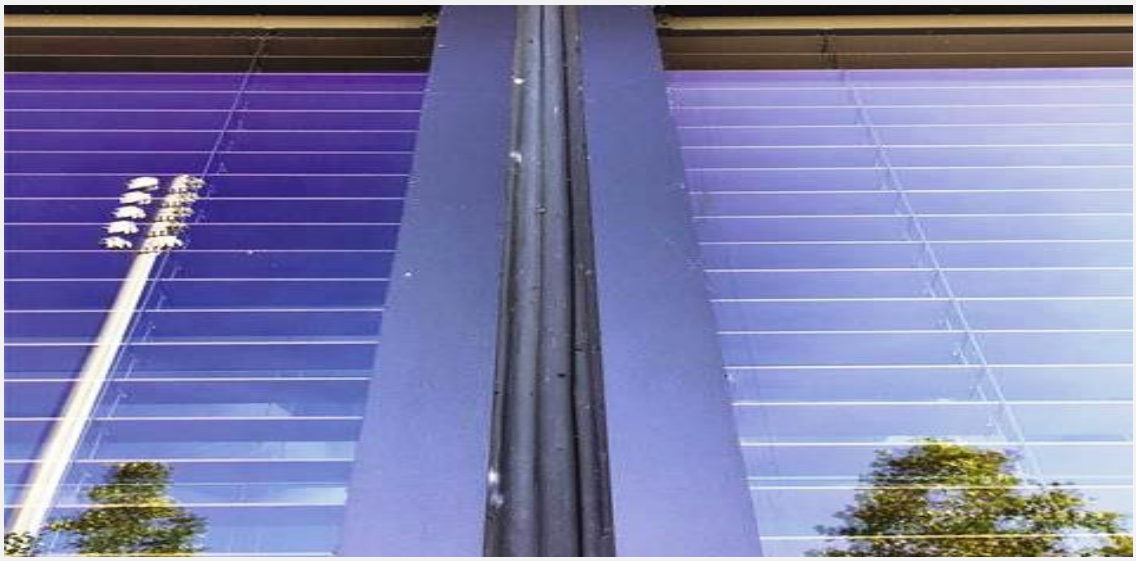
Report about

Expansion joint



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06-02-2024

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Abstract

EXPANSION JOINTS IN BUILDINGS AND BRIDGES Concrete is a plastic material when it is solid, it expands in response to heat, which creates tension in the structure, most buildings are composed of materials that are weak in tension, which is why rebar is used, if the expansion and tension generated exceed a certain point, the building will crack. Temperature variations cause the concrete to change shape, it expands when it gets hotter and contracts when it gets colder.

Concrete will crack if it tries to expand or shrink but is unable to do so. And it will crack if it stretches over a large area.

Concrete gaps designed specifically to prevent deformations caused by the previously mentioned reasons are known as expansion joints.

A little opening that lets the concrete expand and compress is called a concrete expansion joint. It allows for autonomous movement between these structures by being positioned between the concrete and whatever it is abutting.

Expansion joints absorb vibrations and permit soil movements.

Expansion joints are included in bridge construction to reduce stress and absorb shock while ensuring that vehicles are supported adequately. In essence, expansion joints permit contraction and expansion due to heat without creating stress. Cracks are prevented from occurring by expansion joints, which lessen stress within the concrete. It's deliberate. It serves as a standard.

expansion joint-equipped concrete slabs are designed such that passing cars won't detect the change in surface when they're traveling smoothly.

Abstract: Large plan dimensions necessitate the use of roof and structural expansion joints, even though flexible materials are frequently used in building construction. Because of the numerous

factors, it is impossible to specify precise criteria regarding the spacing between expansion joints.

factors at play, like the surrounding temperature at construction and the anticipated range of temperatures for the building's lifetime. Periodic breaks in a building's structure are called expansion joints. An expansion joint is a void left by an engineer or architect in a building's construction to permit the building to move with variations in temperature.

An assembly called an expansion joint is made to safely absorb the expansion and contraction of different building materials brought on by heat. They are frequently located in the spaces between slabs, bridges, and other constructions. For similar reasons, expansion joints have been added to or incorporated into brick external walls in more recent times. The phrase "control joint" is used in concrete and concrete block construction, and it has comparable functions.

Building faces and concrete slabs will expand and contract over the year as a result of the planet's seasonal warming and cooling.

Under the strain of heat expansion and contraction, the structures would fracture if the expansion joint gaps are frequently overlooked during the design phase and filled with basic caulking. Because of the seasonal heat expansion, this basic caulking is unable to withstand it, eventually creating a leak spot in the structure.

If not sealed or handled carefully, this expansion junction turns into the primary source of leaks in the structure, which can destroy the building's interior. Waterproofing these joints is frequently disregarded.

1 - Defination

When we talk about "expansion joints," we mean the isolation joints that are installed inside buildings to allow the various structural frame segments to expand and contract in response to temperature variations without negatively impacting the building's structural integrity

2 - Over view of Expansion Joint

In construction terminology, the term "joint" refers to components that have to accomplish a variety of tasks, such as isolation joints and beam-column joints.

3 - The basic reasons for requiring joints

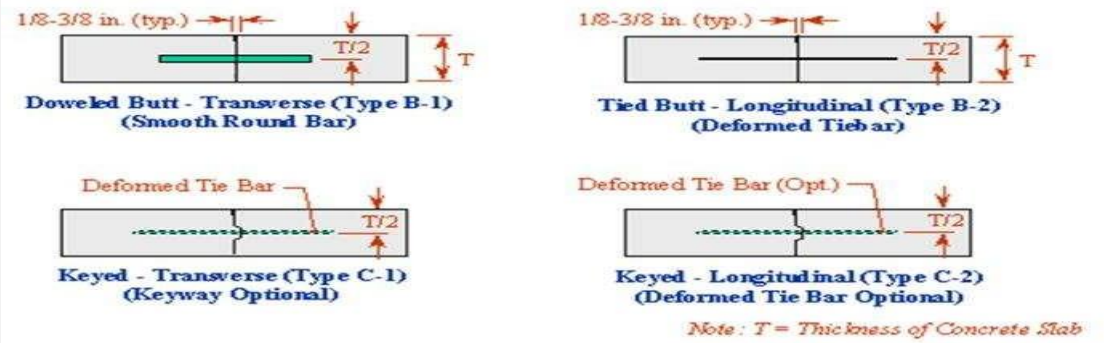
- One concrete placement cannot create the part or structure as a monolithic unit.

- The member has to be of limited size so it can be handled by cranes, etc.

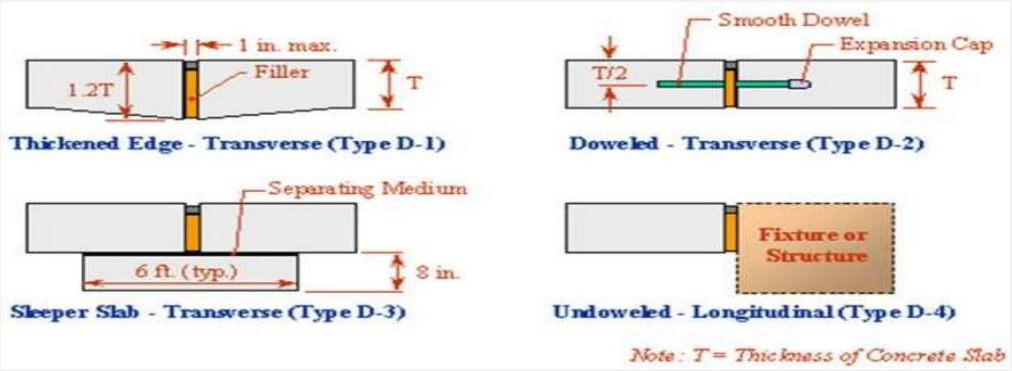
- The structure or member on one side of the joint needs to be able to move relative to that on the other.

Types of joints in concrete

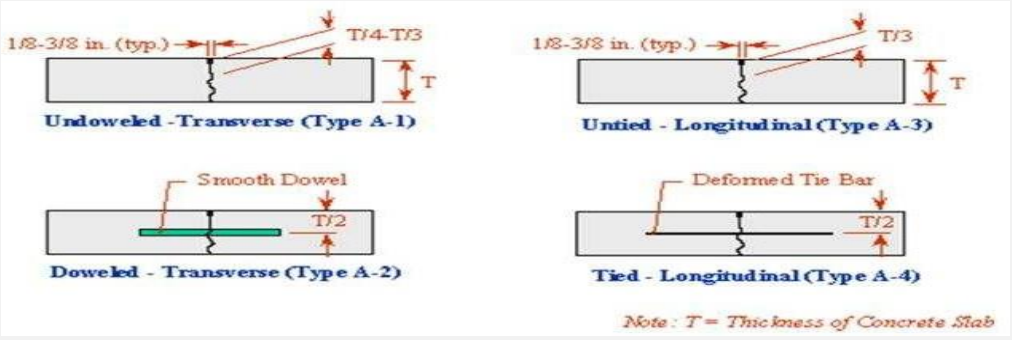
1. Construction Joints



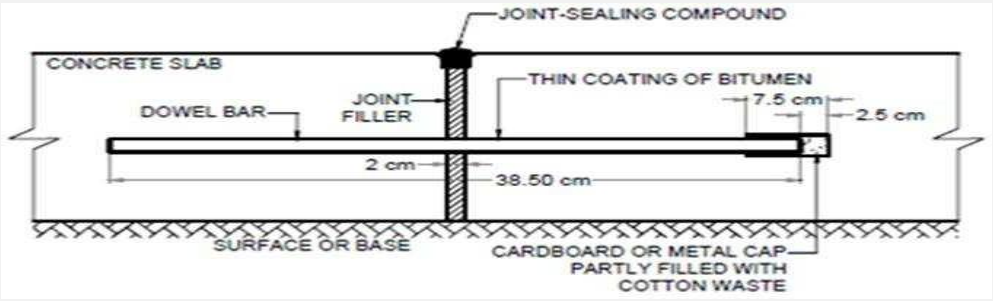
2. Isolation Joints



3. Contraction Joints



4. Expansion Joints



- Details of expansion joint

Provision of expansion joints between cutting slabs of reinforced concrete at designing intervals and at junctions with other projects is standard procedure in the construction of runways, bridges, buildings, and roads. Then, sealing is applied to these joint filers.

A small expansion of concrete occurs with temperature rise. In a similar vein, concrete contracts when it dries and expands when it is wet again. Provision needs to be made for the joint's volume change in order to relieve the generated stresses.

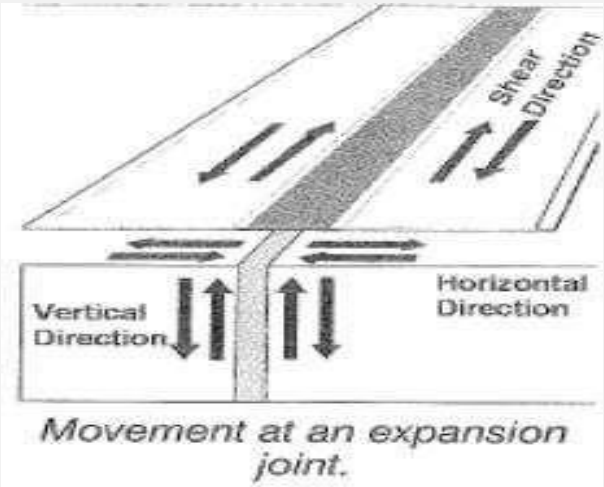
In reality, an expansion joint is a gap, which makes room for a building to enter and exit. Temperature variations are the main source of structure movement, and the degree of expansion and contraction relies on the kind of material used in construction. A building with a steel frame will move differently than one with a concrete frame.

Because there is less room for expansion in a compact building, neither the floor slab nor the roof slab need joints. However, the extension is substantially larger and might be as much as 25 mm in the case of the long building.

As a result, expansion joints are typically included in buildings larger than 30 meters.

Now that the projected movement along the three main axes of the expansion joint gap has been successfully determined, the designer and specifier must make a more crucial decision on the material to be used to seal the joint gap from the element.

F1: Expansion Joint



F2: Movement at an Expansion Joint

Problems due to Expansion Joint

The main problems of expansion joints are:

A. Leakage of Water

B. Pest attack

C. Poor workmanship

But the side effects developed by the water leakage and pest attack are very dangerous and tedious

A) The problem caused by water leakage:

1. During the rainy season, people experience discomfort as water seeps into the walls from the expansion joints.

2. Weather has an impact on wall paints.

3 .The steel members get corroded and results in to risk of structural failure.

4.The electric lines in expansion joints can be short circuited.

B) Problems due to pest attack

C) Problems due to poor workmanship:

The foundation may fail as a result of the expansion joints that are only present in the superstructure.Uneven cracks on the parapet walls may arise from the absence of expansion joints.

- Need of Expansion Joints

A-In the event that it is not supplied, internal compressive stresses will be applied to the structure, and these stresses could be so great that the structure collapses.

B-The degree of expansion is determined by the material's coefficient of linear expansion, the extent of the structure, and the degree of temperature change.

3-The coefficient of linear expansion and temperature variations are uncontrollable.

4-The only thing that can be reduced to keep the structure's expansion within predetermined bounds is its extent.

5-These ideas explain why a building 30 meters long expands by roughly 10 mm when exposed to a 10 degrees celsius temperature change.

6-Small buildings often don't need expansion joints, but they should be installed if the structure's continuous length is longer than 45 meters.

- Factors affecting on Expansion Joints

1. **Earthquake**: expansion joints help lessen the building's thrust during an earthquake.

2. **Wind**: It is possible to reduce the strains that storms and hurricanes generate.

3. **Loads**: expansion joints can lessen bending moments brought on by loads, snow, rain, and vibrations.

4. **Thermal**: the various building materials have varying coefficients of expansion in response to temperature changes, tensions resulting from these variations can diminish as a result of expansion joints.

- Location of Expansion Joints

1. Building sizes can vary, usually measuring more than 30 meters in either direction.

2. Material direction change: Steel deck flutes

3. Building shapes: T, H, O, X, Y, C and others

4. Material Changes:

Concrete to Steel, Wood to Steel, Flexible to Rigid

5. Additions, regardless of shape or size

6. Walls that are not load-bearing, or occasionally load-bearing

- Construction of Expansion Joint

The building must have an expansion joint installed from the foundation to the upper story.

First, build the expansion joint on one side to the required level. Next, install the fiberboard where the expansion joint is to be located. Finally, build the other side. The Sealing chemicals are used to seal fiberboard. Thus, the building's construction is complete.

- Material & Techniques

An expansion joint's gap is never left unfilled. To make it watertight, a compressible material is filled within.

The expansion joint needs the following supplies to be waterproof.

1.**Joint filler**

The typical materials used as joint fillers are bitumen, bitumen including cellular components, cork strips, rubber, mineral fiber, expanded plastic, pith, coconut, etc.

Compressible material that is firmly fitted in the gap should be used as joint filler. Since they are compressible, neighboring sections can easily expand freely. It ought to recover 75% of its initial thickness upon the removal of external pressure. They ought to be strong, long-lasting, and decay-resistant.

2.**Sealing compound**:

Its purpose is to keep out moisture and to keep dirt, gravel, and other foreign objects out of the joint. It must be easily workable, non-toxic, tint less, and insoluble.

3. **Water bars :**

The purpose of the function bars is to stop water from passing through the joints. Rubber, PVC, GI sheet, copper, or aluminum sheets can all be used to make water bars. It is not recommended to use the G.I. Water bar in corrosive environments. The water bar's width can vary from the thickness should be at least 0.56 mm and measure between 15 and 20 cm. To facilitate expansion and contraction at the joints, they are given a U or V fold.

- Installation of Expansion joint

Since installing expansion joints is a specialized task, project documentation should highlight the increased caution needed to finish the job. The contractor should be required by the contract documents to arrange a pre-construction meeting for all parties involved in performing the work at and around the expansion joints in order to guarantee that the following requirements are fulfilled, inform all parties involved about their roles in installing the expansion joints:

1. The floor's expansion joints have to be straight and line up with the expansion joints on vertical planes, like walls and double columns, without any offsets.

2. It is not appropriate to use the expansion joint separation as a location for tolerance build-up from other building tasks.

3. The breadth of the expansion joint gap should be constant throughout. The gap width may need to be adjusted if post-tensioned concrete is used the gap is cast at a temperature other than the stated mean temperature, or both in order to guarantee that the stipulated junction has the designated range of motion

4. To guarantee adequate consolidation, prevent concrete seepage and abnormalities in joint shape, and prevent cavities in the concrete or on its surface, forms should be sturdy and have

tight joints. This will enable the concrete adjacent to the forms to be vigorously vibrated.

5. After the concrete has first cured, the forms should be taken out right away to avoid them being crushed or coming loose from the joint movement.

6. The expansion joint gaps in the decks and floors must be shielded from construction traffic damage along their entire length once they have formed. Joints should be shielded by plates or ramps at crossing places.

7. Joints in the walls should be free of mortar protrusion, masonry ties, protruding shelf angles, and other obstructions that might hinder the movement or obstruct installation of the expansion joint system.

SPACING OF EXPANSION JOINT IN VARIOUS ELEMENTS

1. Walls

   A: Load bearing walls one brick and more in thickness and having cross-walls at intervals is 30 m

   B: Load bearing walls without any cross-walls is 30 m If wall acts as panel walls between columns spaced not more than 9 m c/c no joints are required. Control joints may be given over the center of openings at half the spacing of expansion joint.

2. Roofs:

   A: Ordinary roof slabs of RCC on unframed construction protected by mud phuska is 20 m to 30 m interval and at all changes of direction points of structure.

   B: Thin unprotected RCC slabs is 15 m .

   C: Balconies and parapets is 6 to 12 m Corresponding to joints in the roof slabs.

   D: Framed structures at 30 m intervals and at corners or change of direction points.

Expansion joint treatment techniques for different elements

A) Walls: The wall's joints are kept concealed. Covering sheets made of aluminum, hard board, AC sheet, or wood plank are used to cover them. Typically, the junction is covered with A.C. sheet on one side of the joint, the covering sheet is fastened to the wall with screws, while on the other, the sheet is fastened to the wall through oval-shaped slots oval slots allow mobility at the joint without putting the covering sheet at risk of harm.Water bar and joint filler must always be installed in the roof's expansion joint.Every floor joint needs to be sealed to keep dirt and dust from building up inside.The wall's joints are not left uncovered. Covering sheets made of aluminum, hard board, AC sheet, or wood plank are used to cover them. Typically, the junction is covered with A.C. sheet. On one side of the joint, the covering sheet is fastened to the wall with screws, while on the other, the sheet is fastened to the wall through oval-shaped slots. Oval slots allow mobility at the joint without putting the covering sheet at risk of harm.Water bar and joint filler must always be installed in the roof's expansion joint. Every floor joint needs to be sealed to keep dirt and dust from building up inside.

B) Framed Walls: Two frames, one on each side of the expansion joint, are required in framed structures. The joints receive treatment akin to that of the expansion joint in a masonry wall.

C) Roofing Slab: A water bar and sealing compound should be used to close the joint gap. The masonry below the expansion joint in the slab should have R.C.C. or plain concrete bed blocks installed in order to prevent cracks in the masonry above or below the expansion joint.

Conclusion

- It is critical that a building's designer consider all potential movement during the design process and identify potential elements that could affect the building's performance.

- New techniques using the newest materials are more advantageous and provide speedier craftsmanship as well as long life to expansion joints with water tight provision.

- Adequate provision shall be made for expansion and contraction suited to the service requirements of the structure.

- Expansion joints are crucial components in civil engineering structures to accommodate the movement caused by thermal expansion, contraction, seismic activity, or settlement. Calculating the required number and spacing of expansion joints involves several considerations:

1. **Type of Structure:** Different structures have different requirements for expansion joints. For instance, bridges, highways, buildings, and pipelines each have specific guidelines and standards for expansion joint placement.

2. **Material Properties:** The material used in the structure affects its thermal expansion coefficient, which influences the amount of movement that needs to be accommodated.

3. **Temperature Variation:** Understanding the temperature fluctuations in the region where the structure is built is essential. Extreme temperatures can cause significant expansion or contraction.

4. **Movement Capacity:** Expansion joints must be capable of accommodating both anticipated and unexpected movements. These movements can be calculated based on structural analysis, historical data, and engineering judgment.

5. **Structural Design Codes and Standards:** Codes such as those provided by the American Society of Civil Engineers (ASCE) or the American Concrete Institute (ACI) often provide guidelines for expansion joint design based on specific structural types and conditions.
6. **Spacing Criteria:** Spacing between expansion joints depends on various factors such as the material used, temperature differentials, and structural considerations. Generally, expansion joints are placed at regular intervals along the length of the structure.
7. **Construction Methodology:** The method of construction and joint installation should be considered to ensure the joints perform as intended and are properly integrated into the structure.

- **Determine Movement:** Estimate the maximum expected movement in the structure due to factors like temperature variation, seismic activity, or settlement.
- **Select Joint Type:** Choose the appropriate type of expansion joint based on the movement requirements and structural design.
- **Spacing Calculation:** Use guidelines from applicable codes or standards to determine the recommended spacing between expansion joints. This calculation may involve factors such as material properties, temperature differentials, and structural analysis.
- **Consideration of Joint Characteristics:** Account for the characteristics of the chosen expansion joint, including its size, flexibility, and installation requirements, in determining the final spacing.
- **Consultation:** It's often beneficial to consult with experienced structural engineers or refer to specific design standards to ensure the calculated expansion joint spacing meets safety and performance requirements.
- Remember, the calculation of expansion joints is a critical aspect of structural design and should be approached with care, considering all relevant factors and industry standards.

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