SOLVING THE ELUSIVE PROBLEM

OF

CRACKING IN VENEER AND CONVENTIONAL PLASTER SYSTEMS

By Edwin J. Jakacki

Veneer plaster system installed over cement board at Hillenbrand Hall on campus of Purdue University.

Lightweight materials and new construction methods, such as flat plate concrete design, enable contractors to construct buildings taller and faster than ever before. But these new technologies also present new problems, including one that may be the most elusive of all-surface cracking.

Chicago's United States Gypsum Company, a producer of plaster and veneer plaster wall systems, has devoted a considerable amount of research into the causes of these problems-and their solutions. This article will discuss the company's findings in depth.

Causes of Cracking

Cracking occurs in plaster surfaces when the forces exerted on them exceed the tensile, comprehensive or shear strength of the material. These forces can originate from a variety of sources including shrinkage during drying; humidity expansion or contraction; thermal expansion or contraction; changes in pressure and impacts on partitions. Another cause may be structural movement of the supporting elements produced by foundation settlement, earthquakes, wind loads, volume changes in supporting materials or gravitational loads, dead and live.

U. S. Gypsum Company has developed a variety of materials and techniques that will control the effects of these forces, thereby minimizing or eliminating cracking on gypsum partitions and ceilings. The control mechanisms recommended by U. S. Gypsum recommends fall into two categories: control joints and perimeter relief. Which one should be used depends on 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.

Forces Affecting Partition Planes

Two types of stresses affect the plane of a partition or ceiling assembly. The first and most common is expansion and contraction of the surfacing materials caused by variations in temperature or humidity. The second is applied stress on the assembly from wind loading on building exteriors, slamming doors, pressure changes or sudden blows on interior partitions and deflection of ceilings caused by loads on the floor above. Control joints placed in the face of the partition or membrane are recommended to control the effects of each of these factors.

Four primary conditions require the use of control joints. The first is when partitions or ceilings of dissimilar construction meet and remain in the same plane, for instance the junction of a masonry wall and a plaster partition. In this case, control joints should be placed at the junction of the two dissimilar partitions.

To effectively relieve expansion, contraction or flexural stresses over large ceiling and wall expanses, control joints must be placed strategically.

Another condition is where the wings of "L"-, "U"- and "T"-shaped ceilings are joined Here, control joints are installed to run with the structural members.

A third condition is where expansion or contraction of control joints occurs in the base wall construction and/or building structure. In this case, the control joint should be installed over the control or structural expansion joint.

The final condition is where partitions or ceilings span long distances. In these cases, control joints must be placed at appropriate intervals. For partitions, the interval is a maximum of 30 feet. For interior ceilings with perimeter relief, the maximum is 50 feet in either direction. For interior ceilings without perimeter relief, the maximum is 30 feet in either direction. For exterior walls or ceilings with portland cement plaster, the maximum is 20 feet in either direction.

To effectively relieve expansion, contraction or flexural stresses over large ceiling and wall expanses, control joints must be placed strategically. The most effective positions are from door headers (corners of the door frames) to ceilings; from wall to wall in large ceiling areas; and from floor to ceiling in long partitions and wall fixring runs. In the latter instance, full-height door openings provide expansion control in large partitions.

Application Guidelines

Five general guidelines should be followed during control joint application. First, the application of the control joint requires a break in the panel surface of approximately one half inch. Next, the floor and ceiling frame should be interrupted with a similar gap or control joints in the structure. Third, separate supports must be provided for each control joint flange. Fourth, adequate seal or safing insulation must be provided behind the control joint wherever sound and/or fire ratings are prime considerations. And, lastly, the vertical joint must be continuous with horizontal joints abutting it where vertical and horizontal control joints intersect. Sealant should be applied at all splices, intersections and terminals.

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Forces Affecting Supporting or Abutting Structures

Structures supporting or abutting partitions or ceiling assemblies also are subject to stresses, particularly in high-rise buildings. Basically, there are two types of stresses, each of them quite different.

The first, racking stress, occurs when structural components such as exterior columns or beams are altered and partitions are forced out of the square. Rectangular-shaped partition frames become parallelogram shaped.

Racking may be caused by earthquakes, foundation settlement, excessive wind load, volume changes in materials caused by drying and, most importantly, thermally induced expansion or contraction of materials.

It is most likely to occur in the partitions and ceilings that abut exterior walls. The reason is that exterior columns are subject to thermal expansion with changes in the weather, while the interior columns of an occupied building have stabilized because of climate control. Partition cracking in these instances is typified by separation at the top and side of the partition at one point and crushing at another. It is evidenced most dramatically at the top floors of high-rise buildings where the effect of movement is greatest.

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The second type of stress, flexural tension, occurs when the wall panel tries to follow the deflection of the 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. Load levels can also increase naturally for some time after construction due to plastic creep of the concrete. Overall load increases may total two to five times the amount of the initial dead-load deflection. The evidence of flexural tension is a wide crack at the base that narrows in the center of the field.

Perimeter Relief

The use of slip joints and other perimeter relief is recommended to control the effects of these stresses. Perimeter relief is needed for veneer and conventional plaster construction surfaces under the following condition:

- Where a partition or furring

abuts a structural element other than a

- Where the ceiling abuts a structural element, dissimilar partition or other vertical penetration.
- Where ceiling dimensions exceed 30 feet in either direction.

In each of these cases, perimeter relief is placed at the ends, bases or tops of partition and ceiling membranes.

The technique of leaving the runner track free of permanent attachment to the partition at ceilings and having the stud attached to the structural wall or column but not permanently attached to the partition can be applied to veneer plaster assemblies. It relieves the stress point at partition intersections with structural ceilings or walls or columns.

The supports for the ceiling assembly should be located within 6 inches of the abutting surfaces in cases where a suspended or furred veneer or plaster ceiling meets an exterior or structural wall that is subject to movement. Neither the main runner nor the furring Channels, however, should be allowed to come in contact with the wall. In addition, the junction of the ceiling membrane with the wall lacing should allow for some movement without a buildup of stress.

A minimum clearance of a quarter of an inch should be left between the acoustical trim and the intersecting wall or column in cases where furring on an exterior structural wall meets another exterior structural wall.

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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. ❑

About the Author

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