Emperor Penguins and Efficient Buildings.

Resisting frigid temps with thermal breaks.

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Thermal Breaks Prevent Heat Loss Through Feet Of Emperor Penguins... And Balconies Of Efficient Buildings

Emperor penguins can survive Antarctica's frigid climate because — like efficient building envelopes — their bodies contain 1) an air and moisture barrier, 2) continuous insulation and 3) thermal breaks that prevent heat loss into the environment.

Air and moisture barrier seals out weather

The only animal to inhabit the open ice of Antarctica during the winter, emperor penguins withstand wind chills up to -76°F (-60°C) and blizzards up to 124 mph (200 km/h). Scale-like feathers shield their bodies from harsh wind, ice, snow and water, while their skin provides the final barrier to transmission of moisture and vapor.

In the same way, modern building envelopes prevent the migration of moisture from the outside environment to the inside. Some envelopes employ a combined moisture/air barrier, while others additionally utilize a rain screen.

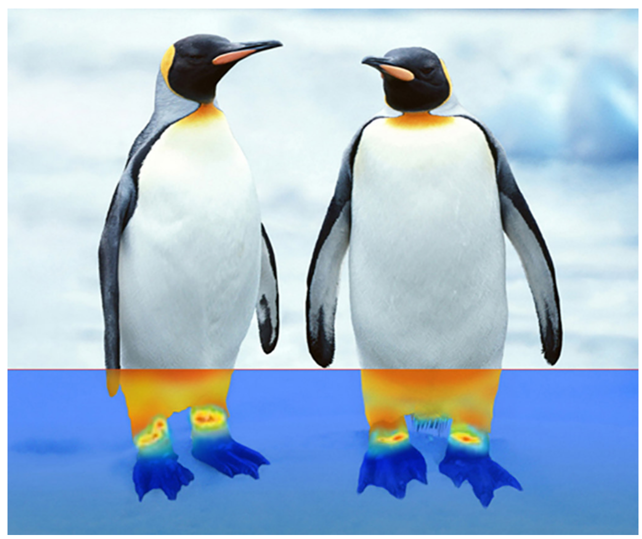
Continuous insulation retains heat, conserves energy

The Emperor penguin's thick layer of continuous blubber serves as its primary insulation against bitter temperatures. Additional insulation is provided by its feathers, which trap a layer of air against the skin.

While the penguin's continuous insulation is dictated by natural selection, the continuous insulation of commercial building envelopes is now being dictated by more code requirements. Many state and local codes already require structural thermal breaks when taking a prescriptive path, and others are not far behind in the adoption of more stringent codes.

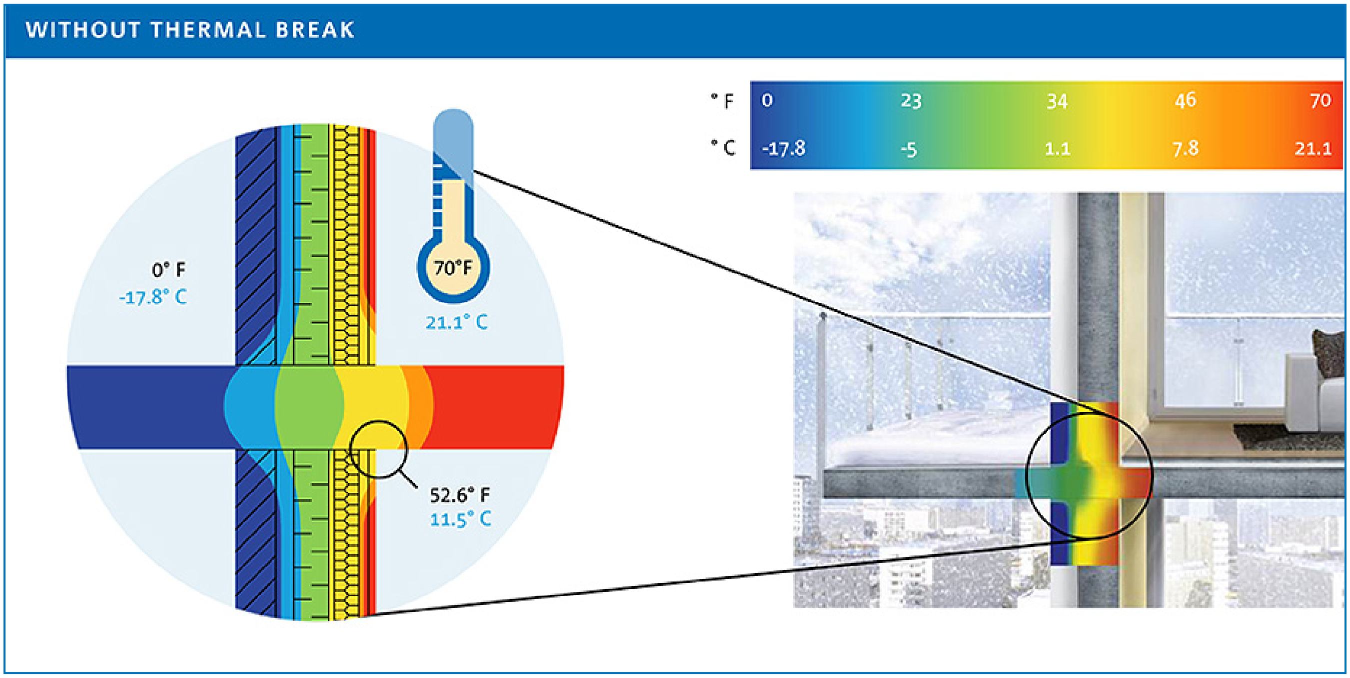
Thermal breaks prevent heat loss into the environment

Emperor penguins prevent the escape of heat through their feet into the ice and water by means of thermal breaks in their legs – a vascular adaptation that thermally separates their rounded, well-insulated bodies (low surface-area-to-volume ratio), from their flat, poorly insulated feet (high surface-area-to-volume ratio).



Built-in thermal breaks of Emperor penguins shown in this thermal image restrict blood flow to the feet, which are regulated at much colder temperatures than the body, preventing heat loss into the environment.

Similarly, the balconies of commercial buildings — cantilevered structural extensions of commercial building floor slabs — quickly equalize to cold exterior temperatures. As a result, balconies continuously draw heat from the interior floor slab into the exterior environment, unless thermal breaks are installed where the balcony breaks the continuous insulation of the building envelope.



Conventional balcony construction creates a thermal bridge in the otherwise continuous insulation of the building envelope, rapidly conducting heat from the interior slab through the balcony into the environment.

Traditional balcony construction wastes heat, chills floors, causes mold growth

Because of their load-bearing requirement, conventional concrete and steel balconies are designed as cantilevered extensions of steel or concrete floor slabs. As such, they not only create a thermal bridge in the otherwise continuous insulation of the building envelope, but they rapidly conduct heat from the interior slab through the cantilevered balcony and into the environment.

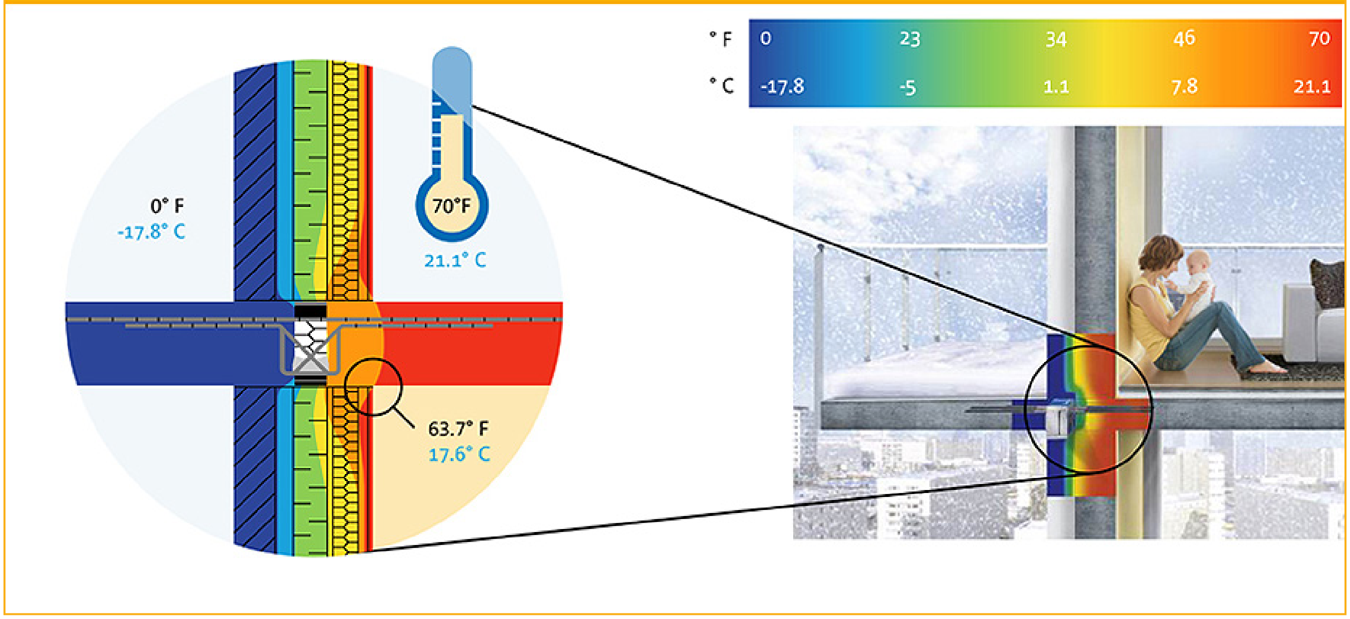
Conventional balcony construction creates a thermal bridge in the otherwise continuous insulation of the building envelope, rapidly conducting heat from the interior slab through the balcony into the environment.

Prior to 2010, wasted heat and cold interior floors were accepted as unavoidable outcomes in North American buildings with balconies, but additional problems of mold growth arose when builders began wrapping exteriors with air tight vapor barriers.

Before air tight envelopes, most commercial buildings leaked air profusely, causing humidity levels inside of buildings to equalize with low exterior humidity levels (typically 18 to 25%) during winter months. Forced hot air typically vented at or near balcony doors and windows further ensured that interior humidity remained too low at the cold balcony penetration to reach dew point, form condensation or support mold growth.

Condensation forming on the underside of an uninsulated balcony penetration can lead to mold growth, respiratory problems and litigation in modern, air-tight buildings having interior humidity levels exceeding 35%.

WITH THERMAL BREAK



In this thermal image, the Structural Thermal Break supports the cantilevered load where the balcony penetrates the building envelope, preventing heat loss through the balcony slab into the environment.

The advent of air tight vapor barriers to prevent leakage of heated air during the late 20th century had a major unintended consequence: increased mold growth.

As a building becomes more air tight, it requires less heat and retains more moisture from evaporation and human off-gassing. This can increase interior humidity to 35 or 40%, which is the target level for human comfort, but which creates a danger zone for condensation when the thermal conductivity of balconies drops the temperature to the dew point on the interior side of the envelope at the point of penetration.

With nowhere to go, that moisture will condense if interior temperatures drop to the dew point, especially within cold wall cavities adjacent to uninsulated balconies and other envelope penetrations. The resulting condensation is leading increasingly to mold growth on sheetrock, studs and insulation on the inside of the building. Mold can grow, and occupants can breathe it, years before it becomes visible on interior ceilings and walls.

By then, remediation will at minimum require removal and replacement of sheetrock, but mold is likely to recur since high interior humidity and cold envelope penetrations in existing structures are unlikely to be corrected due to difficulty and cost.

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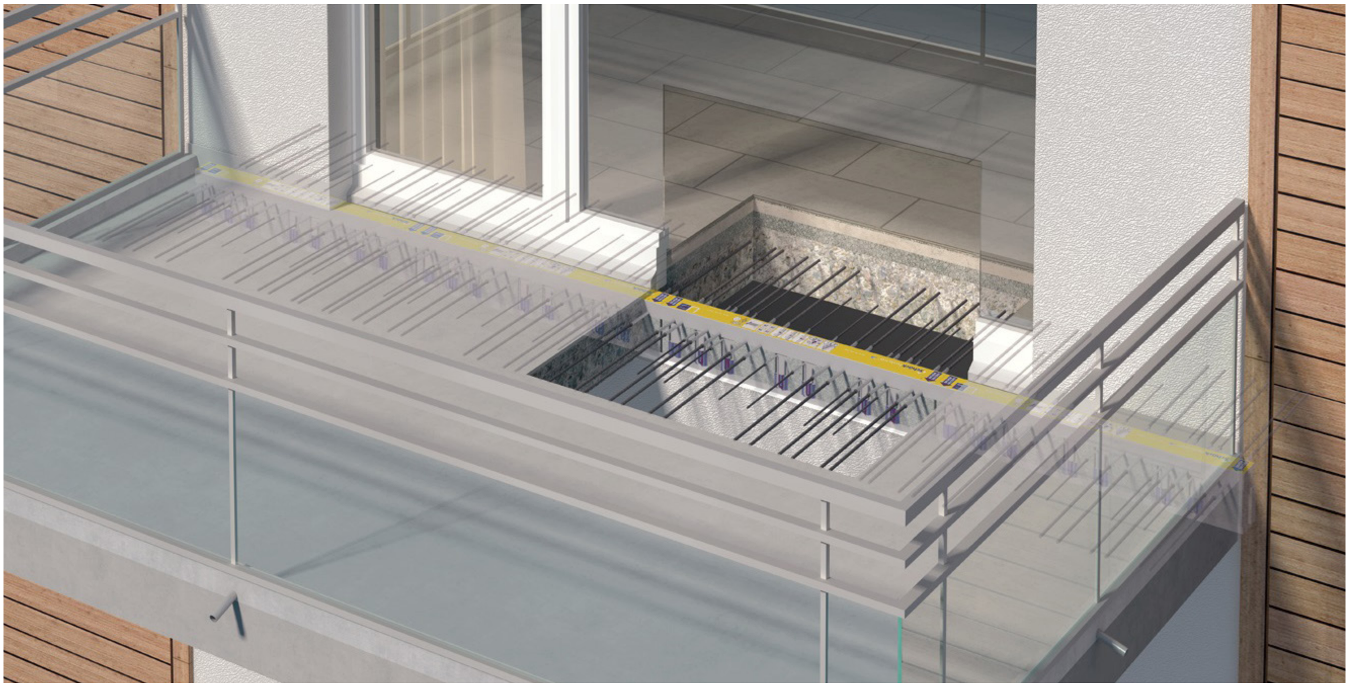
Structural Thermal Breaks eliminate 90% of energy loss through the balcony while supporting cantilevered loads

A Structural Thermal Break (STB) is a fabricated longitudinal assembly the same approximate width as the exterior building wall and height as the floor slab that creates a structural insulated foam break between the interior floor and the exterior balcony to minimize thermal conductivity between the two masses, while optimizing load-bearing capacity.



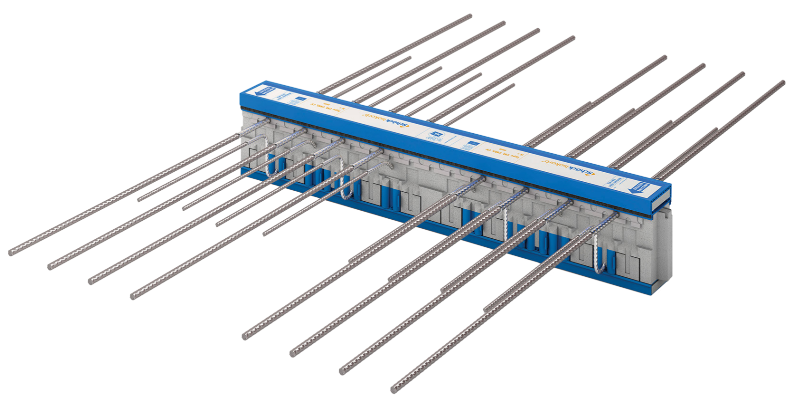
Schöck Isokorb® Type CM Structural Thermal Break (pictured below), is installed where the balcony cantilevers on the building's exterior wall, to reduce overall energy use, carbon footprint and heating system requirements by 14% on average, while improving occupant comfort and preventing condensation, mold growth and health hazards.

STBs for concrete construction contain engineered stainless steel rebar for casting into the concrete slab on the interior side, and into the concrete balcony on the exterior side, yielding structural strength equivalent to that of conventional reinforced concrete extensions of floor slabs.

STBs for steel construction are equipped with flanges and bolts for fastening to steel floor joists on the interior side, and on the exterior side to cantilevered balcony supports (or to other steel connections such as canopies, signage, sunshades, rainscreens, roof mounted equipment and fencing).

Compared to non-insulated connections, an Isokorb® STB element produced by Schöck USA achieves a 90% reduction in thermal conductivity in the connection area for standard load-bearing scenarios, translating into average reductions in energy use and carbon footprint to 14% for the overall building per year.

The reduction in BTUs required to heat the building also allows corresponding reductions in heating system size/capacity, resulting in savings on capital equipment and ongoing operation and maintenance of mechanical systems.



Lastly, thermally isolating balconies improves comfort for occupants and value for developers by increasing the warmth and usability of interior floor space.

Conclusion

Problems related to thermal conductivity of conventional balcony designs worsened when air tight building envelopes became a code requirement. In addition to heat loss and cold interior floors inherent with traditional construction, higher interior humidity levels caused condensation to form on the interior side of cold penetrations, resulting in mold growth. By breaking the thermal bridge between the cold exterior balcony and warm interior floor, structural thermal breaks eliminate up to 90 percent of energy loss at the balcony and increase the comfort of interior living space, while minimizing the developer's exposure to mold-related liability.

For more information on Schöck Isokorb® Structural Thermal Breaks, please feel free to contact me directly at Brent.Chancellor@schock-na.com or +1 347 896 2937.

You can also visit Schöck North America's website at www.schock-na.com.

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