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# Trinity Financial and MBD's $175m Passive House project relies on structural thermal breaks

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425 Grand Concourse - Bronx, NY

Bronx, NY The newly dedicated $175 million 425 Grand Concourse high-rise building serves as the largest Passive House project to date in North America. Passive House is an internationally-recognized building standard designed to ensure thermal comfort while significantly reducing energy use when compared to traditional construction. To meet Passive House criteria at 425 Grand Concourse, the design team incorporated strategies to cut energy use by as much as 70%.

Developer Trinity Financial partnered with MBD Community Housing Corp. and New York City's Department of Housing Preservation and Development to create the largest Passive House public-housing residence.

The 310,000 s/f, 26-story mixed-use/mixed-income structure uses a combination of high-efficiency building systems including an air-tight, insulated building envelope, rainscreens and a façade support system that minimize thermal bridging, energy recovery ventilation (ERV) that introduces continuous fresh air, energy-efficient mechanical systems, water-saving fixtures, sunshades, overhangs, a rooftop trellis, and green roofs.

Other elements include LED lighting, double-paned insulated glass units, domestic hot water boilers, low-flow water fixtures, cold water leak detection, efficient irrigation, and offsite waste sorting and materials reclamation (ensuring a minimum of 50% nonhazardous waste recycling).

A principal tenet of Passive House design entails siting the building to optimize sun/heat exposure. For 425 Grand Concourse, however, this presented a challenge because the more advantageous east-west orientation would have blocked sunlight on the adjacent Garrison Park just to the north. The project team opted for a north-south alignment. Project architect John Woefling, a principal at Dattner Architects and a certified Passive House designer, said, “It was a fundamental Passive House decision that benefits the park and its users.”

To minimize the resulting effect of full sun on the south side of the building, the project team introduced sunshades along the lengths of 13 floors. Each 100 foot-long sunshade, however, presented a potential thermal bridge where it attaches to the interior building slabs via steel brackets. Woefling avoided the problem by specifying structural thermal breaks. He said, “The sunshades are absolutely critical to the success of the building and the thermal breaks are absolutely critical to the success of the sunshades. We tested the building without the sunshades and the results were night and day.”

The role of thermal breaks in Passive House

Thermal bridging occurs where localized assemblies like uninsulated balconies, overhangs, sunshades, slab edges, steel beams, or any other structures penetrate the building envelope. Acting like cooling fins, these penetrations allow heat loss, resulting in cold internal surface temperatures at the penetration. In turn, these conditions promote condensation and mold growth. Thermal bridging also detracts from tenant comfort and adds to energy expenses.

Installing structural thermal breaks mitigates thermal bridging, which strengthens the building envelope performance and helps meet Passive House goals. For this project, the design team specified several hundred Schöck Isokorb structural thermal breaks. Concrete-to-steel thermal breaks attach the sunshades to the concrete slab edges on 13 floors and fasten the steel entrance canopy to the concrete slab. Concrete-to-concrete in-slab thermal breaks were also installed to prevent thermal bridging where the third floor residential terrace adjoins the 24-story tower.

In addition, concrete-to-steel thermal breaks connect the steel clip-and-rail system of the rainscreens to the interior concrete building frame. An important Passive House function, rainscreens are a key element in the façade support system to manage moisture and protect the integrity of the insulation.

The project team also applied concrete-to-steel thermal breaks to the rooftop trellis structure and its protective windscreen.

Putting thermal breaks to work

Each concrete-to-steel thermal break consists of an insulation block of expanded polystyrene with stainless steel rebar projecting from the interior side of the module that ties into the interior slab reinforcement, and stainless-steel threaded rods projecting from the exterior side of the module that bolt to exterior steel beams or connections.

Concrete-to-concrete structural thermal breaks consist of an insulation module penetrated by stainless steel rebar that is tied into the slab or wall reinforcement adjacent to the thermal break before concrete is poured conventionally. Stainless steel tension and shear force bars run through the module for structural strength and tie to the rebar of the interior and exterior slabs.

According to Isokorb, concrete-to-steel thermal breaks can reduce heat loss and carbon emissions by up to 94%. Concrete-to-concrete thermal breaks reduce heat loss at balcony and similar penetrations by up to 88% while preventing condensation and mold growth.

Nay Niang, PE, a senior associate with GACE, the structural engineering firm on the project, works with thermal breaks often said, “We start the process as early as we can. On 425 Grand Concourse, we started the coordination process with Schöck in the design phase. We gave them preliminary drawings and sketches to save time. We showed them what the loading, shear, moment and deflection would be for each thermal break use, and they reviewed it and recommended which products work best.”

Still challenges arose, particularly in installing the thermal breaks for each of the 13 sunshades. “When you install thermal breaks for the sunshades and pour the concrete, the activities on the deck in addition to the torque and loads from the cantilever can create tolerance issues. So, we created mockups and worked out formwork beforehand to try the installation in different ways to minimize construction tolerances and improve the consistency,” said Chengye Xu, project manager with Monadnock Construction, the project’s general contractor. “We were able to use the formwork on multiple floors, which helped save on materials and make sure the thermal breaks lined up between floors to achieve the intended alignment between the metal joints and the sunshades.”

Passive House on the rise

New York City is one of a growing number of North American cities whose building codes now require the mitigation of thermal bridging at penetrations through the building envelope.

National and international bodies that propose model building energy codes are directly addressing thermal bridging. For example, an addendum to ASHRAE 90.1-2019 that specifically addresses thermal bridging and structural thermal breaks is currently under review – making the possibility of inclusion in future editions likely.

While voluntary, Passive House standards are increasingly being incorporated in new construction to save on energy costs and reduce carbon footprint.

Building energy use intensity (EUI) is a metric of Passive House’s effectiveness. The EUI formula (BTU/s/f/yr = EUI) measures a building’s energy efficiency—the lower the EUI, the more energy efficient the building. A conventional code-built building usually achieves an EUI somewhere between 80 or 100. By using structural thermal breaks and other efficiency measures, 425 Grand

Concourse scored a predicted EUI around 22, and helped seal Passive House certification.