TREMCO®
Commercial Sealants & Waterproofing

Wisconsin Institutes for Discovery

Location:
University of Wisconsin-Madison

Owners:
Wisconsin Alumni Research Foundation

The Regents of the University of Wisconsin System

Architect:
Ballinger /Uihlein Wilson Architects

Construction Manager:
Findorff / Mortenson JV

Curtainwall Contractor:
H. J. Martin and Son, Inc.

Fabricator:
Kawneer

Air Barrier/Terracotta & Metal Panel Contractor:
Construction Supply & Erection/ Waukesha Air & Vapor Barrier

Building Enclosure Commissioning:
Wiss Janney Elstner Associates, Inc.

MEP Commissioning:
Facility Dynamics Engineering

Tremco Distributor:
S&S Sales, Inc.

Tremco Sustainable Building Solution:
Proglaze® ETA Engineered Transition Assembly System 3, ExoAir® 110 Self-Adhered Air & Vapor Barrier Membrane, Primer and Termination Mastic, Spectrem® 1 and 2 Silicone Sealants, SCR-900 Silicone Compatible Gaskets

The state-of-the-art design for the project incorporates extensive use of curtain walls and punched window openings with engineered transition assemblies to help achieve a significant impact on the building's energy use and internal environment.

Challenge: Wisconsin Institutes for Discovery is a 330,000-square-foot interdisciplinary research facility developed to foster research collaboration and public-private partnerships. Actually two biomedical research institutes are housed within the facility – the public Wisconsin Institute for Discovery (WID) and the private Morgridge Institute for Research (MIR). The intent is to create a discovery-to-delivery paradigm where different research activities can collaborate to facilitate the process of moving from basic research and discovery to commercialization to actually having an impact on human health.

The $165 million project was developed through the state of Wisconsin's first integrated delivery program. The building owner (the Wisconsin Alumni Research Foundation and the State of Wisconsin), the project architects and the construction managers all sign one contract and, as a result, there was a single focus from the start to meet the owner's requirements. In this case, the owner wanted to push the envelope – literally – to set a new standard for the high-performance building.

Expectations were for the building to be able to perform for 100 years, require very little maintenance of the façade and operate with 50% less energy than the typical University of Wisconsin-Madison research lab facility. The building enclosure was critical in this effort; it had to be airtight not only to prevent air infiltration but to maintain the controlled environment essential for the work being conducted within the facility. The level of humidity control needed to be comparable to a hospital.

The U.S. Army Corps of Engineers (USACE) currently has the most stringent standard for maximum allowable building envelope air leakage in the industry at 0.25 cfm/sq. ft. at a pressure differential of 0.3 in. wag (75 Pa). Though solid walls are generally considered when striving for a more airtight and thermally efficient building, this state-of-the-art facility exhibits extensive use of both exterior and interior glass with curtain walls and punched window openings. In total, 18 different types of glass were used in this structure, six of which were used as part of the exterior enclosure.

"With some of the top researchers in the world working in the facility, the building

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enclosure had to be airtight," commented Kevin LaPointe of H. J. Martin and Son, Inc., the glazier responsible for ensuring the airtightness of the façade at the window-wall interface. "This facility is like a living organism that will change continually. It was one of the most difficult and rewarding projects that we have done."

Innovation + Integrated, Holistic Approach = New Level of Sustainability

In order to achieve sustainability, the building enclosure must be addressed in a holistic way by considering all aspects of design that can affect energy efficiency, durability and occupant comfort. "There are literally hundreds of decisions during the design process and each of these seemingly small choices about material selection and detailing add together to provide either higher or lower overall performance," states David Lang, senior associate at the Philadelphia architectural-engineering firm Ballinger. "Equally important is the process of construction. A Building Enclosure Commissioning (BECx) process was utilized on this project to verify that our high aspirations for sustainability were followed through to the completion of the project."

Given the very cold winters and humid summers in Madison, good thermal resistance, airtightness and vapor control would be especially critical to the energy efficiency and durability of the project's building enclosure. Though fewer windows and more solid walls are often used in climates such as this to provide a more thermally efficient building, Ballinger was able to add more glass and transparency to the exterior while still achieving an efficient "thermal envelope" by incorporating atria with nested layers of glass walls.

A pressure-equalized terra cotta rain screen assembly was selected for the exterior cladding. Different technologies and innovations were considered where there was a good return on investment and extensive research was put into the design. "Even modest percentage improvements in the window system and glazing performance can have a significant impact on the building's energy use," noted Lang.

Tremco's Proglaze ETA Engineered Transition Assembly provides a tested, durable connection from the air barrier to the window assembly.

To optimize the window systems, argon filled low-e insulated glazing units with warm edge spacers providing good argon retention were incorporated, triple-glazed units at a large north facing glazed area, aluminum and terra cotta sunshades at south facing glazed areas and fritted, triple-silver-coated low-e glass at the skylights. The integrated project delivery process put the focus on quality control and the curtain wall with all parties collaborating on how to put things together. The contractors helped in this process as they gained an appreciation of the materials being used and they began to propose taking it to a new level of detailing to enable the building to meet its goals.

For the rain screen walls, detailing a somewhat larger gap between the wall and the window systems allowed enough space to construct a more durable, fully supported membrane flashing between the air and vapor barrier and the window frames. Preliminary wall details showed a membrane flashing that lapped the air and vapor barrier membrane and attached into the perimeter glazing pocket of the curtain wall system. In many cases, connections such as this are difficult and may lead to air and moisture infiltration.

Wiss Janney Elstner Associates, Inc. (WJE) had been hired as the enclosure consultant to perform peer review on construction documents. Their Chicago office performed the initial review and subsequently a proposal was submitted to do building enclosure commissioning for the owner. WJE suggested the use of Tremco Commercial Sealant & Waterproofing's Proglaze® ETA Engineered Transition Assembly in place of the sheet-applied membrane at these critical transitions. This innovative, turnkey solution would provide a continuous, compatible and durable connection from the window and curtain wall systems to the wall assembly, taking this project to a whole new level of detailing to ensure reaching the owner's long-term sustainability goals.

Understanding how components used at these connections would perform was key. Self-adhered membranes provide an effective air and moisture barrier when fully supported. They were not designed, however, to bridge joints in excess of ¼ to ½ inch and/or accommodate potential thermal and seismic movements within the wall façade. Overlapping membrane thickness can interfere with pressure bars used on curtain wall systems and compatibility would be an issue due to the asphalt adhesive on the membrane and the glazing system used on the curtain wall. Tremco was contacted and asked to provide assurance that the adhesive bond with Proglaze ETA to the air barrier from the window assembly would perform long-term and provide continuity of the building envelope to maintain water and air tightness. This is a connection that nobody else wanted to warrant.

The Proglaze ETA consists of pre-engineered silicone materials used as a transition assembly. The system assembly is comprised of a translucent silicone extrusion with a small dart, which is attached to the pressure bar mullion by inserting the dart into the metal race filled with Spectrem® 1 silicone sealant to ensure a durable connection and

positive seal. The opposite end of the extrusion spans onto and bonds to the air and vapor barrier.

"The air barrier connection to the curtain wall is always a concern," noted Fiona Aldous, associate principal with WJE responsible for the building commissioning. "The curtain wall uses silicone as end dams, metal-to-metal joints and around corners. The substrate is a combination of silicone and aluminum. A product compatible with silicone is needed. The sheet-applied membrane bonds to aluminum with primer but at the silicone boots, bridge seals and end dams, the rubberized asphalt can't achieve a bond to the silicone.

"The Proglaze ETA provides a more durable approach to the fenestration and air barrier. It facilitates the review. The person observing is up close on a swing stage, typically right alongside the trades performing the work." The translucent silicone membrane provides visual inspection to ensure that the installer is properly applying a continuous bead of sealant at the contact and lap joint condition. The ribs on the membrane surface also prevent the installer from squeezing the sealant down to a thin film, allowing the sealant to retain some volume to perform as a sealant rather than an adhesive.

"The Spectrem 1 Silicone Sealant was also used to seal lap joints and provide the perimeter seal to Tremco's ExoAir® 110 Air & Vapor Barrier Membrane. The project was started using Spectrem 1 in black but we switched to white because it was easier to see if there were any voids in it," commented Aldous. "The interior conditions and exterior walls must be coordinated from an architectural and mechanical perspective – a holistic approach to meet the owner's project requirements for a high-performance building."

Energy reduction is dependent on a tight façade that minimizes air infiltration

While the intent was to design the interior to allow changeability and flexibility with the lab pods, there was only one shot to do the enclosure which was of paramount importance to the performance of the building.

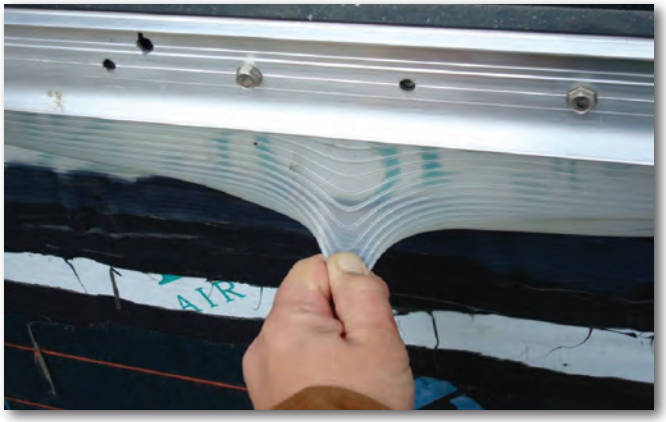
"With an Integrated Project Delivery contract, the architects, the building team (Findorff / Mortenson JV) and the owner all take on shared responsibility," commented John Feller, LEED AP and senior project manager from Findorff. "The directive was for this building to be sustainable. We were not as concerned with LEED points as we were with making it sustainable. Extensive research went into the project. A 20' mockup was built in a Quonset hut with a cmu backup wall and punched window with air barrier and cladding. There was energy modeling, thermal modeling, thermal scans, adhesion testing, compatibility testing of the tie-ins, and third-party inspections. Additional testing included ASTM E1186 Standard Practices for Air Leakage Site Detection in Building Envelopes and Air Barrier Systems and ASTM E

Self-adhered membranes were not a viable solution to bridge joints in excess of ¼" to ½" or accommodate potential thermal or seismic movement.

783 - 02: Standard Test Method for Field Measurement of Air Leakage Through Installed Exterior Windows and Doors.

Kawneer took up to three months to help design and verify the load of the terra cotta panels and worked with the Tremco glazing specialist and design engineers to develop a glazing system with a "fin" on the pressure plate that would provide a shield in the glazing pocket or transition from the curtain wall to the rainscreen system to extend the life of the insulation exposed to driving rain or ultraviolet rays. They did a curtain wall mockup at their Harrisonburg, VA facility for the WID team to make sure all design and construction or sequencing issues were addressed.

"Tolerances were a big issue. We needed to be able to inspect the connection and we wanted a 'stressless connection'. One-quarter inch of stress may be beyond the capability of a sealant depending on the design. With the Proglaze ETA included in the enclosure design, that amount of stress is nothing. It takes the movement



The translucent silicone extrusion incorporated in the Proglaze ETA composition provides a "stressless" connection, eliminating movement as a design concern.

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factor out entirely," noted Feller. "It was also a tested system with documented performance."

Tremco had conducted unprecedented façade testing with this fully integrated system comprised of its ExoAir air barrier systems, Proglaze ETA System 3 (Curtain Wall Pressure Bar system) and Kawneer's window assembly with Tremco's structural glazing system. Independent testing had been conducted for air infiltration, water-resistance and structural performance under seismic and dynamic wind load conditions which may exist under "real world" conditions such as wind loads of 150 psf encountered by a typical 20-story building in Miami, Florida.

Large, complex projects require consolidated scope, coordinated approach

"The nature of large and complex projects generally results in large and complex teams," commented Lang. "We often try to consolidate scope and responsibility with vendors that provide a more coordinated approach to their work as it can help to lead us toward higher quality outcomes."

There will always be problems on projects of this magnitude. With this project, the plane of the wall and the plane of the window were not coplanar. Being recessed from the face of the glazing created the potential for problems. "There are always workable solutions to problems. It is a matter of how you approach solving them that makes the difference," noted Aldous.

The owner wanted to push the envelope and it meant everyone had to up their game. A major focus was on quality control and the curtain wall from the outset. To set the stage, a day-long QC seminar was held for all contractors. The architects presented design concepts and the importance of the building. The owner also participated, talking with the foreman and the trades about the significance of the project which is something they are not exposed to as general practice. The building envelope contractors were brought on board immediately with the mechanical contractors to make sure the project requirements could be met.

"For a high-performance building of this type, everyone had to have a single focus. There was lots of collaboration on how to put it all together. Lessons learned while doing the mockup included quality of work, sequencing and scheduling. WJE provided field checklists and we got everyone's feedback and worked on it together," noted Aldous. "Everyone was a pleasure to work with as they all wanted to make this the best project possible."

Recognizing the elements critical to the success of the project, Tremco's Building Envelope Solutions Team got involved at the outset of the project. This team of building science specialists worked with the window fabricator, the architectural team, the construction management team, the glazier and the air barrier contractor – in various locations across the country – to ensure appropriate product selection for the performance requirements, conducted application and shop drawing reviews, evaluated connection points and compatibilities, assisted with on-site testing protocols/ in-house testing and provided installation assistance to ensure quality of field installation with Tremco's local field sales representative. Providing a single-source approach to the enclosure and critical connection points within it ensured prior performance validation, accountability and minimized the risk associated with this extremely complex and ambitious endeavor.

Testing to determine air leakage recorded levels at 20% below the aggressive goal set for the building – the stringent Corps standard of 0.25cfm/sq. ft. at 75 Pa.

On October 23 and 24, 2010, whole building pressurization testing to determine air leakage was conducted. Leakage tests were performed using both standard variable speed ("blower door") fan assemblies and the building's permanent mechanical systems. Multiple runs of both positive and negative pressure tests were conducted to ensure accurate data. When completed, the building performed beyond the aggressive goals set for the facility. Leakage rates were 20% less than the Corps standard. "We are very thankful to the building's Owners and the entire project team for their strong commitment to quality and innovation during the creation of this truly special building," summarized Lang. "The building has become an important benchmark within our firm and we look forward to applying the many lessons learned on our future projects. From our perspective, the collaborative spirit of the Integrated Project Delivery approach was essential to the extraordinary success of the building's design and construction."

3735 Green Road
Beachwood, OH 44122
216.292.5000 • 800.321.7906

1451 Jacobson Avenue
Ashland, OH 44805
800.321.6357

220 Wicksteed Avenue
Toronto, ON M4H 1G7
416.421.3300 • 800.363.3213

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