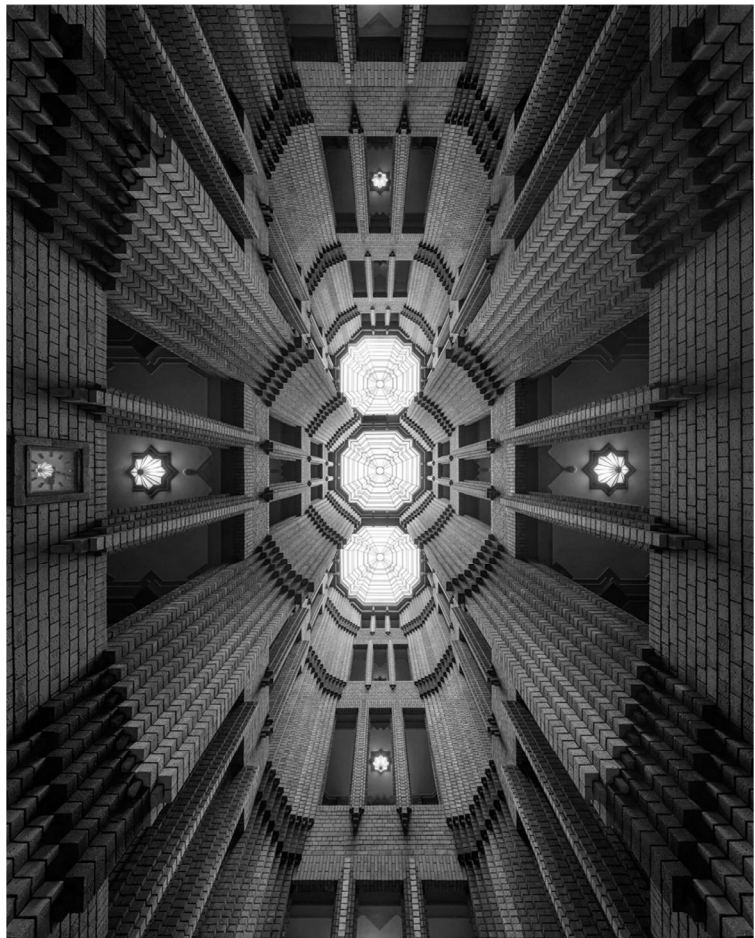


## Construction Practice

- Robotic construction
- IMI workshop
- TMS 602 specifications

Hoechst Fabrik  
Technical Administration Bldg.  
Peter Behrens, 1924



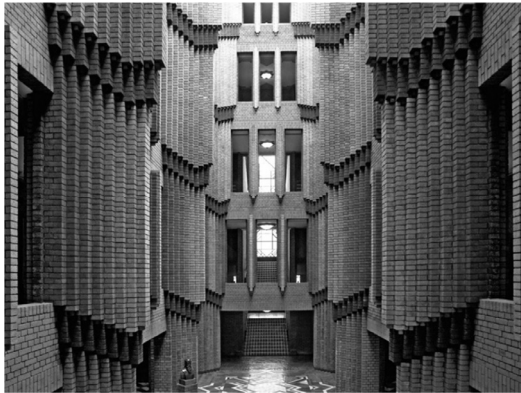
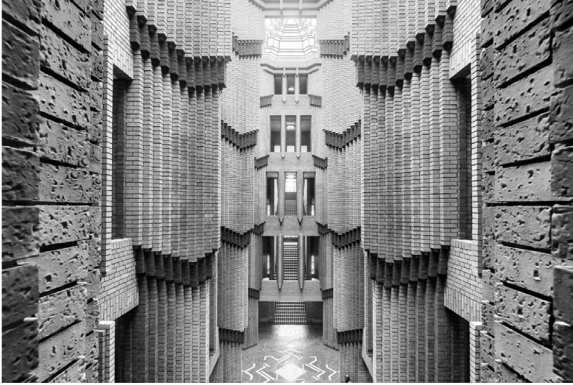
## Hoechst Fabrik Technical Admin. Bldg. Peter Behrens, 1924



# Hoechst Fabrik

Technical Admin. Bldg.

Peter Behrens, 1924



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Masonry

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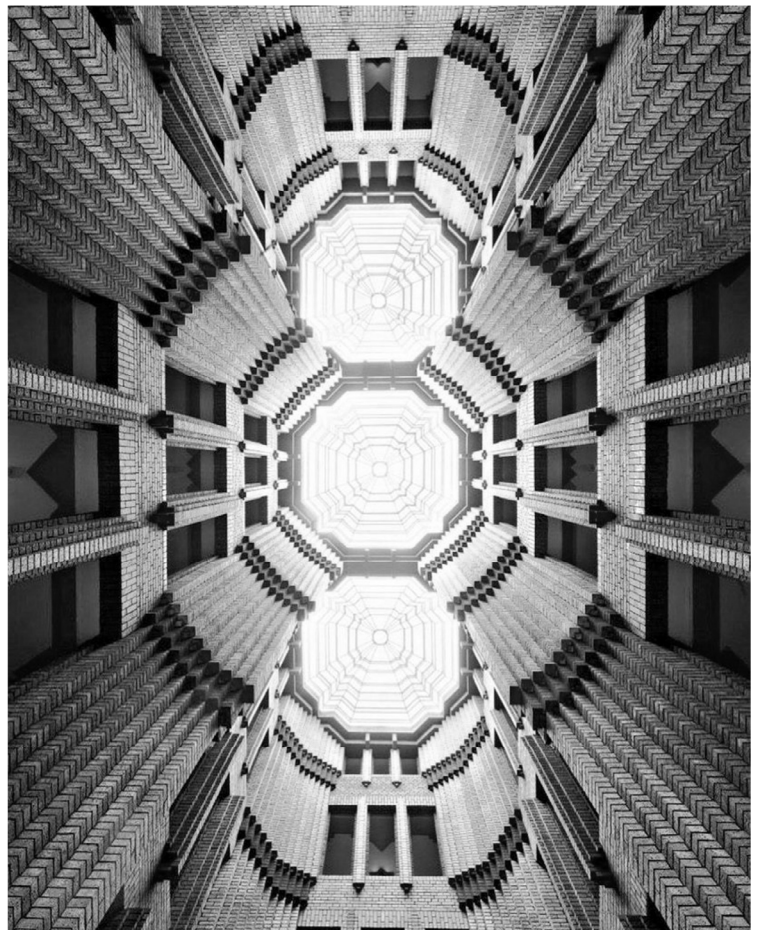
# Hoechst Fabrik

Technical Admin. Bldg.

Peter Behrens, 1924



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# Hoechst Fabrik

Technical Admin. Bldg.  
Peter Behrens, 1924



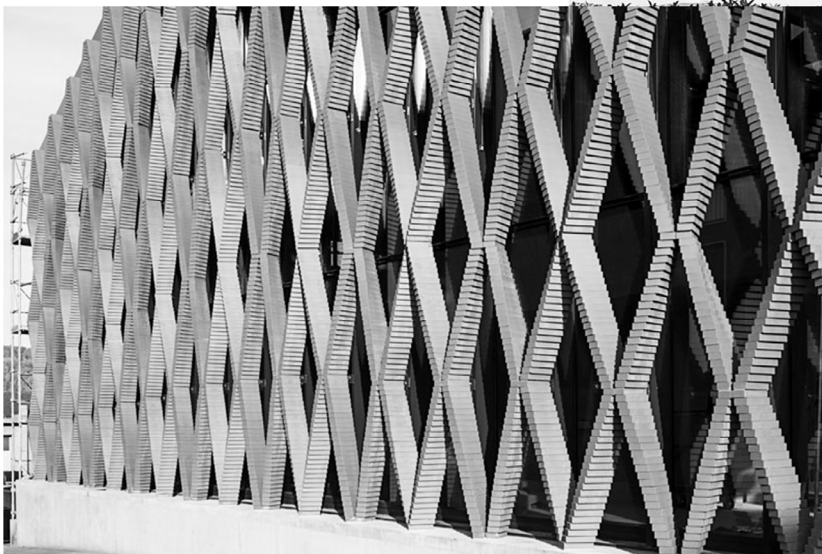
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# Robotic Brickwork

ROB Technologies  
Switzerland



ROB Brick  
Keller AG Headquarters  
Pfungen, Switzerland

University of Michigan, TCAUP

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# Robotic Brickwork

ROB Technologies - Switzerland



ROB Brick  
Keller in Pfungen



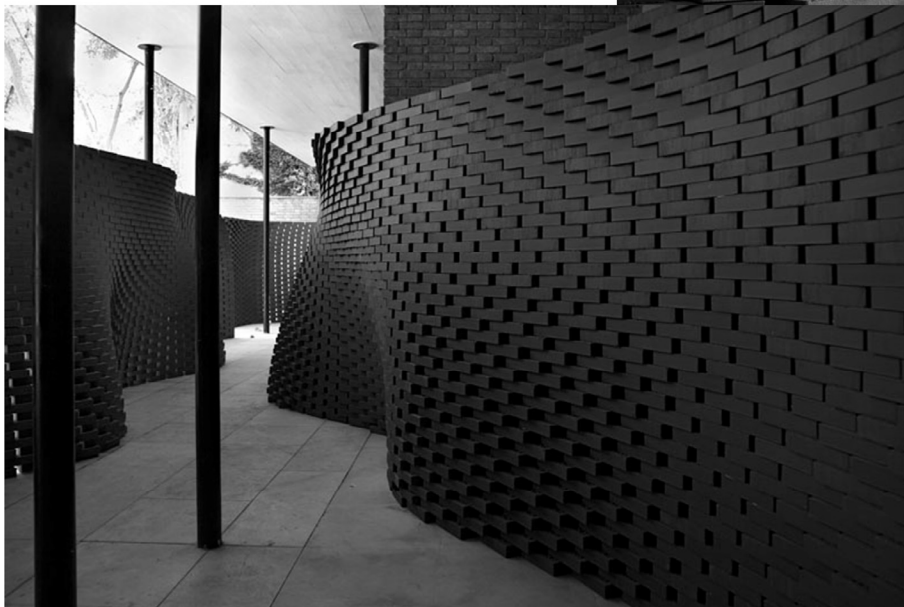
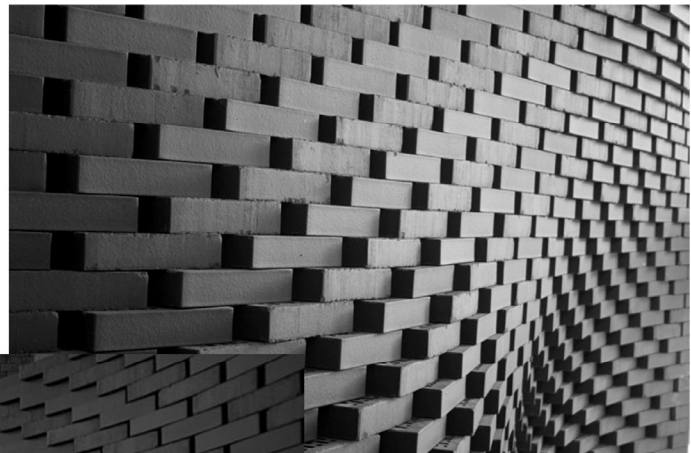
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## Structural Oscillations

11th Venice Architectural Biennale  
Gramazio Kohler Research



University of Michigan, TCAUP

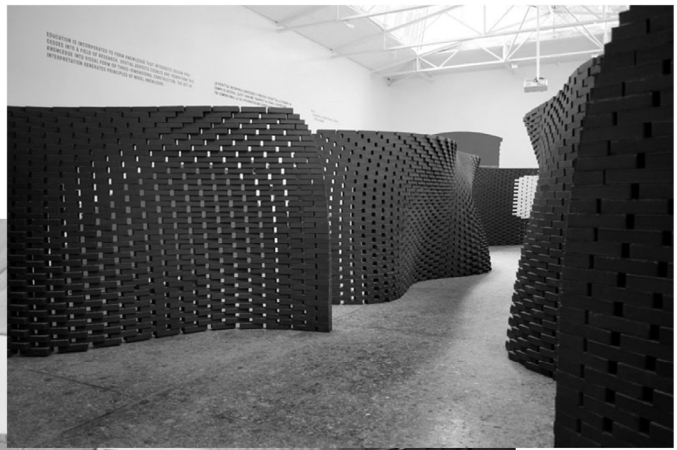
Masonry

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# Structural Oscillations

11th Venice Architectural Biennale  
Gramazio Kohler Research



University of Michigan, TCAUP

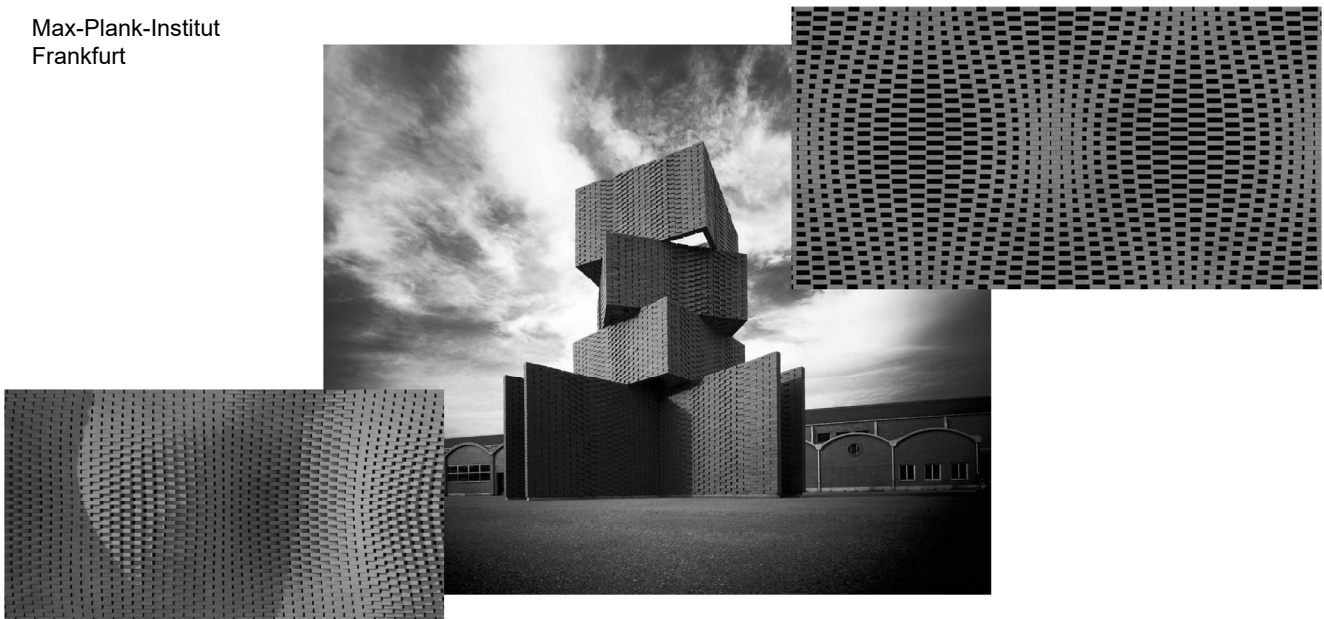
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## Robotic Masonry



Max-Plank-Institut  
Frankfurt



University of Michigan, TCAUP

Masonry

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# IMI Workshop

International Masonry  
Institute  
tuck-pointing



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Masonry

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# IMI Workshop

International Masonry Institute  
brick laying



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# IMI Workshop

International  
Masonry Institute  
Laying Tile



University of Michigan, TCAUP

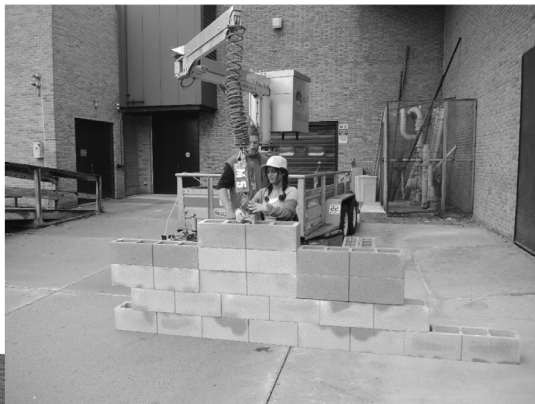
Masonry



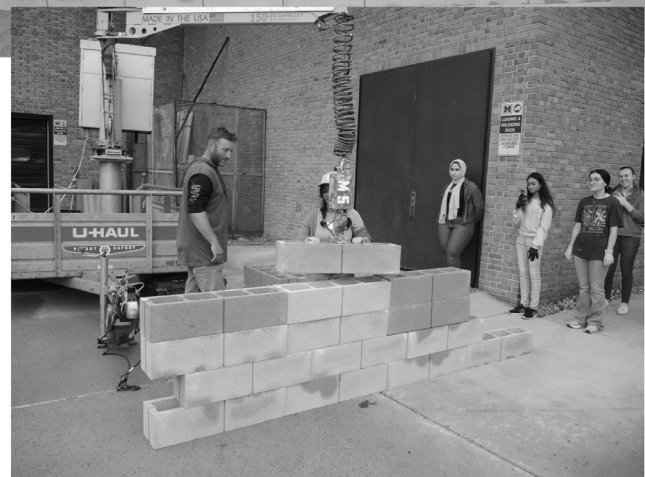
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# IMI Workshop

International Masonry Institute  
the Mule



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# IMI Workshop

## International Masonry Institute

### Flashing



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# IMI Workshop

## International Masonry Institute

### expansion joint



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# IMI Workshop

## International Masonry Institute

### brick laying



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# IMI Workshop

## International Masonry Institute

### Prosoco water repellent



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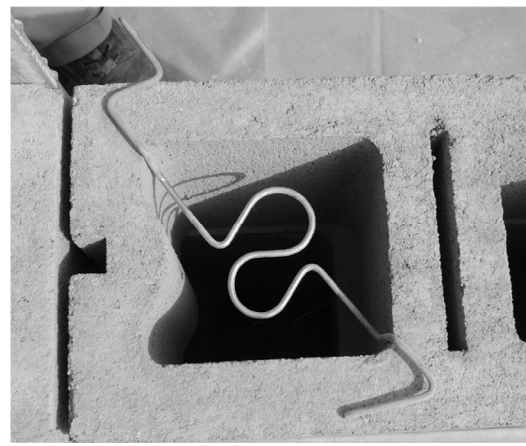
# IMI Workshop

International Masonry Institute  
Wall Grouting

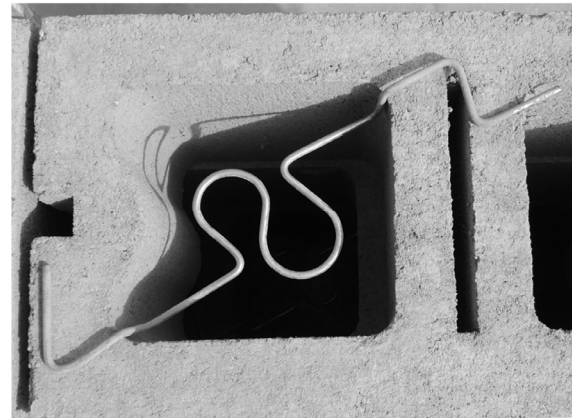


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Wrong way



Right way

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# IMI Workshop

International Masonry Institute  
Wall Grouting



University of Michigan, TCAUP

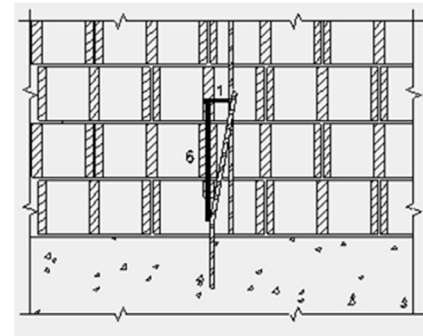
Masonry

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# Construction Practices

## Preparations in advance of laying masonry

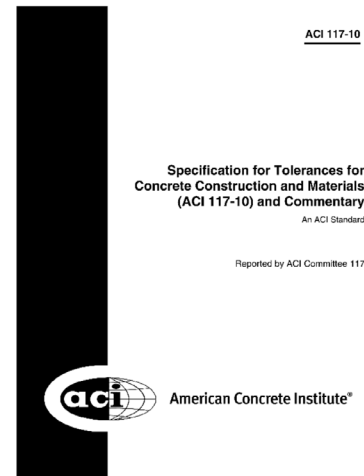
- Clean laying surfaces just prior to laying for good bond
- Check alignment of dowels
- Check foundation tolerances with respect to ACI 117



Slope of 1:6 allowed for  
dowels (TMS 602  
3.4.B.11.d)

Level alignment of footings:  $\pm 1\frac{1}{2}$  in.

Relative alignment: slope not more  
than 1 inch in 10 feet



# Construction Practices

## Protection of Masonry During Construction

### Avoid premature loading (TMS 602 1.8.A)

- An example is backfilling a basement wall before the top is supported by the ground floor.

### Cover top of unfinished masonry (TMS 602 1.8.B)

- Efflorescence is often caused by water in cells evaporating through the faces of the wall.

### Bracing of structure (TMS 602 3.3.E)

- Wind forces on walls are more severe during construction due to:
  - Lack of development of full strength
  - Lack of support (cantilever vs. simple support)
  - Increased wind pressure due to lack of enclosure
- Internal bracing
  - Use of reinforced wall itself to provide stability



# Construction Practices

## Cold Weather Construction

- Objectives
  - Allow sufficient strength gain from hydration of cement in mortar
  - Allow sufficient moisture reduction of mortar before it freezes
- Problems
  - Units with frozen moisture absorb less water, leading to reduced bond and lower quality mortar because of higher remaining moisture content in the mortar
  - Cold units drain heat from mortar, possibly causing it to freeze before adequate moisture can be absorbed
  - Freezing water can expand and rupture mortar



## Cold Weather Construction

### Construction Preparation

- Do not lay masonry units having a temperature below 20°F
  - containing frozen moisture
  - visible ice
  - snow on the surface
- Remove visible ice and snow from top surface of masonry or foundation containing frozen moisture
  - Heat surface to above freezing. TMS 602 1.8C

Ambient Temperature	Requirement
40°F to 32°F	Do not heat water or aggregates above 140°F Heat sand or mixing water so mortar is between 40°F and 120°F Heat materials of grout to above 32°F
32°F to 25°F	Produce mortar between 40°F and 120°F; maintain mortar above freezing until used. Produce grout between 70°F and 120°F; maintain grout above 70°F at time of placement.
25°F to 20°F	Heat masonry surfaces under construction to 40°F Heat masonry to 40°F prior to grouting Use wind breaks when wind speed exceeds 15 mph
20°F and less	Provide enclosure with temperature above 32°F in enclosure



# Cold Weather Construction

## Construction Protection

Mean Daily Temperature <sup>1</sup>	Requirement
40°F to 25°F	Cover with weather-resistant membrane for 24 hours
25°F to 20°F	Cover with weather-resistive insulating blankets for 24 hours Extend time period to 48 hours for grouted construction unless only type of cement in grout is Type III
20°F and less	Maintain masonry above 32°F for 24 hours using heated enclosures, heating blankets, or other methods Extend time period to 48 hours for grouted construction unless only type of cement in grout is Type III

<sup>1</sup> Minimum daily temperature for grouted masonry



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Masonry



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## Construction Practices

### Hot Weather Construction

- Objective
  - Prevent dryout of mortar and grout and allow for proper curing.
- Protection
  - Fog spray newly constructed walls three times a day for three days when mean daily temperature exceeds 100°F or 90°F and wind speed greater than 8 mph.



### TMS 602 1.8 D

Ambient temp > 100°F or 90°F and wind speed greater than 8 mph.

Maintain sand in damp, loose condition  
Produce mortar below 120°F

Maintain mortar and grout below 120°F  
Flush mixer, transport containers, and mortar boards with cool water

Retemper mortar with cool water

Use mortar within 2 hours

Ambient temp > 115°F or 105°F and wind speed greater than 8 mph.

Shade materials and equipment from direct sunlight

Use cool mixing water. Ice is permitted in mixing water prior to use. Ice is not permitted in water when added.

# Construction Practices

## Embedded Conduits, Pipes, and Sleeves (TMS 602 3.3 D)

- Space not more than 3 diameters on center
- Should not displace more than 2% of cross section in columns and pilasters
- Do not embed aluminum unless coated
- Electrical fields from conduits make the problem worse

