Technical
Information

Product and Systems Technology

Preventing Cracks in Veneer and Conventional Plaster System

PM17

Advances in construction technology have produced improved building materials, labor-saving techniques, construction efficiencies and commensurate economies. While lightweight materials and new construction methods, such as flat plate concrete design, enable buildings to be constructed faster and taller than ever before, they also present new problems. Perhaps the most elusive of these is partition cracking.

Causes of Cracking

Cracking occurs in plaster surfaces when the forces exerted on them exceed the tensile, compressive or shear strength of the material. Those forces can come from a variety of sources, such as:

- Shrinkage during drying
- Humidity expansion or contraction
- Thermal expansion or contraction
- Changes in pressure
- Impacts to partitions
- Structural movement of supporting elements produced by:
  (a) foundation settlement
  (b) seismic force
  (c) wind loads
  (d) volume changes in supporting materials
  (e) gravitational loads; dead and live

Crack Control Mechanisms

United States Gypsum Company has studied the various forces that cause cracking and has developed materials and techniques to control the effect of those forces on gypsum partitions and ceilings.

Control mechanisms fall into two categories: control joints and perimeter relief. The mechanism selected depends upon how the force affects the partition or ceiling assembly. If the force affects the plane of the partition or ceiling membrane, a control joint is required. If the force affects the structure supporting or abutting the partition or ceiling assembly, perimeter relief is required.

Stresses Affecting the Plane

Basically, there are two kinds of factors that affect the plane of a partition or ceiling assembly. The first and most common is expansion and contraction of the surfacing materials due to variations in temperature or humidity. This includes shrinkage after installation as the assembly dries and stretching or contracting due to variations in weather.

The second factor affecting the plane is applied stresses on the assembly from wind loading on building exteriors, slamming doors, pressure changes or sudden blows on interior partitions, and deflection of ceilings due to loads on the floor above.

To control the effects of each of these factors, the use of control joints is recommended. The control joints are placed in the face of the partition or membrane.

Common Conditions for Control Joints

There are four principal conditions under which control joints are required:

1. Where partitions or ceilings of dissimilar construction meet and remain in the same plane, e.g., junction of a masonry wall and a veneer plaster partition (see fig. 1).

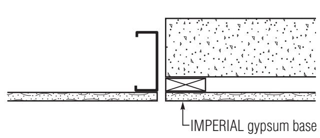


Fig. 1
control joint at junction of veneer plaster partition and masonry wall.

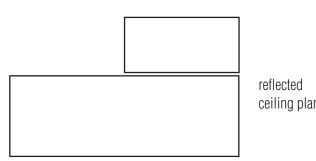


Fig. 2
control joint in "L" shaped ceiling.

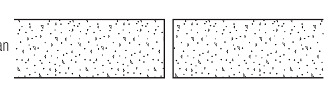


Fig. 3
control joint over structural expansion joint.

2. Where wings of "L", "U" and "T" shaped ceilings are joined, control joint to run with structural members (see fig. 2).
3. Where expansion or control joints occur in the base wall construction and/or building structure (see fig. 3).

4. Where partitions or ceilings span long distances, control joints must be placed at appropriate intervals:
   - Partitions—30 ft. maximum
   - Interior ceilings (with perimeter relief)—50 ft. maximum in either direction
   - Interior ceilings (without perimeter relief)—30 ft. maximum in either direction
   - Exterior wall/ceiling with portland cement plaster—10 ft. maximum in either direction

Placement of Control Joints

Control joints are used to relieve expansion, contraction or flexural stresses across large ceiling and wall expanses. Effective control joint positions are as follows:

- From door header (corners of door frames) to ceiling
- From floor to ceiling in long partitions and wall furring runs (full-height door openings provide expansion control in large partitions)
- From wall to wall in large ceiling areas

Types of Control Joints

USG has developed several types of control joints for use in veneer plaster, conventional plaster and exterior stucco construction. The types of control joint and their recommended uses are identified below.

SHEETROCK® Zinc Control Joint No. 093 For interior use with veneer plaster finish (see fig. 4, 5). May also be used for exterior soffit applications.

The no. 093 control joint is constructed with 3/32" grounds to accommodate both 1- and 2-coat veneer on IMPERIAL® veneer basecoat.

Separation between panels must be 1/4" min., 1/2" max. Flange is designed for staple attachment to panel surface. Requires plastering. Plastic tape that protects 1/4" groove must be removed when plastering is completed.

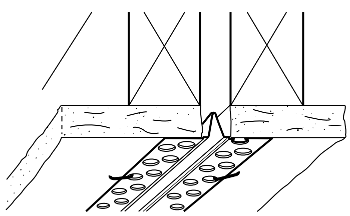


Fig. 4
control joint no.093.

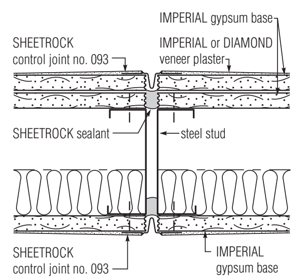


Fig. 5
control joints in face of plaster partition accommodate lateral expansion or contraction up to 1/4".

SHEETROCK® Control Joint No. 50, 75, 100 For interior use with conventional plaster assemblies (see fig. 6, 7). May also be used with exterior stucco.

Control joint sizes reflect various grounds: no. 50, 1/2" ; no. 75, 3/4" ; no. 100, 1" (for exterior stucco). Flanges are perforated for wire attachment to metal lath or temporary staple attachment to gypsum lath. In all cases flanges of the control joint must be positively attached to framing members. Control joint no. 100 may also be back-mounted behind IMPERIAL® gypsum base for use with radiant heat ceiling.

Separation between panels must be 1/4" min.,1/2" max. Plastic tape that protects 1/4" groove must be removed when plastering is completed.

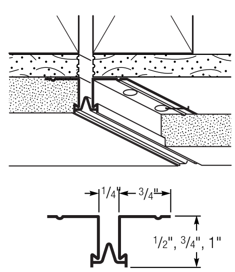


Fig. 6
SHEETROCK control joint.

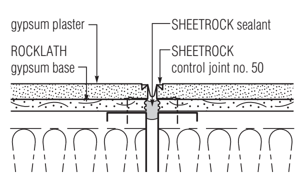


Fig. 7
SHEETROCK control joint no. 50 in metal-stud and plaster partition.

Double-V Expansion Joint For use with conventional plaster assemblies or exterior stucco (see fig. 8). Available in galvanized steel or zinc with 1/2" or 3/4" grounds. Flanges are expanded metal for positive keying of plaster. Separation between panels must be 1/4" to 1/2".

Casing Bead #66 For use with conventional plaster assemblies (see fig. 9). Available with galvanized short flange and galvanized or zinc expanded flange. Provides 3/8", 1/2", 5/8", 3/4", 7/8", 1" and 1-1/4" grounds

Vertical control joints are constructed by intentionally separating beads 1/4". Joint opening should be sealed with SHEETROCK® acoustical sealant (see fig. 10).

Casing beads placed a few inches above floor, separating wall membrane from alternate material backing base boards, also provide protection from floor deflection (see fig. 11).

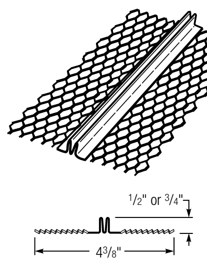


Fig. 8
double-V expansion joint.

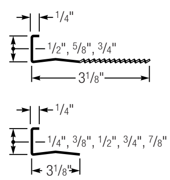
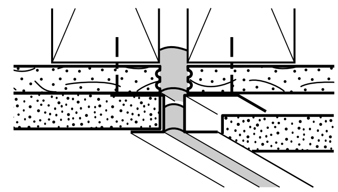


Fig. 9
no. 66 square edge
casing beads (expanded or short flange).



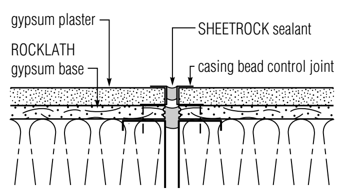


Fig. 10
casing bead control joint in metal-stud and plaster partition.

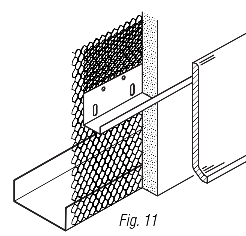


Fig. 11

Control Joint Installation Guidelines

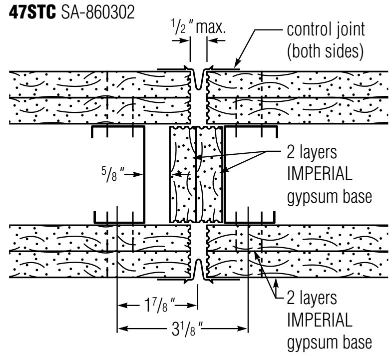
1. Application of control joint requires break in panel surface of approximately 1/2".
2. Floor and ceiling framing should be interrupted with a 1/2" gap at control joints in the structure.
3. Separate supports must be provided for each control joint flange.
4. Adequate seal or safing insulation must be provided behind control joint wherever sound and/or fire ratings are prime considerations.
5. Where vertical and horizontal control joints intersect, vertical joint must be continuous and horizontal joints abut it. Apply sealant at all splices, intersections and terminals.

Fire-Rated Control Joints

Fire and sound control protection must be provided behind control joints to maintain fire rating. Protective barrier may be layers of 5/8" IMPERIAL gyspum base, FIRECODE® core, or 3" Thermafiber SAFB Insulation (see fig. 12).

Fire-rated Control Joints (Warnock Hersey International-495-PSV-0824, 0824A)

Two-hour rated steel stud partitions
47STC SA-860302



One-hour rated steel stud partition

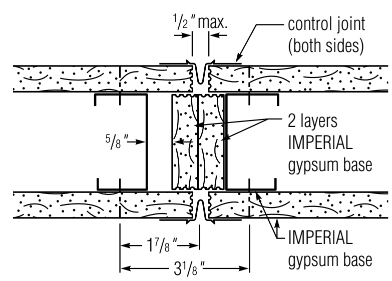


Fig. 12

Forces Affecting the Supporting or Abutting Structure

There are basically two types of stresses that affect structures supporting or abutting partitions or ceiling assemblies, particularly in high-rise structures. The nature of them is quite different.

The first, *racking stress*, occurs when structural components such as exterior columns or beams are altered and partitions are forced out of square. Essentially, rectangular-shaped partition frames become parallelogram-shaped (see fig. 13).

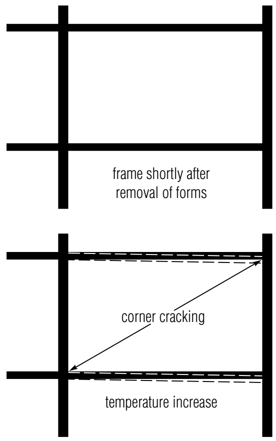
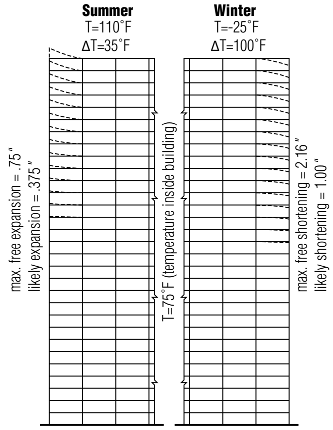


Fig. 13
type A cracking – frame movement cause racking cracks.



Note: movement will be cyclic with seasons, but most severe in winter.

Fig. 14

Section of a 30-story building shows effect of differences in indoor and outdoor temperatures. Right side shows how much differential movement could be expected in top floor-slab during winter; on left, movement during summer.Numerical values assume free movement of exposed exterior column due to temperature change. Actually, free movement is restricted by bending stiffness of frame and actual movement will be less.

Racking is caused by a number of factors, including: seismic forces (earthquakes), foundation settlement, excessive wind load, volume changes in materials due to drying and, most important, thermally induced expansion or contraction of materials.

Racking is most likely to occur in partitions and ceilings that abut exterior walls. The reason is that exterior columns are subject to thermal expansion with changes in the weather, while interior columns of an occupied building have stabilized with interior climate control. Partition cracking as a result of racking typically is evidenced by separation at the top and side of the partition at one point and crushing at another. This is most dramatic at the top floors of high-rise buildings where the effect of expansion is the greatest (see fig. 14).

The second stress, *flexural tension*, occurs as the wall panel tries to follow the deflection of the structural (slab) floor and/or ceiling. This deflection, particularly in flat-plate design, can change dramatically as dead loads and live loads increase with building occupancy, and increases naturally for some time after construction, due to plastic creep of the concrete. It may total two to five times the amount of the initial dead-load deflection (see fig. 15). Evidence of flexural tension is a crack that is wide at the base and narrows in the center of the field.

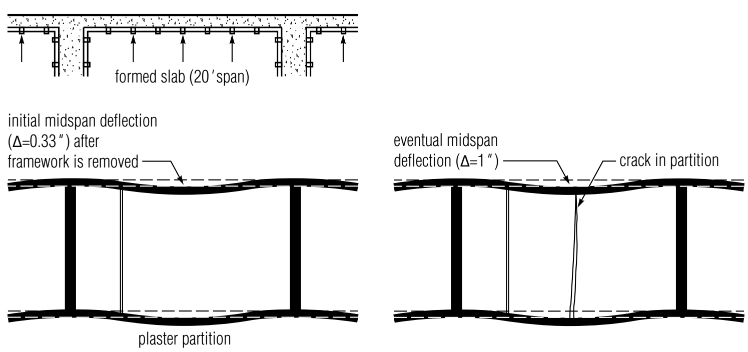


Fig. 15
type B cracking – caused by slab deflection

Perimeter Relief

To control the effects of each of these factors, the use of slip joints and other perimeter relief is recommended. Perimeter relief should be provided for veneer and conventional plaster construction surfaces where:

(a) partition or furring abuts a structural element (except floor) or dissimilar wall or ceiling (fig. 16);
(b) ceiling abuts a structural element, dissimilar partition or other vertical penetration (fig. 17); and
(c) ceiling dimensions exceed 30 ft. in either direction (fig. 18).

Perimeter relief is placed at the ends, bases or tops of partitions and ceiling membranes.

Typical perimeter-relief or slip-joint details for veneer and conventional plaster construction are illustrated below.

The principle of leaving the runner track free of permanent attachment to the partition at ceilings (fig. 19) and having the stud attached to the structural wall or column but not permanently attached to the partition (fig. 20) can be applied to veneer plaster assemblies as well to relieve the stress point at partition intersections with structural ceilings and walls or columns.

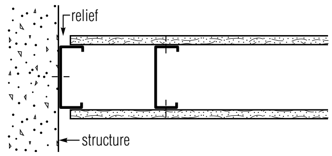


Fig. 16
perimeter relief at junction of partition and structural wall.

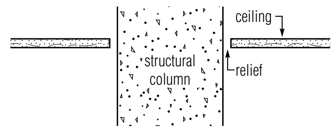


Fig. 17
perimeter relief of ceiling at structural column penetration.

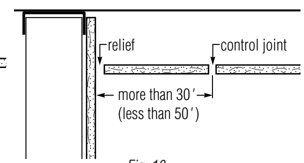


Fig. 18
perimeter relief of large ceiling surface.

Where a suspended or furred veneer or plaster ceiling meets an exterior or structural wall which is subject to movement, the supports for the ceiling assembly should be located within 6 in. of the abutting surfaces, but neither the main runner nor furring channels should be allowed to come into contact with the wall (fig. 21). Also the junction of the ceiling membrane with the wall facing should allow for some movement without a build-up of stress.

Where furring on an exterior structural wall meets another exterior structural wall, a minimum 1/4" clearance should be left between the acoustical trim and the intersecting wall or column.

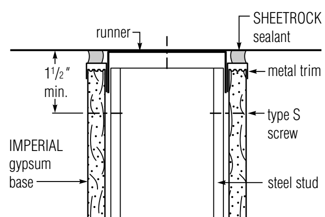


Fig. 19
perimeter relief of partition at structural ceiling.

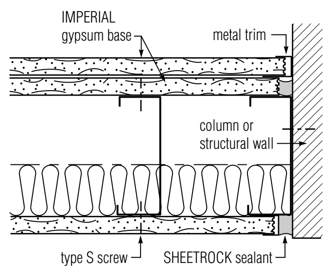


Fig. 20
perimeter relief of partition at structural wall or column.

Where partitions are constructed across the junction of two floor slabs with expansion joints between, partition panel base attachment must be made to only one of the slabs, allowing the other partition facing to float free (fig. 22).

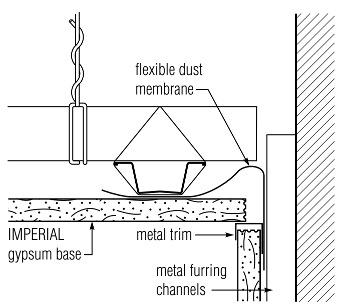


Fig. 21
perimeter relief of suspended ceiling at exterior wall.

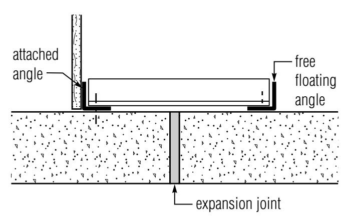


Fig. 22
construction of partition across junction of two floor slabs

Note
Products described here may not be available in all geographic markets. Consult your U.S. Gypsum Company sales office or representative for information.

Notice
We shall not be liable for incidental and consequential damages, directly or indirectly sustained, nor for any loss caused by application of these goods not in accordance with current printed instructions or for other than the intended use. Our liability is expressly limited to replacement of defective goods. Any claim shall be deemed waived unless made in writing to us within thirty (30) days from date it was or reasonably should have been discovered.

Safety First!
Follow good safety and industrial hygiene practices during handling and installing products and systems. Take necessary precautions and wear the appropriate personal protective equipment as needed. Read material safety data sheets and related literature on products before specification and/or installation.

Manufactured by
United States Gypsum Company
550 West Adams Street
Chicago, IL 60661

800 USG.4YOU (874-4968)
usg.com

PM17/rev.10-10