SPEIGHT MARSHALL & FRANCIS
A Professional Corporation

Technical Bulletin

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Introduction

Buildings are subject to dimensional changes caused by a variation of temperatures. Properly evaluating the amount of horizontal movement, resulting from thermal loads throughout of the life of the building, is one of the more complex tasks during the design process. If not properly addressed, the internal stresses generated by thermal loads will find a mechanism for release, and can cause excessive cracking.

An expansion joint is a controlled mechanism allowing a structure to move as a whole and keep the differential movement of components to a minimum. This will help to ensure brittle cladding, particularly masonry, is not subjected to excessive displacements and consequential separation or cracking, thus allowing water to penetrate into interior spaces.

Thermal Expansion Issues Observed by SM&F
(2009 images)

Subsequent $23M renovation & addition designed by Speight, Marshall & Francis with RRMM Architects

Expansion Joints

The term "expansion joint" refers to the isolation joints provided within a building to permit the separated segments of the structural frame to expand and contract in response to temperature changes without adversely affecting the building's structural integrity or serviceability.

When considering an expansion joint, the following factors should be examined and taken into account during location and design:

- Dimension and configuration of the building
- Design temperature change, both during construction and in operation
- Provision for temperature control
- Type of framing, type of connection to the foundation, and symmetry of stiffness against lateral displacement
- Materials of construction

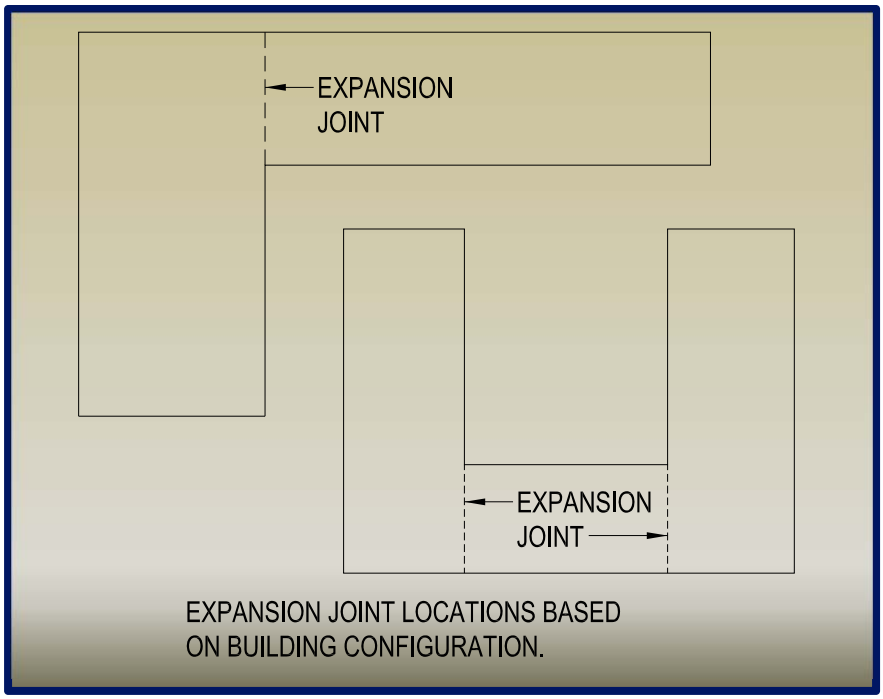
Design Requirements–Location and Spacing

Thermal movement occurs in all building materials and must be accounted for in construction. Warmer materials expand and colder materials contract. While the individual members in a structure may only experience small changes in length, the cumulative effects of changes can become significant, even when the changes in length take place slowly.

Buildings with a large horizontal dimension will require expansion joints. There are no code requirements stipulating when expansion joints must be employed. Because there is a cost associated with expansion joints, the general preference is to use fewer joints with larger spacings.

Below are recommendations commonly used for locations and spacing:

- Where framing or decking change direction
- Where separate wings of L, U and T shaped buildings or similar configurations exist
- Where the type of decking changes (i.e. where a precast concrete deck and a steel deck abut)
- Where additions are connected to existing buildings
- At junctions where interior heating conditions change (heated office abutting an unheated warehouse, canopies, etc.)
- Where movement between walls and the roof deck may occur



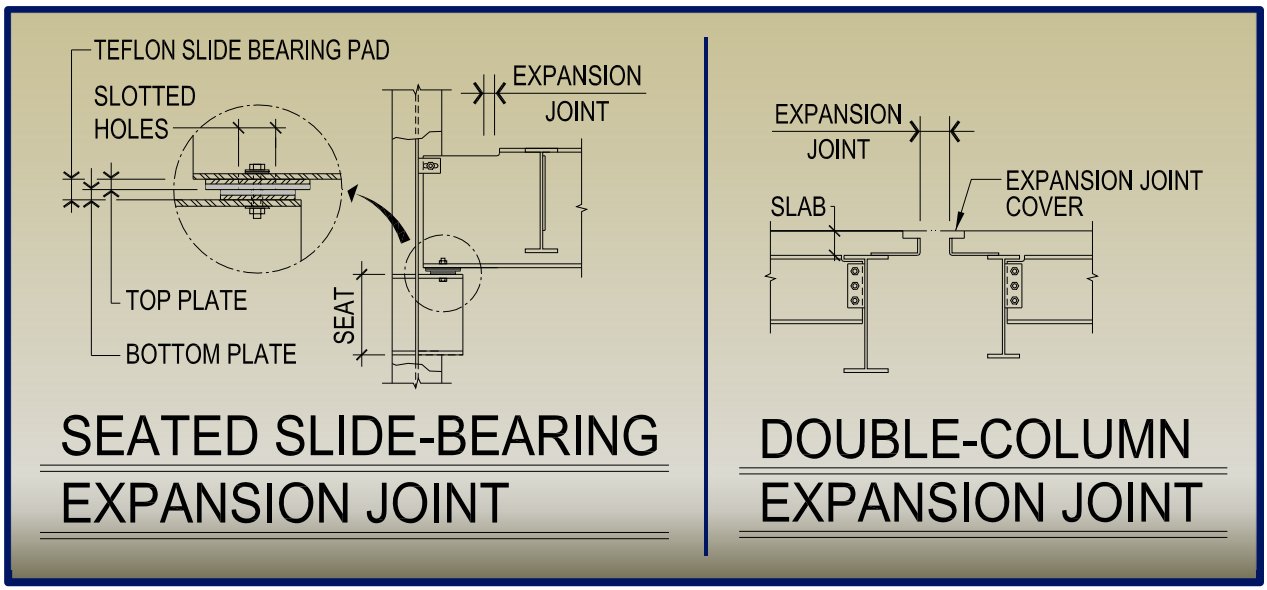
EXPANSION JOINT LOCATIONS BASED ON BUILDING CONFIGURATION.

When more specific site information is not available, most engineers typically assume a design temperature range of 50° to 70° F for continuously heated and air-conditioned buildings in their operation stage. It should be noted temperature differentials during construction stage could be more significant and exceed the design temperature changes after completion of the structure. Construction temperature changes should be considered by the designer.

Types of Expansion Joints

There are several types of expansion joints widely used in the industry. Most engineers will agree the best way to create an expansion joint is to use a line of double columns to create a complete separation in the building frame. This essentially creates two buildings adjacent to each other, which reduces the cumulative effect of expansion and contraction of structural members.

When joints other than double columns are used, the next best alternate is a slip surface joint at a bearing connection. Low friction sliding elements, such as Teflon pads, are typically used between the faying surfaces. Since there is no totally frictionless slip connection, some level of restraint to movement due to binding or debris build-up should be considered. It is important to ensure the design allows for sufficient load reversal to account for the effects of contraction as well as expansion of components.



Size of Expansion Joint

The width of an expansion joint depends linearly on the length of the building and the design temperature range experienced by the building. Building construction tolerances should be considered such that the separate sides of the expansion joint should never come in contact with each other even when the building fully expands. It should be noted the floor, wall, and ceiling finish materials selected to cover the expansion joints should be able to accommodate the anticipated movement. This would also be true of any mechanical, electrical and plumbing components spanning across the expansion joints.

Conclusion

The issue of thermal movement of a building is typically a serviceability issue and should be left to the judgment of qualified and experienced engineer. There are many variables when examinating the issue and some components are more sensitive to differential displacement than others. The lack of a properly detailed expansion joint may hamper or destroy the function of the facility, causing damage to the structural or architectural components. These can include water infiltration followed by corrosion, cracking, and other adverse conditions. Speight Marshall and Francis, P.C., has a wide range of experience with properly locating and detailing expansion joints. Don't hesitate to contact us with your next project.

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SPEIGHT, MARSHALL & FRANCIS, P.C.
2125 McComas Way, Suite 103
Virginia Beach, Virginia 23456
Find us on Facebook
www.smandf.com
(757) 427-1020
(757) 427-5919