



Expansion and contraction can tear a roof apart. If this movement is not anticipated and planned for, the stresses that are created can split or ridge the membrane. Accommodating these forces on the roof requires the installation of expansion joints at regular intervals.

The roof is not the only component to experience these stresses. Virtually all building materials expand and contract as their temperature changes. The amount of expansion or contraction a building will experience and the points in the structure where these forces will be concentrated is predictable. For example, using the appropriate formula, an engineer can calculate that a steel bar 100 feet long will expand  $\frac{3}{4}$  inch when the temperature rises 100 degrees. If this bar is restrained, the stresses that will result can be calculated with another formula. In a building, if these forces are restrained, they can build up to the point where they can easily push a wall over.

Although the roofing membrane is subject to these same forces, it is much weaker than other building components. At temperatures above 80F it becomes quite plastic, allowing it to conform readily to changes in the substrate. But when the movement of the substrate is added to the movement of the membrane itself, stresses can develop that will exceed the ultimate strength of the membrane and it will split. Using expansion joints to limit this movement to predetermined points can accommodate this stress while maintaining the watertight integrity of the roof.

Some factors may make the use of expansion joints a necessity. If there are changes in the type of decking used, or in the direction the deck is laid, movement and stress may be concentrated at these points. Because these stresses are usually not great enough to endanger the structure itself, the architect or specifier may not require expansion joints. But these stresses can crack or split the roofing, and expansion joints should be used.

In short, expansion joints should be used wherever:

- expansion joints are provided in the structural system;

- steel framing, structural steel or decking change direction;
- separate wings of L, U, T or similar configurations exist;
- the type of decking changes, such as where a steel and precast concrete deck abut;
- additions are connected to existing buildings;
- interiors with different heating conditions meet, such as a heated building abutting an unheated warehouse; and
- movement between vertical walls and the roof deck may occur.

For expansion joints to be effective, they must extend across the entire width of the roof and not terminate short of the roof edge or perimeter. Generally the components will be spaced 150 to 200 feet apart. They should be detailed and constructed to a raised height of at least 8 inches above the roof line, and water drainage should never be attempted through or over them.

## Divide and conquer

Another way to control thermal stresses in a roof system is with the use of dividers, which transmit stress from one area of the roof to another by dividing the entire roof area into smaller sections. These sections should be rectangular and uniformly spaced where possible.

Dividers are simply raised double wood members attached to a properly flashed wood base plate that is anchored to the roof deck. Dividers are usually set 150 to 200 feet apart. They should be located between the structural roof expansion joints and not restrict the flow of water. The architect or designer should determine the location and type of area divider to be used.

The use of raised curb area dividers is consistent with good roofing practice. The use of elastic, preformed control joints that are designed to be installed in the flat plane of the roof is not recommended because roof system movement may result when these units are used.

More information on expansion joints and dividers may be found in the details contained in the *NRCA Roofing & Waterproofing Manual*.