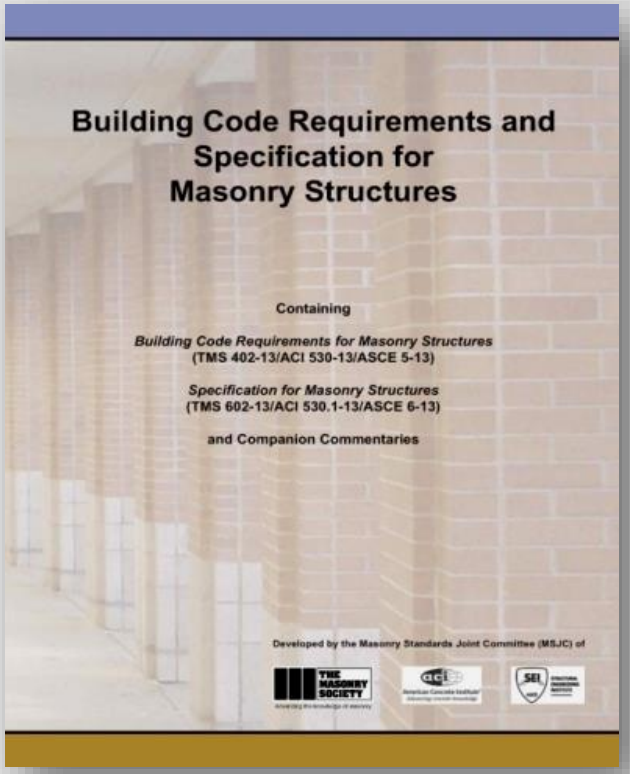

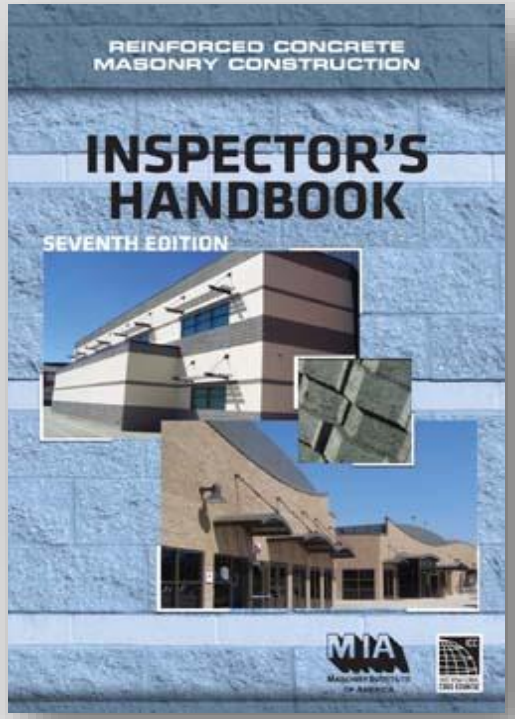

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