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Tracing the past: A digital analysis of Wells cathedral choir aisle vaults

Nicholas Webb[a,b,*], Alexandrina Buchanan[a,b]

[a] School of Architecture, University of Liverpool, United Kingdom
[b] Department of History, University of Liverpool, United Kingdom

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ABSTRACT

Architectural historians have identified Wells cathedral as a key monument in the transition between high and late Gothic, a move in part characterised by the rejection of simple quadripartite or tierceron rib vaults for more complex vaults. Here we will show how digital methods are used to reopen questions of design and construction first posed in 1841 by pioneer architectural historian Robert Willis. Digital laser scanning documents vaults accurately, thereby establishing their geometries to a high degree of certainty and, at Wells, highlighting differences between the choir aisle bays which have previously been treated as a single design. Significantly, we will show how digital techniques can be used to investigate these differences further, using point cloud data as a starting point for analysis rather than an end point. Thus we will demonstrate how modern technologies have the potential to reignite historic debates and transform scholarly enquiries.

1. Introduction

This article discusses how 3D digital documentation and analysis techniques are used to investigate the design and construction of the medieval choir aisle vaults at Wells cathedral in the south-west of England (Fig. 1). In his 1841 lecture 'On the construction of the vaults of the middle ages' Willis posed several questions concerning medieval vaults that he was unable to answer at the time, as obtaining detailed measurements through manually surveying numerous vaults, unreachable without scaffolding, was logistically unfeasible (Willis, 1842). Our primary aim is therefore to demonstrate that recent advances in digital surveying techniques, most notably laser scanning which is now known to offer a robust and realistic method of adequately surveying heritage assets, can provide us with a base model as a tool for detailed analysis beyond the digital survey data itself. This has the potential to challenge simplifying assumptions based on traditional approaches in the study of medieval architecture that can lead to sweeping narratives (Bork and McGehee, 2011) and to open new questions about design and construction processes and knowledge transfer between sites (Talaverano et al., 2012; López-Mozo et al., 2015).

Previous historiography has demonstrated the significance of the Wells cathedral choir aisles but has treated them as a single repeated design (Wilson, 2011, 1990; Crossley, 2003; Monckton, 2006) although subtle variations between bays have been identified by eye (Monckton, 2006, fn. 72, citing Buchanan). For example, the plastered infill panels forming hexagons running along the apexes of the north aisle appear to be flatter than those of the south aisle, which appear to have a more defined curvature. Fig. 2 attempts to show this, however, it is difficult to perceive by eye, hence the requirement for contemporary digital tools for a more objective and thorough analysis. These observations therefore make Wells an ideal case study as they reveals the variety of design and construction processes coexisting at this key moment in architectural history, whilst still offering an apparent level of consistency throughout. Wells also presents an opportunity in relation to Willis's hypotheses, which have been used to frame this paper. The aim of the present research is to create a digital version of an existing building as accurately and efficiently as possible and subsequently enabling a detailed analysis of the vault geometry, as opposed to producing a digital model primarily for documentation and visualisation purposes. Nevertheless, the surveyed digital models will also stand as heritage assets for future use and analysis.

2. Context

2.1. Willis's call to the RIBA

Professor Robert Willis (1800–1875), engineer and pioneer architectural historian, called on members of the newly founded Royal Institute of British Architects to survey medieval vaults in order to gather evidence to test his ideas about their design and construction (Willis, 1842). He presented four hypotheses which have underpinned the current research: (1) that medieval vaults did not use Classical stereometrical principles, where the full 3D geometry of a design is worked out prior to construction, but instead that medieval vault ribs

* Corresponding author at: School of Architecture, University of Liverpool, United Kingdom

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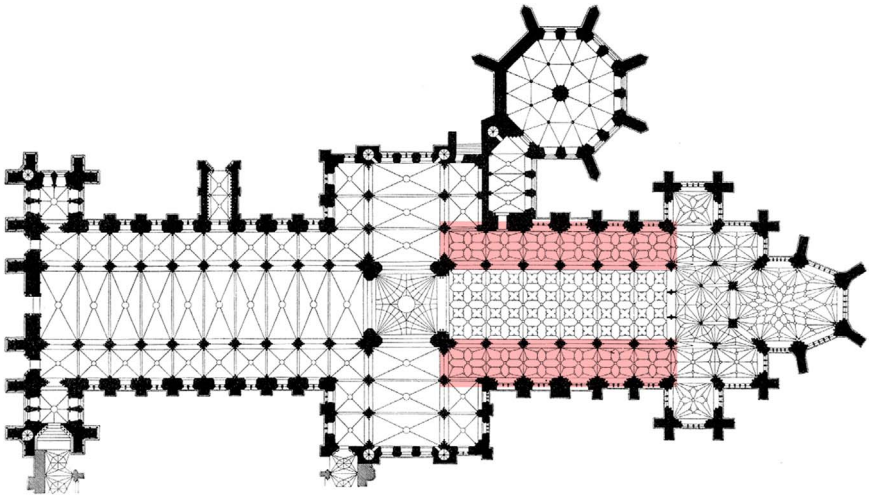

Fig. 1. Georg Dehio plan of Wells Cathedral modified to highlight the north and south choir aisles.

Fig. 2. North choir aisle vaults (left) and south choir aisle vaults (right). Image: JR Peterson.

are defined first using projections and then the intervening surfaces are filled in with a lightweight panel. This means that the geometry of the ribs is the defining factor in the vault's design; (2) that the tas-de-charge (or springer block - the lowest course of stone in a vault, where the ribs begin to diverge) offers particular design challenges which he suggested were met by ignoring geometrical accuracy in favour of constructional contingency; (3) that rib curvatures can be based on single or multiple arcs, and are dependent upon three points (impost, apex and centre). Which of these factors was variable, and how they were determined, he attributed to workshop practice, requiring further research, and (4) that the projection of lierne vaults (those involving ribs which neither spring from the tas-de-charge nor define a longitudinal or transverse ridge) required the pre-existence of a 2D plan.

2.2. Wells cathedral

The significance of architecture in south-west England for the development of late Gothic, first identified in the 1950s, has been confirmed by recent scholarship (Pevsner, 1953; Bock, 1961, 1962; Wilson, 1990; Crossley, 2003; Wilson, 2011). In both 3D form and rib configurations, the Wells vaults anticipate the 'net vaults' designed by Peter Parler at Prague Cathedral, thus establishing the principles of their design and construction provides vital data for investigating international influence and the possible transfer of technical ideas (Talaverano et al., 2012; López-Mozo et al., 2015).

In addition, the data produced by this research has both complicated existing interpretations of the construction at Wells (Colchester and Harvey, 1974; Draper, 1981; Ayers, 2004) and offered the potential for solutions. The present research focuses on the eastern arm, which began to be extended and remodelled sometime after 1300, whilst retaining some elements of the existing choir, including the two westernmost arcade piers on each side and the aisle walls, which were remodelled, with the insertion of new windows. These existing bays provided the width and length for the new choir aisle bays and heights for the new piers which corresponded to those of the older work. There have been suggestions that the remodelling of the south aisle wall pre-

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