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This is Not proper Crack Control
Causes of Concrete Masonry Cracks

1. Excessive deflection
2. Structural Overload
Causes of Concrete Masonry Cracks

3. Differential settlement
Causes of Concrete Masonry Cracks

4. Shrinkage

- Moisture change
- Temperature
- Carbonation

General trend = shrinkage

Length change

Time (cycles)
Shrinkage Cracking

Restraint at bottom only
Shrinkage Cracking

Restraint at top and bottom
Accommodating Movement

- **Control Joints**
  - Used in concrete masonry construction

- **Expansion Joints**
  - Used with clay brick
Purpose of Control Joints

- Relieve horizontal tensile stresses
- Reduce restraint and permit longitudinal movement
- Separate dissimilar materials
Goal of Crack Control Provisions

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Restraint at top and bottom

Limit crack widths to less than 0.02 in (0.5 mm)
- able to be bridged by most coatings
- prevents water penetration
Specifying Concrete Masonry Units

- Included in C 90
  - Compressive Strength
  - Absorption
  - Dimensional Tolerances
  - Density Definitions
  - Linear Drying Shrinkage

C 90
Standard Specification for Loadbearing Concrete Masonry Units

TEK 1-1C
Specifying Concrete Masonry Units

- NOT Included in C 90
  - Color
  - Texture
  - Density
  - Water Repellency
  - Fire Ratings
  - Thermal Properties
  - Sound Properties

Most architectural concrete masonry units are custom made. Work closely with producers to get exactly what you want.

C 90
Standard Specification for Loadbearing Concrete Masonry Units

TEK 1-1C
3.1 Types - Two types of concrete masonry units are covered as follows:

3.1.1 Type I, Moisture-Controlled Units - Units designated as Type 1 shall conform to the requirements of this specification.

3.1.2 Type II, Nonmoisture-Controlled Units - Units designated as Type 2 shall conform to the requirements of this specification with the exception of Table 1.

This section was removed.
Does not appear in C 90-00 & later.
### Recommended Maximum Unit Moisture Content

- **When 50% or more of the surface area is observed to be wet, the unit is considered to be unacceptable for placement.**

- **Damp surfaces are not considered wet.**

- **Test procedure:** The surface is considered wet if moisture is observed and the surface does not darken when free water is applied.
Control Joint Spacing Recommendations

1.5 \( h \) maximum

So, for \( h = 8 \) ft, spacing \( \leq 12 \) feet
for \( h = 20 \) ft, spacing \( \leq 30 \) feet

25 feet maximum

1.5 \( h \) maximum

TEK 10-2B
1. Control joint spacings are based on the use of horizontal reinforcement having an equivalent area of no less than 0.025 in² / ft of height to keep unplanned cracks closed.

\[ \text{Sum of steel area} \div \text{height} \]

TEK 10-2B
1. Control joint spacings are based on the use of horizontal reinforcement having an equivalent area of no less than 0.025 in$^2$ / ft of height.

i.e. 9 gage joint reinforcement every other course (16 in.) or….
Control Joint Spacing Recommendations

1. Control joint spacings are based on the use of horizontal reinforcement having an equivalent area of no less than 0.025 in$^2$ / ft of height.

.... by the use of bond beams and....

#3 bars at 48 in. (4 ft.)
#4 bars at 96 in. (8 ft.)
#5 bars at 144 in. (12 ft.)
The Role of Reinforcement in Controlling Shrinkage Cracking

**Without** horizontal reinforcement

**With** horizontal reinforcement

Length after shrinkage if unrestrained

[Figure showing the difference in shrinkage cracking with and without horizontal reinforcement.]
Joint Reinforcement

- Primary function - control wall cracking associated with shrinkage

- Secondary Functions
  - metal tie system for bonding
  - structural reinforcement where allowed by code

TEK 12-2B
Joint Reinforcement

Consists of two or more longitudinal wires connected with cross wires forming a truss or ladder configuration.
Joint Reinforcement

- Must be spliced a minimum of 6 inches per MSJC
- It is permissible to lay joint reinforcement on face shell and mortar over it.
Control Joints

Backer rod in mortar joint raked out to a depth of at least 3/4”

Sealant
- polysulfide, urethane, silicone or epoxy. Avoid oil-based caulks or other materials that dry out rapidly or do not bond effectively to masonry.
Types of Control Joints with Shear Resistance

- Preformed gasket
- Grout shear key
Types of Control Joints with Shear Resistance

- **Dowels**
  - Smooth dowel - sleeved or greased on one end
  - Horizontal reinforcement discontinuous at joint (except for structural bond beams)

- **Special unit shape**
Control joints can be eliminated completely if enough horizontal reinforcement is provided.

ie., where $A_s \geq 0.002 A_n$

Maximum reinforcement spacing for 8 in. CMU (not solid grouted):
- #4 bar - 24 inches
- #5 bar - 40 inches
- #6 bar - 48 inches
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4-hour Rated Control Joints

Ceramic fiber blanket

Note: Special unit shape and grout shear key type control joints are also rated 4 hours as long as they contain backer rod and joint sealant.

TEK 10-2B
Control Joint Locations

• Typically use above grade in concrete masonry walls
  – Shrinkage cracks are an aesthetic rather than a structural concern

• Generally not used below grade
  – Less temperature and moisture variation
Control Joint Locations

- At maximum of one-half control joint spacing from corners
- Between main and intersecting wall
- At changes in wall height
- Adjacent to opening
- At pilasters and changes in wall thickness
Control Joints at Openings in Unreinforced Walls

Openings less than 6 feet
Control Joints at Openings in Unreinforced Walls

Openings more than 6 feet
Control Joints at Openings in Reinforced Walls

Preferred strengthening of opening with reinforcement - extending lintel reinforcement and joint reinforcement under the sill.

TEK 10-3
Control Joints at Openings in Reinforced Walls

Opening strengthened with joint reinforcement first two courses over opening and under the sill

TEK 10-3
Control Joints for Multi-wythe Walls

If wythes are unbonded...

...consider control joint requirements separately for each wythe.

If wythes are bonded...

...continue control joints from back-up through face.

TEK 10-1A
Impact of Mortar Strength

Weak mortar

Strong mortar
CMU Band in Clay Brick Veneer

Joint reinforcement w/ no slip plane option

Wall tie, within 12 in. (305 mm) of band

Clay brick

Joint reinforcement, W1.7 (9 gage) (MW 11) at 16 in. (406 mm) o.c. or equivalent

Concrete masonry accent band

Wall tie, within 12 in. (305 mm) of band

Vapor retarder, per local practice

Adjustable ladder wall tie (hot dipped galvanized) @ 16 in. (406 mm) o.c. vertical

Closed cell rigid insulation, as required

Air space, 1 in. (25 mm), min., 2 in. (51 mm) preferred

TEK 5-2A
CMU Band in Clay Brick Veneer

**Slip plane top and bottom of band option**

- Wall tie, within 12 in. (305 mm) of band
- Clay brick
- Sealant and building paper or other bond break material
- Joint reinforcement
- Concrete masonry accent band
- Wall tie, within 12 in. (305 mm) of band
- Vapor retarder, per local practice
- Seismic clip-type wall tie
- Closed cell rigid insulation, as required
- Air space, 1 in. (25 mm), min., 2 in. (51 mm), preferred

TEK 5-2A
Clay Brick Band in CMU Veneer

Wall tie, within 12 in. (305 mm) of band
Concrete masonry
Joint reinforcement, W1.7 (9 gage) (MW 11) at 16 in. (406 mm) o.c. or equivalent
Clay brick accent band
Wall tie, within 12 in. (305 mm) of band

Vapor retarder, per local practice
Adjustable ladder wall tie (hot dipped galvanized) @ 16 in. (406 mm) o.c. vertical at 16 in. (406 mm) o.c., as required
Closed cell rigid insulation, as required
Air space, 1 in. (25 mm), min., 2 in. (51 mm), preferred

TEK 5-2A
Summary

• Better manage movement through masonry systems by
  – Proper design
  – Using MSJC installation standards
  – Proper location of control joints
  – Proper use of bond beams
  – Proper placement of joint reinforcement