Second Chances: Maintaining Architectural Aesthetics With Timber Repairs

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In prior articles, we discussed how preservation of timber structures requires an understanding of involved materials to develop successful repair strategies that extend their serviceable life. When structural deficiencies affect the architecture aesthetic, additional challenges arise. In *Licensed Architect*, Spring 2015 issue (Vol 19 No.1), the need for a methodical assessment of timber components' relationship to the entire building was discussed. Similarly, by accurately assessing deficiencies within the components, the preservation engineer may avoid more intrusive repairs so that elements are not sacrificed when only portions are found to be deficient. This article reviews repair approaches of timber assemblies to historic fabric and the original aesthetic. Two projects are presented to illustrate this. The first includes a decorative roof truss and the second addresses a bell tower.

Investigation of Existing Timber Structures

Evaluating existing wood structures may be done with destructive and non-destructive approaches. It is the responsibility of the architect or engineer overseeing the work to ensure that the approach selected will provide the necessary information required to assess the structure. The Second Chances article, "Evaluating Timber Structures," in *Licensed Architect*, volume 18, No. 1 (Spring 2014), should be referenced for discussion regarding wood material assessment. These methods can include nondestructive and, more intrusive approaches. "Non-destructive" examination, defined here, is the evaluation of a member in a manner to allow it to remain in service. Non-destructive techniques (such as sounding, probing, drilling, sampling, etc.) requires minor damage and must be performed with care. It is imperative that the assessment identify material properties, extent of distress, and structural requirements.

Project 1: King Post Truss Reinforcing in River Forest, Illinois

The First Presbyterian Church is a large 1920s masonry complex in River Forest, Illinois. The church includes seven decoratively painted trusses that span 45 feet across the nave. Ornamental wood brackets are located at truss bearings at the exterior walls. This project was in response to a failed support that dropped several inches at a decorative wall bracket. Roof purlins near the failed support were also pulled apart.

Initial inspections revealed advanced wood decay at the truss bearing. The remaining roof trusses were subsequently examined. Original drawings provided information regarding the truss assembly, and our investigation permitted more accurate documentation of the members, utilizing drills, probes, and moisture meters. Material analysis identified the wood as Douglas fir (Pseudotsuga menziesii) with dense property characteristics. Recorded knot sizes, grain slopes, and characteristics revealed that the wood was consistent with select structural and No. 1 grade material. The assessment also validated that the wall brackets at supports, and isolated truss webs, were decorative and not part of the structure.

The truss included solid sawn timbers with 12 inch by 14 inch bottom chords, 12 inch by 16 inch top chords, and 8 inch by 8 inch, and 8 inch by 12 inch webs. A 1-1/4 inch diameter steel rod was located within the king post. Bottom to top chord connections consisted of a bent steel plate and through-bolts. The bottom chord splice and purlin connections were made with steel plates and hangers, respectively. The parapet and cricket above the failed support was in disrepair and the primary moisture source for the decay. Inspection openings revealed advance decay at other trusses existed, with indications of imminent failure apparent. Consequently, emergency shoring was provided. A structural analysis revealed that the original truss construction was within acceptable stresses, and connection capacities governed the design.

Two repair options were reviewed. Option 1 was to replace the decayed bottom chord (from support to splice at mid-span). Option 2 was to locally

repair the decay. Readily available replacement materials were limited to engineered lumber (glulam, parallel strand lumber, or similar). Solid-sawn members required a long lead time, and obtaining seasoned timbers to avoid member twisting and warping was problematic. Engineered lumber, though dimensionally stable, was unacceptable aesthetically and from a preservation perspective. Though replacement provided simpler detailing, the original finish would be sacrificed.

Consequently, option 2 was explored further. The decay, which was limited to the truss ends, could be removed without losing the decorative painting. Low member stresses within the truss accommodated concealed connections splices to the replaced portion, a preservative treated glulam member modified to accept the original bent-plate connection to the top chord. Minor top chord decay was treated with preservative and epoxy. The repair was clad with Douglas Fir stained to match the original finish.

Project 2: Bell Tower Restoration in Chicago, Illinois

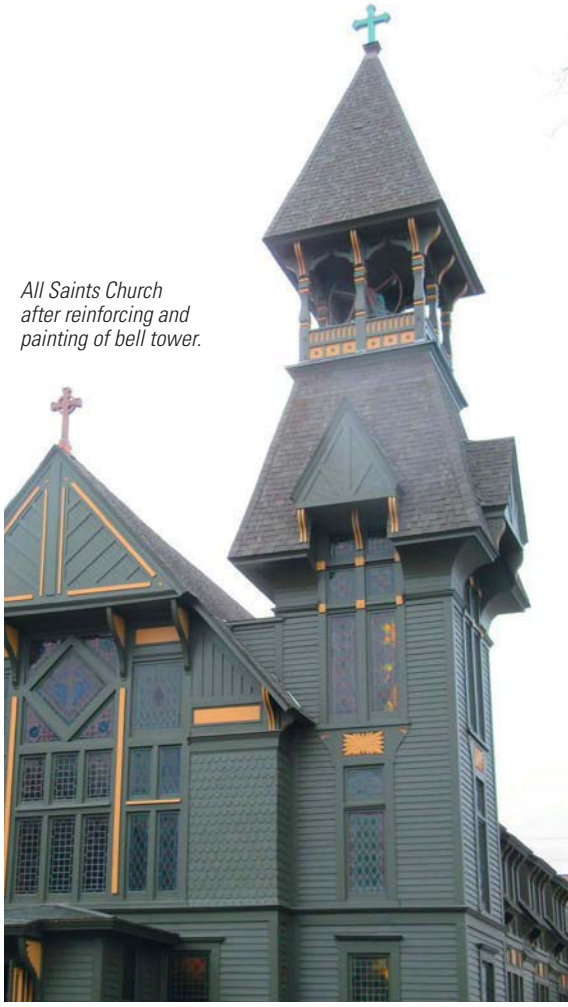
All Saints Episcopal Church in Chicago, Illinois, built in 1884, designed by Architect John Cochrane, (designer of the Illinois State Capitol in Springfield). Cochrane's design for the landmark church, in the Stick Style, was actually constructed in a rural area later annexed to the city, and is one of the oldest wood framed Chicago churches, as wood-framed churches was not permitted after the 1871 Chicago Fire.

The All Saints bell tower had been altered through the life of the structure, however, the original framing remained. As part of a restoration being performed, including foundation and wall reinforcing, a detailed investigation of the bell tower was implemented. A visual assessment, non-destructive examination, material analysis was performed.

The investigation determined the tower base was generally intact. Past remediation efforts, including selective member replacement and cladding repairs, had effectively protected the underlying structure. The belfry framing included eight decoratively carved 8 inch by 8 inch timber posts, extending from the structure below, to the belfry roof. The posts, were over-clad during a prior repair, were in poor condition. The wood was identified as Red Pine (*Pinus resinosa*) with severe decayed. Insect damage was also noted, most likely by roundheaded beetles (commonly known as old house borers). The post over-cladding restricted ventilation contributing to the distress. Although, a small portion of restoration, these findings were devastating to the project, and raised questions whether the belfry could be restored within the construction budget.

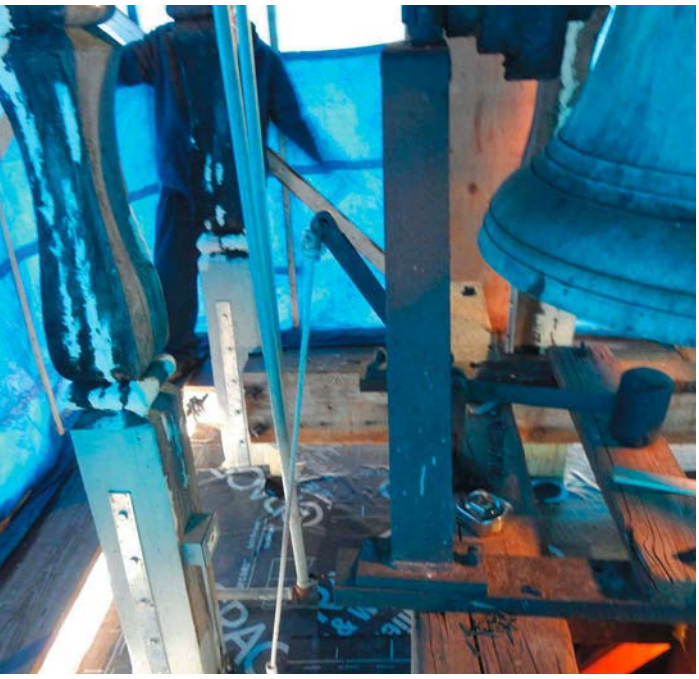
To evaluate repair options, the timber framing was analyzed to measure stresses through the timber assembly. The geometry of non-structural elements, such as the perimeter wall at the belfry was examined for possible modifications. The decayed post bases diminished the stiffness of the belfry to resist wind loads, and lacked adequate strength to resist bending and overturning forces when subjected to anticipated loads. To account for these issues, three primary reinforcing tactics were introduced.

First, epoxies were used to consolidate decayed wood elements. Epoxy, which modifies the hygroscopic behaviour of the wood material (its tendency to shrink and swell with changes in humidity), need to be performed systematically to prevent differential movement with wood elements exposed to environmental changes. To achieve this, epoxy treatment was applied along members to create more monolithic elements with uniform treatment. The second tactic was to ensure proper anchorage of the belfry was provided to the tower base.



All Saints Church after reinforcing and painting of bell tower.

This was performed with steel straps properly anchored the epoxy-modified belfry structure that continued down to intact tower framing. The third reinforcing tactic incorporated a rigid "belt frame" element within the reconstruction of the belfry railing walls. This was achieved with the introduction of heavier railing frame elements clad with plywood sheathing. The railing assembly was through-bolted at each of the belfry posts to provide continuity of the frame around the belfry. The belt frame significantly reduced the effective length, and flexibility, of the decorative belfry posts, and provided adequate stiffness for the final assembly. New timber railing elements were constructed with treated timber satisfying AWPA use category 3B or better to resist exterior conditions. At salvaged timbers, field applied preservative treatments were used to help control future decay and insect damage, and enhance the long term serviceable life of these



Epoxy repair and steel reinforcing work in progress at base of belfry at bell tower.

Rebuilt railing (belt-frame) at base of belfry at bell tower.

Reconstructed truss end with new preservative treated glulam in position.

Partial view of church sanctuary with temporary shoring in place at failed truss. Closer view of truss end reconstruction in progress with new preservative treated glulam.

components. New flatlock lead-coated copper roof and flashing was also installed at the belfry floor. Finally, the tower and belfry railing walls were painted to mimic the aesthetic and color scheme of the historic bell tower.

Summary

When endeavoring to retain the aesthetic character of timber structures, a methodical approach must be utilized that considers the wood material, geometry, and its relationship to the building, during assessment and repair. Identifying the limits of defects or deteriorated conditions is critical when assessing and repairs and ensure deficiencies are properly addressed. Thinking beyond the damaged element, as demonstrated with the use of the belfry railing, is also important, as available redundancies within structures may be taken advantage of to address inadequacies of a single element. As with any assessment, these wood structures must be evaluated on a case by case basis by a professional familiar with timber construction, and who can develop repair strategies to give the historic fabric the best opportunity for continued service.

Credits: *First Presbyterian Church of River Forest building committee. Work at All Saints Church was performed in collaboration with BauerLatoza Studio, and with Larry Dieckmann AIA, Stephen Christy, Rev. Bonnie Perry of the All Saints Building Committee.*

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