Removal of original acoustical tile ceiling.

Second Chances: A New Ceiling for Queen of All Saints

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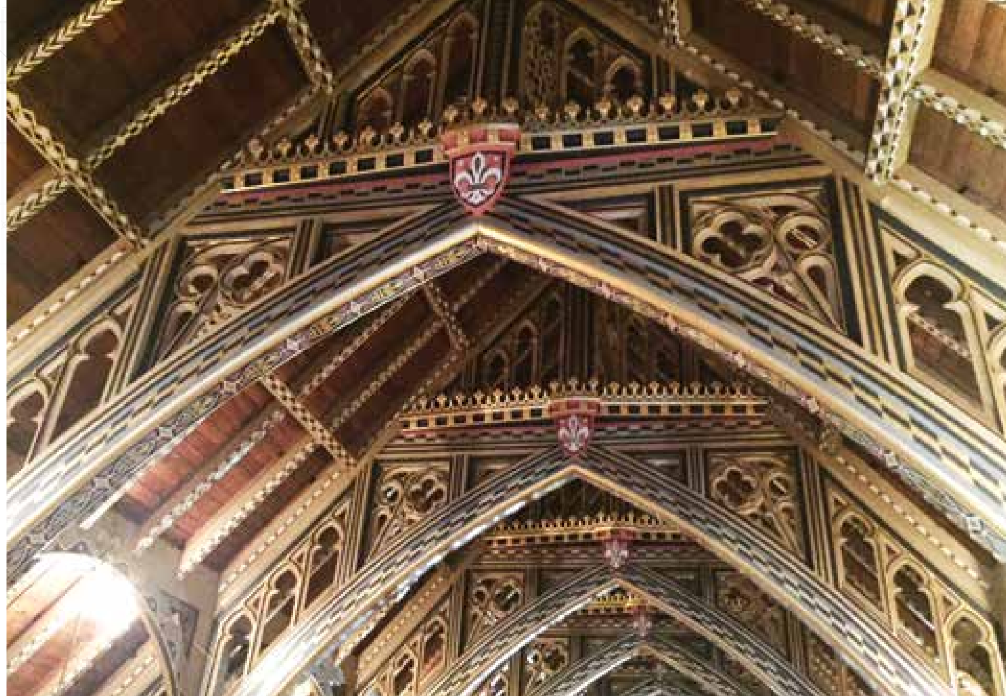
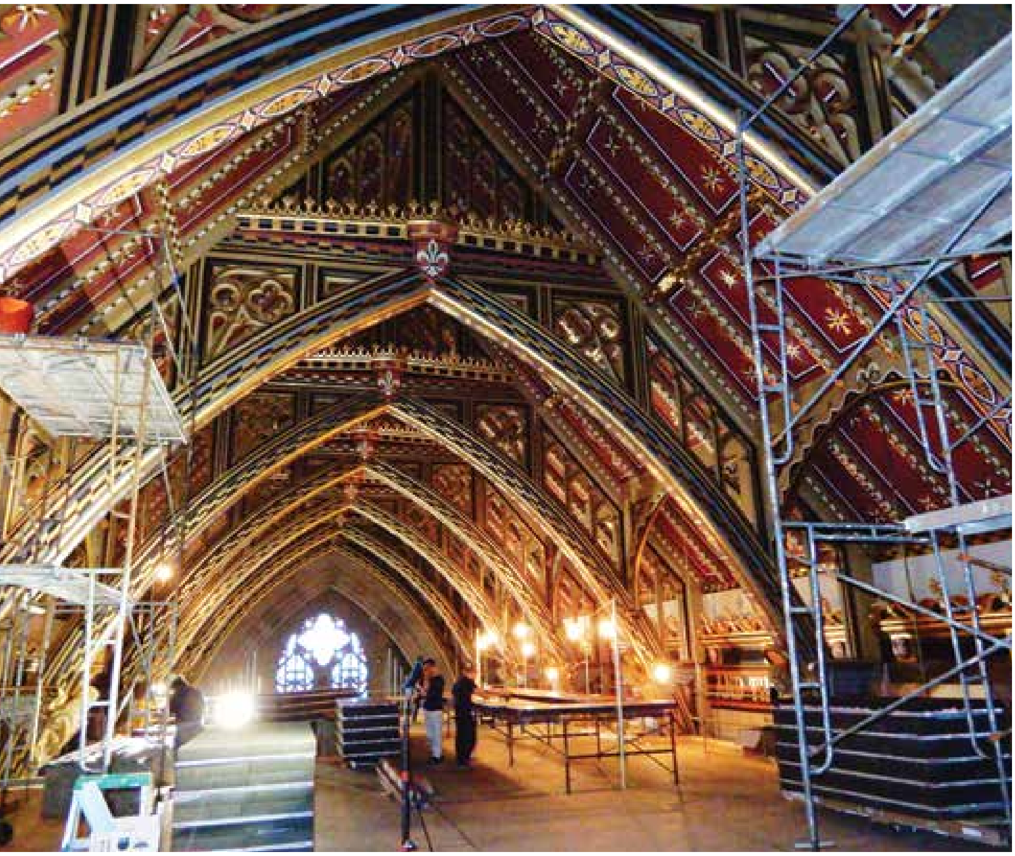
On occasion, even systems within buildings of the recent past require a second chance at serviceability. Constructed in the 1950s, the Queen of All Saints Basilica – a significant structure for the Archdiocese of Chicago – and built at a scale and level of ornamentation of some of the more spectacular churches within the United States, provides an illustration. Common of structures in this era, its construction included a combination of structural systems with timber-trussed roofs carried by load-bearing masonry and interior steel columns, all supported on cast-in-place concrete foundations. The basilica follows the traditional gothic style with a cathedral ceiling comprised of steeply pitched slate roofs (14:12) over the altar, nave, and choir loft. It became apparent that ceiling-material substitutions in the original construction (12-inch-square acoustical tile for plaster) tested serviceability limits, and displaced ceiling tiles motivated the parish to seek remediation approaches.


Exposed wood decking and decoratively painted wood framing.

The steep-pitched acoustical tile of the cathedral ceiling (approximately 45 feet above the floor at the eave and 70 feet above the floor at the ridge) was supported by a concealed spline system secured to rafters and purlins that spanned between the timber trusses. The framing created a coffered panel layout of the ceiling within the rafters and purlins. The tile ceiling, rafters, purlins, and trusses were each hand-painted and gilded in situ. Above, a wood plank roof deck spans parallel to the ridge and bears on the rafters and trusses. The deck was topped with heavy felt (43 pound) underlayment and slate. The assembly was insulated with foil-faced mineral wool insulation above the ceiling tiles, with a small air space (1-1/4 inch +/-) between the insulation and the wood deck, ventilated with top-surface-mounted vents at the upper and lower portions of the roof slope at the center of the truss bays.

Recurring issues of ceiling tiles sliding down the concealed spline support were problematic. Apparent contributing factors included differential movements of the timber roof framing and tiles that exceeded tolerances of the concealed spline support. Despite maintenance efforts, including supplemental nails and sealant, reliable support of the tiles remained difficult. When it became apparent that tiles were at risk of falling from the ceiling, the parish proactively retained WJE to work with Daprato Rigali Studios (DRS) to develop an appropriate long-term repair strategy.

Repair approaches sought by the parish necessitated ceiling tile replacement that would provide a



Painting of prefabricated panels on the scaffold near the ceiling.

Panel installation in progress.

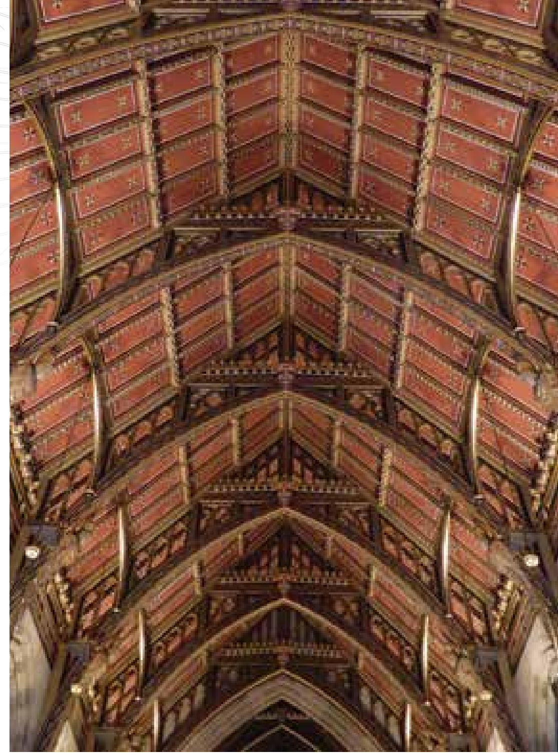
more dimensionally stable system while maintaining the aesthetics of the existing ceiling system. Consequently, a new properly engineered assembly was required, which could be painted and gilded to replicate the original ceiling. Our evaluation included detailed visual and structural examinations of the existing ceiling system, with careful evaluation of the thermal and hygrothermal behaviors of the existing and proposed assemblies. DRS provided important input regarding constructability issues associated with new assemblies, working out color systems, as well as creating stencils for painting and gilding. Kirkegaard Acoustic Design LLC also provided insight and suggestions related to the ceiling modifications in order to maintain acceptable acoustical properties for the space.

Our investigation revealed that the existing ceiling assembly lacked a continuous air barrier. Though the wood deck was in serviceable condition, it was apparent that the assembly was vulnerable to condensation, ice damming, and consequential moisture problems – as evidenced by moisture staining at the ceiling. The poorly sealed foil-faced insulation allowed conditioned interior air to come into contact with the underside of the roof deck. In winter months, the interior air could reach cold surfaces at the metal roof vents and the tongue and groove roof deck which were below the dew point temperature. The surface mounted vents, spaced roughly 18 feet apart, created air flow paths that were disrupted by the rafters. Though some gaps were included in the assembly to facilitate lateral air movement, the installed layout lacked an effective path for ventilation. Consequently, the temperature of the wood deck varied considerably, contributing to ice damming problems. Additional concerns were also voiced by the parish regarding the susceptibility of these vents to wind-driven rain.

Several repair options were considered to maintain aesthetics, address ceiling support deficiencies, and enhance thermal and hygrothermal performance characteristics of the insulated assembly. Initial thoughts leaned toward salvaging the tiles, but the extent of problems necessitated a more full-scale ceiling replacement. Prefabricated metal-clad foam panels were considered but quickly dismissed as they did not satisfy code-prescribed non-combustibility requirements. The use of spray-polyurethane foams enclosed within a new decorative panel showed promise to address non-combustible assembly issues; however, sealing work areas to control spray-foam odors and debris while maintaining church operations made this system impractical. The alternate panel addition also introduced acoustical challenges.

The replacement ceiling system which was ultimately selected introduced a non-vented compact roof assembly. The surface-mounted vents were sealed with custom fabricated copper closures secured in place and packed with mineral wool insulation. The replacement ceiling panels were comprised of a new system of aluminum honeycomb panels fully adhered to rigid Foamglas insulation. The fully bonded insulation, a cellular glass product very impervious to moisture and noncombustible, controlled potential vibration of the aluminum panels, and the surface (less absorptive than the original acoustical tile) proved to enhance acoustics within the basilica. Supplemental mineral wool insulation was provided to cushion the top of the adhered panel assemblies to the underside of the roof deck to increase R-value and reduce air voids in the system. Panel perimeters were air sealed with a fire-rated foam and the panels were ultimately held in place with continuous gaskets supported by painted wood trim. The dimensionally stable panel system also allowed for a uniform appearance and finish. DRS created a studio atop a scaffold located approximately 42 feet above the church floor amid the gilded roof structure, which allowed them to paint and apply gilding to custom-fabricated panels on site and replicate the design and patterns of the original ceiling.

As part of the assessment of the new compact roof, WJE used THERM to create two-dimensional computer simulations of the original and replacement assemblies to identify temperature gradients and condensation potential. The simulations demonstrated that the replacement ceiling system provided significant improvements with respect to thermal resistance and condensation resistance over the original ceiling assembly. Completion of the ceiling enabled disassembly of the scaffolding and tuning of the organ, allowing the full grandeur of the space to be realized once more.



Completed installation of ceiling and scaffold removal.

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