
BERGHAMMER
Construction Corporation

# Case Study

Aurora St.Luke's Medical Center
## Knisely & Schroeder Façade Replacement and Renovation

Berghammer Construction
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**Aurora Health Care - St. Luke's Knisely Tower**
**Façade Replacement and Renovation**
Project Location: Milwaukee, Wisconsin
Project Cost:
Exterior: $13,083,957
Interior: $1,955,270
Project Size:
Exterior/Knisely: 104,000SF
Exterior/Schroeder: 7,500SF
Interior: 114,000SF (patient rooms)
Start Date: 04/04/2011
Completion Date: 12/01/2013

**Construction Manager: Berghammer Construction**
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**Owner: Aurora Health Care**

**Berghammer Construction**

**HGA Architects & Engineers**

**GRAEF**
Structural Design

**Ring & Duchateau LLP**
Mechanical Design

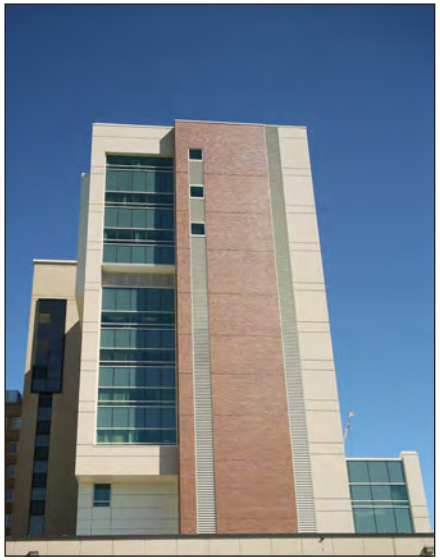
## Project Description

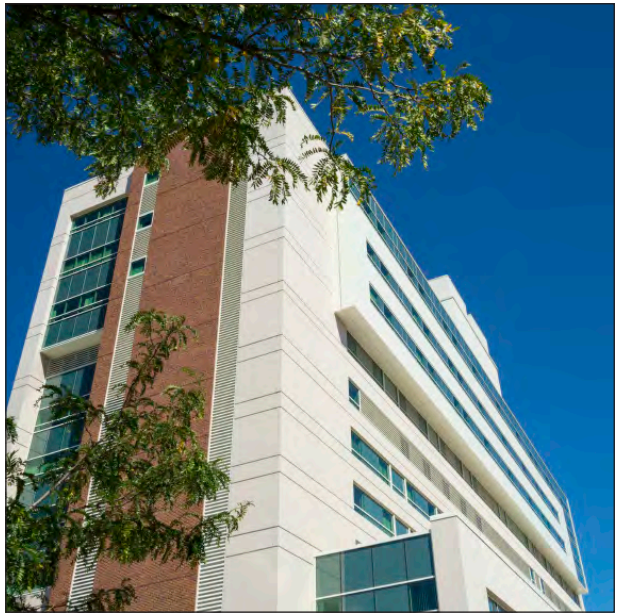
Aurora Health Care recognized significant infiltration and structural issues in the 40-year-old façade enclosing the Knisely Tower Building at the St Luke's Medical Center (SLMC). The Knisely Tower, which houses eleven floors of intensive care patient rooms and supports a Flight for Life helipad, was originally built in 1973 and was expanded vertically in 1990. An adjacent Schroeder Pavilion building, also part of the façade replacement scope, contained surgery suites immediately adjacent to the failing exterior walls. Adding to the project's complexity is its campus location. Surrounded on three sides by lower structures, these adjacent buildings contain major access and life safety exiting points for the thousands of patients, staff, and visitors present on St. Luke's campus every day.

The challenge:

- Remove and replace, not just over-clad, the failing façade panels while SLMC's intensive care and surgical facilities remained in operation
- Demo the failing, existing material and install new panels over the roof areas of adjacent occupied buildings
- Temporarily protect the interior walls and systems while exposed to weather conditions
- Complete the work with the least amount of interruption to hospital services
- Provide the highest performance wall system that could be supported by the existing concrete and steel structure
- Protect existing interior spaces after the existing façade was removed and before the new façade was installed
- Complete the work without risk to patient, visitor, staff or construction personnel

Our mission was to provide an extraordinarily designed and thoroughly tested building enclosure that met the aesthetic goals of Aurora Health Care and the structural and thermal requirements of current building codes, while maintaining high quality execution with the least amount of impact to hospital operations.





Overall St. Luke's Campus Streetscape (Knisely - far left)

## Lasting Impact on Community

### Design Goals

Aside from the immediate goals of removing the safety risks of the failing facade and the opportunity to improve the energy efficiency of the 1970's building skin, there was another clear and specific goal. The design of the building façade must improve the streetscape of the 29th Street Entrance of the Knisely Tower and more importantly, unify the St Luke's Medical Center campus image.

### Sustainability Goals

There are also sustainability aspects of the project. Reuse of the existing structural and infrastructure systems allowed the project to be completed without the time and cost impact of demolition and new construction. The new façade material is expected to improve energy efficiency by 30%. The useful lifespan of the existing building has been extended by another 40 years and the materials selected for the building will require lower expenses for future maintenance.


Innovative phasing and careful site utilization made the project possible.


# Construction Innovations

## Integrated Project Design

Execution of the design and engineering of the project was performed in a modified Integrated Project Delivery Format (IPD). A better description may be Integrated Project "Design."

The design-build team included:

- Berghammer Construction
- HGA Architects
- GraefUSA
- Ring and DuChateau

After the Design Build team was established, the major subcontractors were brought on board. Those major subcontractors included:

- CS&E for metal panels and structural steel
- GFRC for lightweight gypsum reinforced spandrel panel fabrication
- KMI for masonry and spandrel panel erection
- Klein Dickert for aluminum glass and glazing

Major subs were selected for their experience, reputation for quality, individual team members from each sub and competitive price, in that order. This innovative approach allowed each subcontractor to participate in the design process and coordinate the connection requirements of their products, the sequence of their installation, and the details between all adjacent materials. Construction documents produced by HGA included every dimension and connection detail resulting from the integrated design process. The result of this collaborative approach benefitted all parties through the elimination of potential field coordination issues uncovered later that could result in quality, schedule or cost impacts.

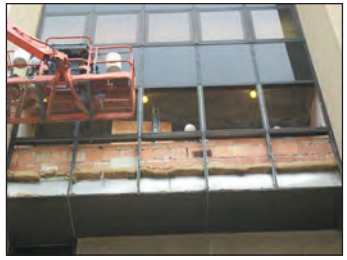

## Peer Review

To ensure that the all aspects of the new façade design would perform as required, a third party expert was engaged to provide a Peer Review of the design documents. Wiss, Janney, Elstner (WJE), a national expert in façade performance and design, was brought on to review the new design details prior to their final development and inclusion in the construction documents.

WJE was also engaged to verify that materials used for temporary weather protection would not allow condensation or water vapor between the new system and the required temporary protection. An interesting result of this study was the determination that if the existing batt insulation was left in place at several locations it would actually reduce the performance of the new system, so it had to be removed. An example, against all intuition, that more of something is not always better.

## 3D High Definition Laser Mapping

The project contained a unique design challenge. Where other projects use dimension references from established control lines or benchmarks to locate the specific building elements, this project required specific building elements to establish control lines and benchmarks. To retain existing finishes, it was critical that the placement and sizing of the new window frames were exactly the same as the existing windows. 3D High Definition Laser Mapping was used to accurately collect the required dimensions locating each window opening on each elevation of the twelve-story building. The process involved setting up lasers in select locations that recorded the target location and elevation of the head and sill of each critical window opening. The data received was then transferred and fabrication drawings and installation plans were completed following these dimensions.



Façade Mockup

## Real World Mock-up

It is not unusual or difficult to test new façade mock-ups for air and water infiltration. It is however, difficult and very expensive to test new façade designs for performance in low exterior temperatures and high or variable interior humidity levels. High humidity levels that typically are required in hospitals often result in window condensation on cold exterior window frames. While computer simulations can estimate thermal performance, simulations do not take into account real world variations in humidity, cloud cover or installation details or errors. To further ensure success a real world mock-up was planned.

Five months before the start of construction, a mock-up of the new design was fabricated and installed on the west elevation of the building. Monitoring was performed during typical Wisconsin winter conditions and temperature, humidity and dew point information was collected. Results confirmed that condensation would not occur on the window system during real world conditions. Fortunately, the mock-up did find two surprise issues regarding last minute design dimension changes. A movement of the window system a few inches to the outside of the building and the resulting addition of a sill flashing created infiltration issues uncovered during the test. Adjustments were made to the mock-up and the system passed when retested.

Before

After

## Extraordinary Efficiency and Style

The transformation and campus image improvement shown in the "before and after" photos at left is nothing less than "extraordinary." What cannot be seen is the effectiveness of the thermal performance of the new system. Calculations anticipate a 30% or more reduction in energy use.

Façade removal and replacement on a very tight, occupied medical site.

## Excellence in Planning, Engineering, Design and Construction Management

Thorough preconstruction planning and design by the entire IPD team was a major factor in the success of this project. Logistics of completing the work were more than just the access and schedule issues of a typical project. Other challenges such as Patient Safety, Infection Control, Disruption Avoidance, Active Hospital Impacts, and Existing Field Conditions were all overcome by a proactive team of Owner, Design-Builder, Architect, Engineer and Subcontractor.

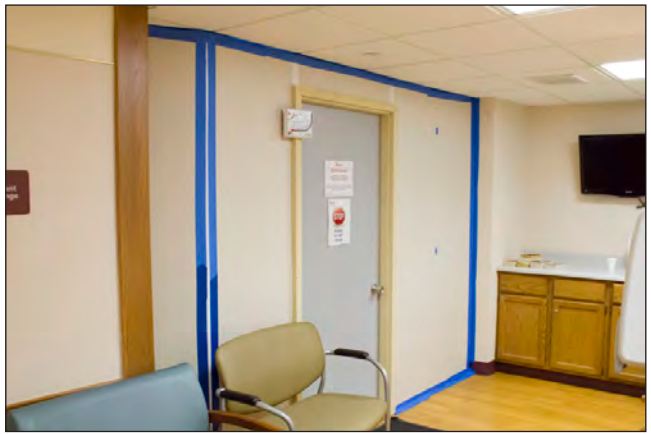
### Logistics

Completing this project would be difficult in any location like the one at the St. Luke's Medical Center. Oklahoma Avenue to the south is a major city thoroughfare but our best access point to the project. The east elevation of the building façade is directly above one of the busiest entrance and exit points for patients, visitors, and staff. The north elevation is only accessible by crane reaching over the building from the south and erecting the north façade "in the blind."

The only elevation with direct access to the façade work is the west elevation—which is the busiest area for hospital deliveries, is directly below the Flight for Life helipad and also near the largest concentration of fresh air intakes on the campus. Construction equipment planning and placement must always consider the location of air intake louvers to avoid drawing equipment exhaust fumes into the building.

Construction storage and parking was planned for an empty lot two blocks away. Early planning required material to be stockpiled at the remote site and delivered to the tight site only when needed. This plan allowed the scheduled construction process to continue uninterrupted by material shortages or delivery delays.


Barriers and negative air pressure to contain dust from entering occupied patient spaces.



## Disruption Avoidance Program

Perhaps even more dramatic than the challenges listed earlier was the vital requirement that hospital operations needed to continue on every floor during the entire façade replacement schedule. Patients adjacent to the work area are expecting to recover in peaceful, comfortable surroundings. They are not expecting to be surprised or frightened by noise, vibrations or odors. Our Disruption Avoidance Program forecasted to hospital staff when and where heavy construction operations were anticipated. The Disruption Avoidance Program detailed the daily activities planned, the type of work involved and the level of noise to be anticipated. Work operations could be shut down at any time as a result of a patient or physician complaint.

## Life Safety and Infection Control

Patient rooms and surgery areas require the highest levels of Life Safety and Infection Control Measures. Accordingly, all construction life safety and infection control programs must be approved in advance by the Hospital. Life Safety programs require that fire protection systems remain in service, fire and smoke barriers remain intact and emergency exiting requirements not be compromised.

Key components of the Infection Control plan require specific activities to control the spread of dust and odors. Generally this concern is addressed by temporary adjustment of the HVAC system and the addition of portable HEPA filters. By placing the work area in a negative air pressure condition, the resulting positive pressure surrounding the negative pressure area acts to contain all dust or odor in the work space. Removing the façade of the building made this requirement especially difficult. Anticipated exposure of interior walls to variable wind pressure required additional planning, engineering and monitoring of negative pressures within the work space.

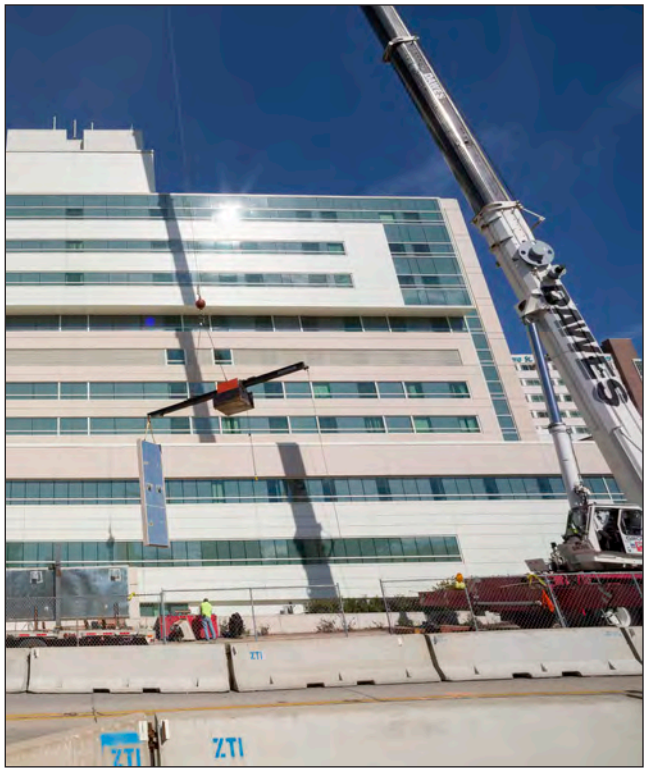
## Active Hospital Impacts

Construction operations are always considered secondary to the continued operation of the Hospital and the comfort of the patient. As a result, any construction operation could be shut down if that activity creates an interruption. In addition to his responsibility overseeing the renovation work inside the hospital, a Berghammer Superintendent was assigned the responsibility of acting as the contact point for all department and nursing managers. Any complaint was immediately investigated and resolved, with resolution typically involving rescheduling the work activity or, if necessary, a change in work method.

A unique example of active hospital impacts was the planned response to Flight for Life approaches to the helipad. After Flight for Life helicopters radioed in their intent to access the helipad above the Knisely Tower, a call was placed by Hospital Security to the Berghammer On-Site Superintendent. In compliance with the planned response to this event, all construction operations ceased, materials in progress of installation were secured, and all mast climbers and crane booms were lowered to the ground. Construction operations would not resume until Flight for Life helicopters had cleared the pad.

## Field Conditions

Since the building was fully occupied during the Preconstruction phase, it was impossible to verify the exact location and condition of every slab edge where new connections where required to be installed. It was also impossible to verify that the work had been installed according to the as-built drawings provided from 1973. Once the existing slab edge was uncovered during demolition, it was immediately surveyed and discrepancies were communicated to the architect and structural engineer. Alternate methods of connecting the new façade to the structure were quickly developed and issued and work in the field could continue on schedule.




Use of the "Flying Jib" allowed panels to be installed beneath upper floor projections. This panel is on its way to being installed "in the blind" on the opposite side of the building.

## Construction Management

Scheduling was a critical aspect of this project. The Berghammer Superintendent performed an outstanding job of coordinating and planning the work. Each day's operation was planned months in advance so that material and manpower were available as needed. Changes in the schedule due to weather or Flight for Life operations were tracked and communicated. Schedule recovery plans were then developed and implemented.

Quality Control programs were implemented at several levels. Initial inspections were performed by Berghammer QC personnel using a newly developed tablet based QC program. This QC program could record and then immediately email punch list items to any and all required subcontractors. It could also record and distribute photos of any item as necessary. After items identified by Berghammer QC were corrected, a Final quality inspection was performed by WJE. Results of their inspection were distributed and final corrections, if required, were made and documented.

## Design

The design of the new Knisely Tower Façade by HGA Architects is no less than outstanding. During the six month design period, the HGA Architects and Graef USA Engineers were able to convert their vision to reality. At the very beginning of the programming stage, project goals were established as:

- Energy efficiency
- Enhanced campus image and Aurora "branding"
- Long-term lifespan of selected material
- Low maintenance
- Speed of construction
- Use of sustainable materials

Now at the conclusion of the project we can confidently say the goals of the project were met.  And as these notes are finally assembled it is minus 17 degrees outside. Our new façade is performing as expected!