Understanding Structural Thermal Breaks

If a reinforced concrete slab extends through a building envelope's insulation layer to support a balcony or parapet, it will create enormous radiator fins that can transfer heat from the building's interior into a cold environment. In addition to wasting energy and increasing the carbon footprint of the building, localized cold spots in the concrete slab lower interior surface temperatures, resulting in condensation that can contribute to mold growth and damage finishes.

Structural thermal breaks are designed to minimize heat loss through the building envelope at connections between structural slabs and balconies, parapets, or slab edges. Thermal break systems typically comprise a 76 mm (3 in.) thick polystyrene insulation layer that matches the depth of the concrete slab and is installed in line with the insulation layer within the building envelope (see Fig. 1).

Fig. 1: Structural thermal breaks are relatively lightweight and can be installed by one person following the product's installation manuals and detailed illustrations. Alternate ends of each module are machined to provide tongue-and-groove joints and ensure a continuous and rigid installation. The blue top of each module is a protective polymer cap (firestops are also available). Note: The white bars in the photo are glass fiber-reinforced polymer (GFRP) bars

Each module has reinforcing bars with straight and curved sections to transfer flexural and shear forces across the insulation. The reinforcing bars are stainless steel, which is approximately one-third as conductive as structural steel. Because they carry shear forces, modules are labeled to indicate the exterior face of the insulation. Most thermal break manufacturers will provide specialty engineering services, designing the thermal break based on forces supplied by the Engineer of Record. For construction in seismic hazard zones, additional modules, specifically designed to resist lateral movement as well as uplift forces, will be provided.

Balcony Installations

Thermal breaks can be installed at the project site for cast-in-place applications or installed in precast concrete balcony elements at a factory and later shipped to the jobsite.

Thermal break modules are typically shipped in standard lengths of about 1 m (3.28 ft). Smaller lengths can be created by cutting through the insulation layer using a handsaw (Fig. 2), taking care to avoid cutting reinforcing bars and compression modules.

During installation, thermal break modules are placed onto the slab formwork in a gap prepared between the slab and balcony reinforcing bars (Fig. 3(a)). The tension bars are then tied into the reinforcing bar cages on either side. Concrete is placed up to the top surface of the thermal break (Fig. 3(b)).

Structural thermal breaks can be configured to accommodate balcony step-downs, in-slab ducts, and waterproofing membranes. It's best to contact the thermal break manufacturer to determine the best way to solve thermal bridging issues on specific projects.

Parapet Installations

Structural thermal breaks for parapets also consist of an insulating block pierced by stainless steel reinforcing bars. The bars projecting below the insulation are fabricated with

180-degree bends that will be cast into the rooftop slab, and the bars projecting above the insulation extend vertically to be cast into the parapet (Fig. 4).

Post-Tensioned Slab Installations

Structural thermal breaks can also be installed in post-tensioned slabs with some advanced planning regarding the placement of the live ends to allow access for the jack. The design team should contact the thermal break manufacturer early in the design process to discuss possible solutions. In buildings with discrete balconies, it may be possible to locate the live ends of tendons in the gaps between balconies. In buildings with continuous balconies, blockouts may be used to access the live ends of tendons (Fig. 5). After tensioning, these areas can be filled with concrete or with rigid insulation and sealed with grout.

Concrete-to-Steel Connections

Structural thermal breaks are also available to connect structural steel balconies to concrete slabs, including

Fig. 2: A thermal break module may be cut with a handsaw if required

Fig. 3: Structural thermal breaks in balconies: (a) during placement of balcony concrete; and (b) after placement of balcony and slab concrete. Note: Modules are installed with the top plate flush with the exterior concrete structure. The white bars are GFRP bars

Fig 4: Thermal breaks for parapets are installed at the vertical wooden parapet forms and tied into the horizontal reinforcing bars. Reinforcing bars are fabricated to transfer both bending and shear across the insulation layer

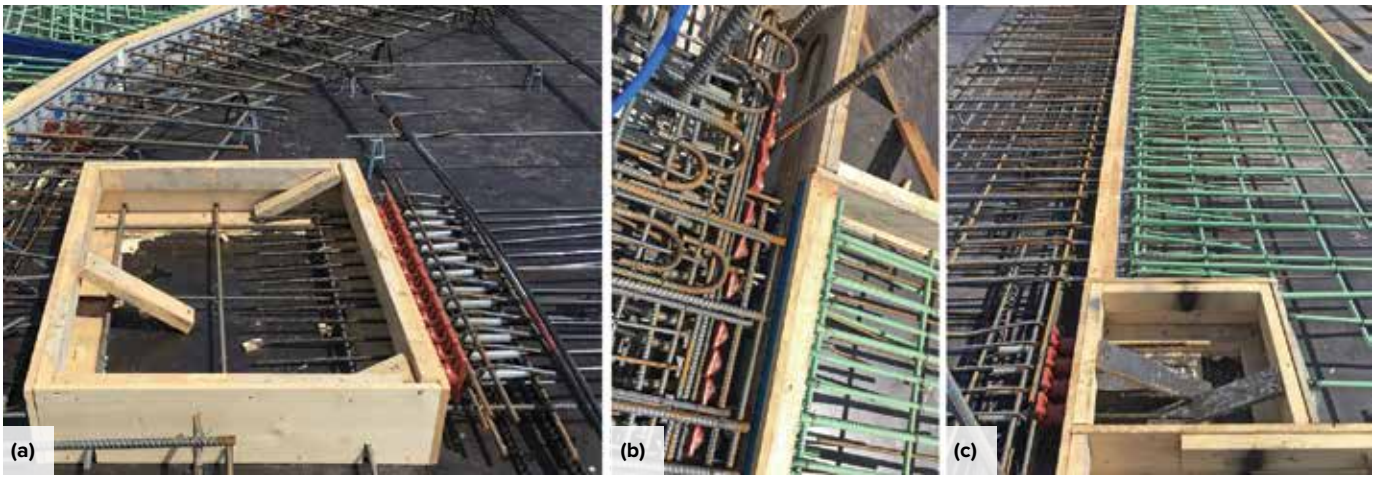

Fig. 5: Structural thermal breaks can be installed in post-tensioned slabs: (a) a blockout within the slab; (b) a thermal break at dead ends of tendons; and (c) a blockout within a balcony. In the latter case, the opening can be filled using rigid insulation and concrete

retrofitting a balcony on an existing structure. In one case, thermal break reinforcing bars are anchored in bored holes injected with a chemical adhesive, and the surfaces of the thermal breaks are sealed with waterproof sealant and a nonshrink grout. The steel frame of each balcony is then fastened to the thermal breaks with bolts.

Planning Ahead

Planning is crucial. It's a good idea to contact the thermal break manufacturer early in the bidding process to discuss pricing and project needs, including scheduling deliveries to match the construction schedule for each floor.

The construction team should also be prepared ahead of time. Many manufacturers offer technical information, installation manuals, and videos on their websites. Some also offer training sessions and on-site consultations. Educating the construction team, as well as working with a supplier who will be there to support the project, will make for a smooth and successful installation.

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