

Development of an *in situ* repair strategy for the timber roof of the Breeding Barn at Shelburne Farms

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EXTENDED ABSTRACT

Shelburne Farms is a 566-hectare National Historic Landmark District located on the eastern edge of Lake Champlain in Vermont, U.S.A. Significant for its landscape, designed by Frederick Law Olmsted, Sr., and buildings, designed by New York architect Robert Henderson Robertson, the farm is dominated by four monumental Victorian buildings. The Breeding Barn (1891), the center of Dr. Webb's horse-breeding efforts, consists of a main block 32.6 m wide by 127.4 m long, with a two-story annex. The riding ring at the center of the building is framed with composite trusses based on a design by Camille Polonceau. The trusses consist of timber top chords with iron struts and bottom chords.

After decades of neglect, the barn has become the focal point of a multi-phase stabilization and repair effort. The structural repair of the barn, which took place in 2009-10, posed several interesting challenges. Plane frame structural analysis of the principal truss indicated overstresses in several of the iron bottom chords, though augmentation seemed unacceptable with respect to impacts on historical integrity and significance. Decay of valley members in each of the large dormer pairs that dominate the roof required extensive repair work. Because of difficulties associated with the removal of such long timbers, it was necessary to make repairs *in situ* and without removing the roof covering.

As part of the repair process, the project team conducted an investigation that included accurate and detailed examination of surviving fabric to discover the nature and condition of materials and connections, using laser scanning, resistance drilling, load testing, and metallographic analysis. The investigation led to the development of repair strategies for roof frame elements that included scarfing of new timber where there was adequate support for the joints, and inserting engineered lumber to fill long voids left by the removal of decayed material. A modest testing program allowed the project team to assess the effectiveness of various repair strategies for *in situ* implementation of them.

This paper presents information on the history of the Shelburne site and the Breeding Barn with particular focus on the assessment, testing, and repair decisions for the roof of the Breeding Barn. Discussion of the assessment includes a comparison of field measurements of deterioration obtained by resistance drilling during the assessment phase with the extent of actual deterioration found during the repair work. A testing program was designed to compare capacities of repaired timbers to solid control timbers to allow for evaluating

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