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Book Review

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Book review

Repair of Historic Timber Structures, 2nd Edition

David Yeomans. ICE Publishing, London, UK, 2020, ISBN 978-0-7277-6438-6, £51.00, 168 pp.

Much has changed in timber engineering since this book was first published in 2003. As it is about historic structures, time might not seem to matter, but in the world of analysis and restoration, the philosophy and techniques of repair have moved on. The author, Dr David Yeomans, has an international reputation for his work on historic timber structures. Being both a practical, practicing engineer and an academician, he can write with the authority of someone with decades of the respect of the engineering community.

Dr Yeomans writes with an attitude of opinion, and this is a strength. He makes it clear that he thinks that modern codes are based more on theory than practical engineering and that they do not serve conservation well. To counter this problem, the book sets out to provide a comprehensive and logical set of skills for the benefit of those embarking on the conservation of timber structures. He accepts that engineers need codes to support their work and demonstrates how, despite perceived shortcomings, this can be achieved. With the benefit of the author's reputation behind the publication, the reader can have confidence in accepting the philosophy behind the techniques described.

The book is arranged logically and is written clearly and concisely. The illustrations are abundant and detailed. It is possible to sit and read the book from start to finish and remain interested, inasmuch as the chapters are well organised into topics which can be easily accessed for reference to particular items.

The first short chapter sets out the philosophy and approach, not only to inform the method of working to the engineer using the book but also to record the logic of the author's arrangement for the rest of the book. In terms of specific advice, which is clearly based on experience, clarity of the appointment is given importance, alongside gaining an understanding of context. The advice that 'If the building is listed, find out who the conservation officer is' and a reference to 'the building police' are examples of the need to build team understanding and gain the opinions of others, who may have a different agenda from the engineer. A medical analogy is used to demonstrate the complexity of the engineer's task in developing solutions. The history of the building is compared with a medical patient's lifestyle, and an understanding of this precedes examination, diagnosis and treatment.

As long ago as 1991, Dr Yeomans published a series of six articles in *The Architects' Journal*. These covered a series of topics relevant to Georgian buildings in Britain: trade and materials, floor structures, roof structures, walls and partitions, joinery and stairs. They were comprehensive and packed with illustrations, and it is perhaps disappointing that chapter 2 of this book, 'Structures and materials', is only a brief overview of the historic development of timber structures (e.g. the differences before and after the Great Fire). The introduction to the chapter recognises this, explaining that this publication is intended to be only a brief review and not a full history of carpentry. There is less information than was in those articles published previously. Perhaps Dr Yeomans plans to publish a more detailed book on the history of timber structures at a later date; let us hope so. There is a comprehensive set of references, which the reader can use to go into greater depth. This is primarily a manual for repair, and there are merits in curbing the detail, which keeps the overall book succinct and focused on technique.

It is in chapter 3, 'The form and behaviour of joints', that Dr Yeoman's views on analysis and codes come to the fore. The primary joint in timber framing is the mortice and tenon. There is reference to research work into the tension strength and moment resistance of these joints, but the recommendation here is to assume that they only have strength in compression and that they form pin joints. There may be a difference of opinion here, between this safe assumption taken by many engineers and the observation by carpenters that much care is taken by craftsmen to ensure that joints provide both tension and moment resistance. As noted in the book, for a historic structure, little is known about either the initial standards of carpentry or the long-term degradation. This is a good example of the book providing a clear, unambiguous recommendation, with background for the advice being given. The chapter goes on to provide brief but useful advice on the historic development of ironwork. Methods for assessment of capacity are not covered, other than to advise that the joint at the base of the principal rafter, when made by spiked blacksmith straps, has never been known to fail.

Chapter 4 addresses the important issue of how to go about The Survey. Once again experience shows through in the advice that 'a survey without a clear purpose is of limited value'. There is much valuable content throughout the book, but the wisdom contained in this chapter alone might be worth its purchase. The structural engineer should measure and record at the same time; it is important to understand the history of the structure and obvious changes and construction stages and their effect. Again, there are medical analogies – first understand the building anatomy through a preliminary assessment before making the detailed survey; look for timber structures hidden beneath 'Georgianised' masonry fronts. The reader is warned to be aware of inserted inferior-quality structures, such as where floors have been added in previously open medieval halls. There are several useful examples showing what the engineer should look out for. In the detailed survey, the need to identify the structural elements is emphasised and advice is given on how to go about the task by using marks and tags on the building with a table for each timber, 'similar to a dental plan'. Intimate examination with exploratory surgery may be needed! There are examples of common types of distress, and the chapter ends with advice on equipment needed.

Dr Yeomans has written much on structural behaviour, including his book *How Structures Work*, and so it is interesting to find out what he has selected to be included in chapter 5, which covers this topic. It is typical of the approachable style of this book that the chapter begins with 'a cautionary tale', given to guide the engineer away from too much reliance on computer analysis at the expense of a lack of 'qualitative understanding'. The importance of considering alternative load paths is rightly emphasised, as is the need to build experience, so that a body of knowledge can be used to compare the performance of apparently similar building structures. The recommendation is to use a 'quantitative analytical approach', employing modern understanding to build 'meaningful models' to test various possible structural behaviours due to different material/structural characteristics and loads. Structural analysis is seen as essential but only if appropriately calibrated. The use of analysis enables structural intervention to be properly understood, particularly in relation to how much it increases structural safety. As Michael Dickson memorably wrote, 'Let the building speak to you'. In building assessment, the object is not to obtain accurate stresses but to identify properly load paths, material characteristics and the response of the structure to applied loads.

As expected from an author who has written much about the importance of understanding the different behaviours of roofs depending on the

interaction of the structural members, there is an interesting discussion of the various forces carried by the purlin, collar and rafter and their effect on spreading loads. It is thought provoking and very much more useful than prescriptive instructions on how to calculate the load. This is a book for engineers trained in three-dimensional structural analysis and requires careful reading. Hammer beam roofs have attracted considerable academic debate over how the loads are carried. In the past, Dr Yeomans has written at length on this topic, and here he is forthright in saying that much of what others have previously written on the subject is non-sense, a refreshingly direct view from someone who, after many years of study and experience of surveying such roofs, has clear understanding of the way the forces are distributed. This continues throughout the chapter with summaries of the behaviour of box frames, aisled frames, cruck frames, base crucks, trussed roofs, floor loads and floor structures in medieval timber, as well as masonry buildings, and finally walls and partitions. The writing is concise and precise – a clear head is needed to follow the wealth of detail provided. Even if one had no need to use the book for practical purposes, this whole chapter can be read to enjoy a celebration of the author's years of experience of examining and figuring out old timber structures.

In the chapter on the strength of timber, we return to the difficulty that Dr Yeomans has with modern procedures and codes. The chapter begins with demonstrating the logic of not using code-grade stresses and then proceeds to discuss how a long-withdrawn British code (CP 112) can be used to derive safe permissible stresses. The dilemma is well understood – engineers, both for their own satisfaction of showing safe strength and to satisfy the regulatory authorities, need to know what stresses a timber member can withstand. In fact, it is unusual to find high stresses in timbers of old buildings; problems with distress are more likely to be due to missing or severely degraded elements. Pragmatism is necessary, and the conclusions to the chapter indicate that Dr Yeomans knows this. Although codes for newly constructed modern structures are not applicable when assessing medieval structures, the engineer needs to be able to underwrite

the performance of the structure. The problem remains and is only partially resolved through the advice given in this book.

In the chapter on intervention strategy, a distinction is made between listed and unlisted structures. There is a clear sense of past battles – 'some attitudes to conservation have been adopted by those with little practical experience' – and perhaps there should be more emphasis on the fact that the engineer can often earn their fee by advising that little needs to be done. It can be that intervention is seen as a justification for appointment and payment of fees. The penultimate chapter on decay and repair covers some of the commonest problems encountered in conservation of historic timber. This is another excellent reading, demonstrating how modern structural methods and materials can be used sensitively.

The book concludes with a diverse set of case studies. Of course, given Dr Yeoman's noted interest in the topic, this starts with a study of a purlin repair and is followed by the use of ring forces to avoid the intrusion of a beam in a Wren church. There is another roof example, which shows how the effects of an 'improvement' resulted in distress, due to changing the load distribution. Finally, there is a large wooden gate, which is a fine example of an intervention requiring a full understanding of structure, materials and repair techniques.

As noted, several times, there are strong opinions in this book. Dr Yeomans has a passion for his subject and for the structures he works with. A building or structure is 'a cultural artefact'; he asks, 'is the roof of a church ... as culturally important as its stained glass or its wall paintings?' Strength of feeling comes across throughout the book because sometimes the engineer is the only one present to speak up for the significant historic and heritage value of the structure. The book is both a compellingly read and a useful work of reference.

Richard Harris