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The new White Tower staircase, Tower of London

The White Tower, built by William the Conqueror and dating from around 1077, is one of Europe's most important monuments of the period. It has been known as the White Tower since about 1240 when King Henry III ordered the 'Great Tower' to be lime-washed. Its south entrance is raised about 6.4m above ground level and was probably originally accessed by a wooden staircase parallel to the wall as it is today. A stone building including a staircase was built in the early twelfth century but demolished in 1674.

Having been unused for 300 years, the south door was returned to service with the building of the previous wooden staircase in 1973. After 40 years of constant use, its condition had seriously deteriorated and six years ago it was identified as a maintenance priority and temporary scaffolding was installed to make the structure secure until new stairs could be commissioned and built. More recently, to enable continuing public access during the removal and installation process, temporary public access was installed on the west elevation.

The design brief from Historic Royal Palaces (HRP) required the new stairs to be built on the same footprint, reusing the old footings and to be as historically authentic a design as possible, to reflect the Norman architecture of the tower itself. Surviving

examples of Romanesque carpentry are lap-jointed, for example the roof of St Mary's Kempley, Gloucestershire, and the bell tower of St Mary's Pembridge, Herefordshire, (early C.12th and C.13th respectively). Although mortice and tenon joints do not feature in these examples, the massive posts of the evolving design could not be securely jointed without them and still produce a structure capable of withstanding the rigors of the Tower's two million visitors a year. Therefore, a compromise design of prominently lap-jointed and halved cross-bracing was adopted to create the visual impression of Romanesque carpentry.

A degree of modular construction was incorporated into the design in anticipation of the heavy pedestrian traffic entering the White Tower daily. This will allow the staircase to be repaired in sections as the need arises. For example, the stair treads can be easily removed and replaced.

The oak for the project was selected from Mapledurham and Hardwick Estates, Oxfordshire, only a short distance from the yard where it was hewn and framed. About 50 trees were selected and felled in early spring 2014. While the timber needed to satisfy the engineer's criteria, perfection in the timber was avoided to better reflect carpentry typical of the Romanesque period.

The workhorse of the project was a Forester Mk VI sawmill which enabled the timbers to be taper-sawn as well as saving much effort in the hewing. Even so the hewing work required the efforts of a six-man team to complete to schedule.





Left to Right: Fred Clift (IJP), Jeremy Poll (Radley House Architects), Graham Goddard (Miles & Co.).

By summer 2014 the timber was prepared and cutting could begin. The first frame to be fabricated was the largest main elevation measuring some 60 feet long. This was cut at Owlsworth IJP's workshops by Dan Winch, and Miles & Co's Graham Goddard and team.

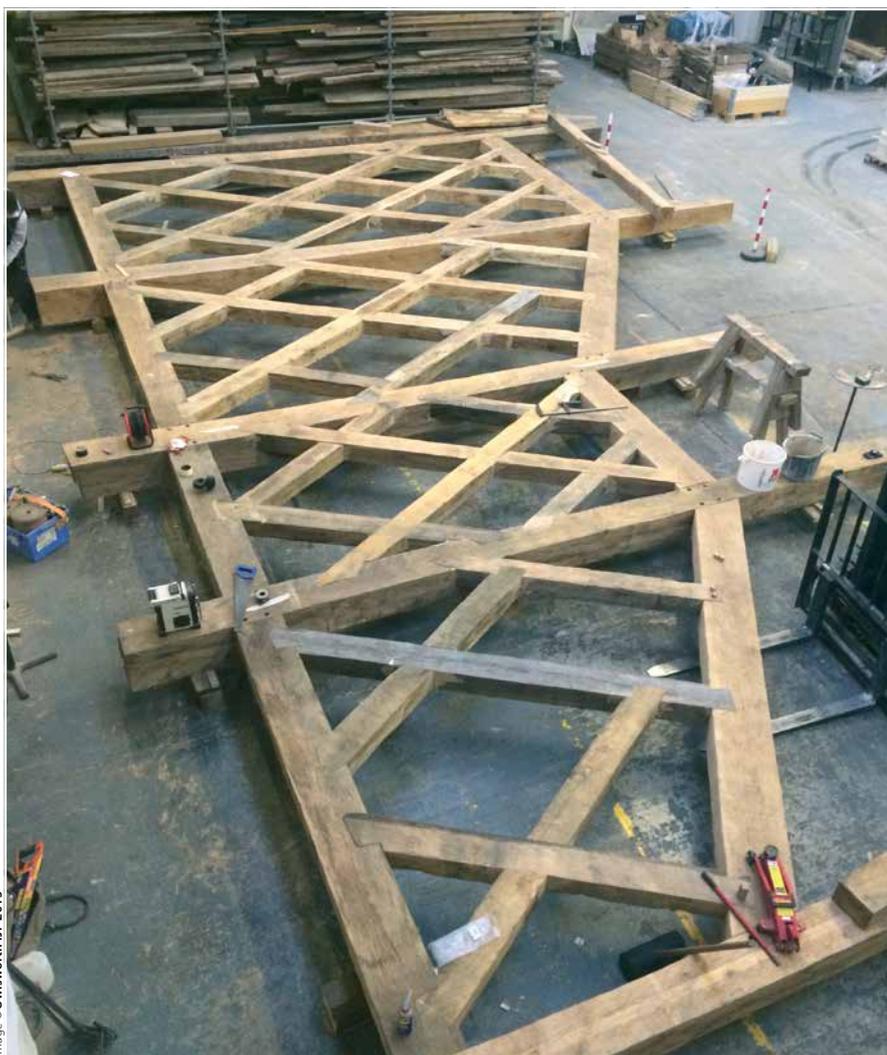


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To have cut the timbers conventionally by machine would clearly not have looked very Norman, so to further ensure an authenticity of design, all the timbers were box-heated, cut from suitably sized trees and all the visible surfaces were hand hewn. The work of hewing was greatly assisted by Miles & Co's Forestor Mk VI band mill which is also well adapted to sawing the required tapers in the posts. To lessen the work of hewing the in some cases very large trees, the sapwood was slabbed from the butts with the saw, to leave an over-sized but square section timber. This eliminated the usual notching and joggling stage from the hewing, leaving a half inch or so to be chipped and broad-axed. Even this was a challenge to hew as the total twenty-five tons or so of timber, represented a quite substantial total surface area.

A hewing team was assembled on the advice of expert Henry Russell and then further expanded with the arrival of Michael Burrey and team from Massachusetts, USA. His assistant Rick even brought over a late seventeenth century axe which might have been taken to America by pioneers from England.

The planking for the balustrade would most likely to have been riven in the Norman period, as pit sawing was not generally practiced but would have been impractical in our case. We therefore compromised by using boards quarter sawn from standing dead trees which were already partially dry, reducing shrinkage problems. Our band mill also has the 'advantage', of cutting at an angle rather less than perpendicular to the timber's edge, producing a surface which looks a fair substitute for a pit-saw cut.

Once the previous staircase was removed early in 2014, the post-holes created during the 1970's installation could be investigated. These had to be reused with minimal disturbance to the fabric of the building and its archaeology. However, given the greater size and dimensions of the new staircase, the post-holes in the battered plinth of the White Tower were investigated to see if they could be enlarged.

This work was done under close archaeological supervision as there was a risk of disturbance to the Norman stonework surrounding the post-holes. The investigations



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The angled batter in this section was discovered to be of the original 11th century fabric. Consequently postholes from the previous staircase could not be enlarged as planned. A design change incorporating metal shoes overcame this obstacle.

confirmed this stonework as a part of the original 11th century fabric. In the light of this discovery and once everything was carefully recorded, it was decided not to enlarge the post-holes and an



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The lower landing showing the quarter sawn oak boards of the balustrade.

alternative was designed. This was a challenge for the architect and structural engineer at a point in the project when the staircase was already in production. After much head-scratching, a solution was devised which safe-guarded the historic fabric, whilst making sure that the staircase was structurally sound. The solution involved shaping the bottoms of each post to

A crane's eye view after most of the principal raising had been completed.



The seven-year long White Tower Stairs Project involved a delicate interplay of vision, archaeology, design, craft and engineering and would not have been possible without participation of the following principal players:

Historic Royal Palaces:

Tracey Simmons MRICS, Project Manager and Conservation Building Surveyor

Jane Spooner, Curator for the White Tower

Alden Gregory, Acting Curator

Fiona Keith-Lucas, Assistant Curator;

Archaeology and Historic Buildings

Tony King, Buildings Maintenance and Facilities Manager

Jeremy Poll, Architect, Radley House Partnership

David Pattison, Assistant Architect, Radley House Partnership

Clive Dawson, Engineer, Hockley & Dawson

Rebecca Thatcher, Quantity Surveyor, Baker Mallet

Glanvilles Survey Drawings,

Chris Edge, Director

Miles and Company:

Daniel Miles, Specialist Consultant

Graham Goddard, Head Carpenter and Sawyer

Nigel Betts, Carpenter

Michael Trussell, Carpenter

Simon Graves, Carpenter

Alyn Gallimore, Assistant

Owlsworth IJP:

Robin Dukes, Managing Director

Rob Gandy, Director

Daniel Winch, Site Manager

Fred Clift, Head Carpenter

Krzysztof Morzy, Carpenter

Jack Hogston, Assistant Carpenter

Mic Poynter, Mason

Tim Morgan, Blacksmith

Pahal Man Gurung, Blacksmith

Adrian Ivory, Driver

Consultants:

John Clements, E V Bullen Electrical

Contractors:

Steve Mackrory, Tree Felling and

Extraction, Mackrory and Sons

Jim Savage, Unique Scaffolding

Hewing Team:

Michael Burrey, Team leader

Rick McKee

Justin Keegan

Chris O'Reilly

Andy Hyde

Anthony Sawyer

Henry Russell, Hewing Demonstrations



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Engineering considerations required metal fixings for the halving joints. False wooden peg ends were made to fit over the fixings so as not to distract from the hewn finish.

fit the existing holes together with stainless steel armatures inserted inside the post feet. These sat on an adjustable shoe, resin-set into the existing pockethole. This took a considerable amount of time to execute and even involved the fabrication of full size polystyrene mock-ups of each post foot.

The framing began in autumn 2014 in the workshops of both Miles & Co and Owlsworth IJP, each tackling separate sections of the frame. By April 2015 work was begun on site. Interest was provided for the carpenters and

public alike, as the work was carried out without installing a hording but relying on the existing railings to fence the worksite. The carpenters gave regular talks and demonstrations during the installation to inform the public of the work in progress. This included a hewing demonstration by Henry Russell. The staircase was open to the public on the 21st August 2015.

With thanks to Dan Miles for his assistance in preparing this article and Owlsworth IJP for providing extra images of the build.



Image © Dan Miles 2015

Left to right: Graham Goddard, Miles & Co.; Site Manager Dan Winch and Fred Clift Owlsworth IJP.

