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The Roofs of Wren and Jones: A seventeenth-century migration of technical knowledge from Italy to England

Simona Valeriani

Abstract

Seventeenth-century English architecture saw the introduction of a new style, influenced by continental Europe, and driven, to a large extent, by the work of Inigo Jones and Christopher Wren. But along with the aesthetic novelty came novel building techniques; construction methods embedded within the stylistic changes showing that the continental influence was felt as much within the structures of the buildings as it was upon their façades. Focussing here on the methods used to construct wooden roofs, this paper attempts to chart some of the ways in which the influence of Italian craftsmen and architects was received and adapted by Wren and Jones, and how facts about roof construction travelled into England through technical solutions to the problems the new architecture presented.

Introduction

The general subject of the present paper is the migration of knowledge regarding roof construction from Italy to England during the seventeenth and eighteenth centuries. On a European level this period sees, as a development of a long-standing tradition, a great increase in the number of trips abroad by artists and architects, and at the same time, an increase in requests for qualified personnel willing to transfer, for example, from Italy to Germany, Russia or Bohemia. These were craftsmen at various levels (artists, building artisans, etc.) who collaborated with local trades, sometimes forming a “school”. In addition, the flow of printed works intensified in these centuries, favouring the circulation of technical information.

The aim of the current research project (called “Travelling Knowledge: Building Techniques in Europe between the Sixteenth and Eighteenth Centuries”) and of the present work is to investigate the ways in which technical knowledge “travels” from one country to another: either through the diffusion of books and manuals, or in other cases, thanks to the efforts of designers and labourers who directly transmitted the "new" knowledge. Questions about how well technical knowledge (that is, facts about roof construction) travel are at the heart of these case studies, chosen as representative of various pathways (related to practice and to craftsmanship) taken by technical knowledge as it travelled through Europe. Until now critical study has examined the aesthetic and formal aspects of these phenomena, underlining, for example, the propagation of architectural forms and styles. The theme of the transfer of scientific and technological-construction knowledge is much less studied.

At the base of this research project is an investigation conducted by the present author from 2001 to 2005.[1] Beginning with a thorough analysis of roof structures and of the spaces below the roofs of some Roman basilicas,[2] together with the examination of pertinent written documents,[3] it was possible to reconstruct the genesis and the development of roof structures from Antiquity to the eighteenth century in and around Rome.[4] The materials, the various structural typologies and the construction details (joints, metallic connecting parts, marks made during construction) were at the centre of the investigation. The primary aim of that project was to identify the strategies followed in the course of the centuries during the design and construction phases (at

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[1] Valeriani 2006.

[2] For each of the items analyzed a mapping of the salient characteristics of its structure and its workmanship was developed, as well as a detailed survey at a scale of 1:20.

[3] Because the research was based on the buildings in the area of Rome, particular attention was given to the architectural treatises that were influential there: writings that were specifically local and the great treatises. In parallel, some works that were never published but remained only in manuscript form that were of particular interest with regards to the subject under examination were used as sources.

[4] The lack of thorough studies in this field (up to the present prevalently on the subject of restoration and historiographically fragile; see the Introduction to Valeriani 2006) has made it necessary to undertake a comparative study. It was necessary to select buildings to analyse (based on their pertinence and their accessibility). The work accomplished thus far is intended as a first contribution to the subject.

the same time other aspects such as the organisation of the work site and the means of supplying it were examined as well).

In addition to the historical-technological dimension, the buildings taken into consideration were also studied in terms of the history of their construction, starting with the material evidence that is found in little-examined parts of the buildings and which can provide information on the transformational phases that are now erased in the visible parts of the building.[5]

The specific project "Travelling Knowledge: Building Techniques in Europe between the Sixteenth and Eighteenth Centuries" is part of the larger project entitled "The Nature of Evidence: How Well do Facts Travel?" A first case study of this project regards the introduction of new types of roof structures in England in the seventeenth century, some of the preliminary results of which are presented here.

Imported designs in seventeenth-century English woodworking

In England, the introduction of architectural forms evolved from the Italian Renaissance in conjunction with the necessity of adopting new solutions for traditional problems, such as that of covering large spaces without intermediate supports. In this context, the buildings designed and/or executed by Inigo Jones (1573-1652) and Christopher Wren (1632-1723) introduce roof designs inspired by the classic exemplars of the *king-post truss* and the *queen-post truss* (in Italy commonly called Palladian truss).[6] In this case, the technical

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[5] Another aim of the project was the development of the foundations for use in the dendrochronology of Central Italy. In regard to the results obtained from the project in this field, see the Introduction to Valeriani 2006.

[6] Trusses made up of tie-beam (*catena*), rafters (*puntoni*), a collar beam (*controcatena*, a horizontal element connecting the tops of the secondary rafters), lateral posts, and sometimes a central king post (sometimes connected to the counter-tie-beam). In many Italian examples it is possible as well to find secondary

knowledge appears to have been spread through the circulation of treatises and other writings about architecture, as well as the journeys undertaken by English architects in order to study the architecture of France, the Netherlands, Germany, and Italy.[7]

To date, the literature that has dealt with the timber structures designed and built by Jones and Wren has contributed interesting information on the subject,[8] but there are a number of gaps; especially with respect to the new structures introduced in England in the seventeenth century compared to the written and crafted Italian sources (about which very few historical studies have been published). The first such woodworking innovations are usually credited to Jones, who brought the "Palladian" style to England.[9] His work was influenced both by direct experience of the architecture of antiquity (seen during his journeys in Italy), as well as by his careful study of the treatises of the time, which he meticulously annotated, using them as veritable

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rafters (*sottopuntoni*, beams placed parallel to the rafters in order to increase the section of resistance, normally about two-thirds as long as the rafters), elements that are normally lacking in English structures. The name "palladiana" is commonly used in Italy to describe this kind of structures. This is why the term is used here to. Despite of the name this kind of truss was not invented by Palladio and was common in Italy already long before his time. However he uses it very often in his buildings and designs, which is probably the reason why it has taken his name (see Valeriani 2006, 124-127). A form of truss with lateral posts existed in England even before the seventeenth century. However, this was based on a different structural concept and did not include diagonals joined to the king post. The difference between these structures and those introduced in the seventeenth century is discussed in Yeomans 1986, as is the possibility that these were developed with pre-existing English woodworking techniques as a point of departure, a hypothesis that Yeomans does not consider sustainable.

[7] Such as the travels of Inigo Jones in Italy and France and that of Wren to Paris. In regards to Jones's library (in which there were many Italian architectural treatises), see Harris, Orgel and Strong 1973, 63-67. For Wren, see Whinney 1958. For the travels of Jones in Italy and France, see Harris, Orgel and Strong 1973, 17, 36-42, 55-57. In regards to his relations with France, see Higgott 1983.

[8] The subject in question has been analysed in the writings of David Yeomans (1986, 1992b), great expert of historic English woodworking, and was taken up again some years ago in a doctoral thesis discussed at Cambridge University by James Campbell (1999, 2002).

[9] It has been observed that the new types of trusses were used even before Jones by Robert Smithson (see Yeomans 1992a, 26). The woodworking in the Banqueting House in Whitehall show such strong resemblances to that of St. James's Palace that it cannot be excluded that Jones drew inspiration from them.

textbooks and as “architectural guides”. During his travels as part of the entourage of Count Arundel in 1613-1614, he carried with him at least twenty such books from his personal library.[10] However, Jones’s influence on successive developments in English architecture was limited due to the Civil War of 1640-1660, and instead, the works of Wren have been considered more influential.

Wren concerned himself thoroughly with the problem of roofs, developing genuine innovations in building practice in this area. On the basis of an analysis of numerous contracts and accounting documents relative to the construction of the city churches following the Great Fire of 1666, James Campbell (1999, 2000) has shown that such innovations were introduced by the architect and not, as one might expect, by the woodworking masters. The carpenters, however, were the instruments of transfer and diffusion of the new techniques, as they were able to apply the innovative technology, acquired on Wren’s building sites, in other contexts: introducing it in other parts of the country and making it known to their fellow craftsmen.

In the following section some of the characteristics considered to be distinctive of the structures introduced by Jones and Wren will be analysed and, on the basis of material and documentary testimony relative to the Italian woodworking of that time, an attempt to identify the possible path by which knowledge travelled between the two countries will be made. In particular, the following case studies will be analysed: (i) The post-to-tie-beam problem; (ii) the use of metal connecting elements; (iii) the problem of building “composite” beams; and, finally, (iv) the case of structures with discontinuous rafters. (The non-expert reader can find an illustration of most of the technical terms used in this paper in Fig. 1.)

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[10] As regards to Jones’s annotations of architectural treatises, see Newman 1988.

Although the standard literature tends to consider Jones and Wren as innovators, and to therefore regard any foreign influences on their technical designs as being true only for the general forms and not the specific solutions adopted, some cases will be discussed here in which this position needs to be revised. In fact, concerning both general structural forms and specific technical solutions, they seem to have been neither full-scale inventions nor outright copies, but, rather, to have been solutions only partially adapted from designs already in use in other countries.

(i) The Post-to-tie-beam problem

An important element in the design and execution of king-post and queen-post trusses (fig. 1) is the nature of the connection of the vertical posts to the tie-beam. From antiquity, in Italy and the Mediterranean basin there were two distinct common structural types, one involving mortising the horizontal and vertical members, and the other involving a separation of the two, with only a metal band that held them together. In the latter case, the metal element came into play only at the moment when a curvature of the tie-beam occurred, and because of the separation, a possible sinking of the apex (and, consequently, of the king-post) did not have a negative effect on the tie-beam itself.[11]

In Italy, it is possible to detect regional preferences for one type or the other: in Rome, for example, it was common to have the post connected to the tie-beam only by a metal strap, whilst in Venice and the northeast of the country it was more common to have them mortised, or at least touching each other and securely connected. Such local preferences notwithstanding, the subject was hotly debated among Renaissance technicians. Evidence of this is to be found in

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[11] See Valeriani 2005 and the literature cited therein.

published and unpublished works of the time where explicit reference is made regarding this matter. For example, the works of Pellegrino Tibaldi[12] (edited during the 1580s but never published), of Bernardino Baldi[13] (posthumously published in 1621) and of Gioseffe Viola Zanini (first published in 1629), which all recommend separating the king post from the tie-beam and list the advantages of this solution (figs. 4 and 5). While it is improbable that either Jones or Wren were familiar with manuscripts such as Tibaldi's, we can be sure that they both knew directly or indirectly the work of Baldi, and that Jones used to quote Zanini in his notes to Palladio's Books.

Baldi has been considered the probable source for Jones and Wren concerning the statics of truss structures. It is true that the *Exercitationes* were cited in Wotton's *Elements of Architecture* of 1624 as a fundamental reference for roof structures, but no detailed references on the technical information contained there were added:

> And so having runne through the foure parts of my first generall *Division*, namely, *Foundation*, *Walles*, *Appertitions*, and *Compartition*; the *House* may now have leave to put on his *Hatte* (…). Therefore obtaining both the Place, and the dignity of a finall cause, it hath been diligently handled by diverse, but by none more learnedly then Bernardino Baldi Abbot of Guastalla (before cited upon other occasion) who doth fundamentally, and *Mathematically* demonstrate the firmest *Knittings* of the upper *Timbers*, which make the *Roofe*. (Wotton 1624, 78-79)

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[12] Pelligrino Pellegrini, called Tibaldi; see Tibaldi 1990, 308-309. Note the solution to the mortise king post-puntone that, for as much as can be understood from the imprecise drawing, is unusual in the Italian tradition. The ends of the posts are actually wider than the "body" and the rafters, at least in the first two drawings, are not inserted into a "tooth" but rest on the oblique face of the end of the king post. An analogous solution would become common in England beginning in the seventeenth century.

[13] *Esto enim transuersaria trabs AB parietibus vtrinque fulta I, K, arrectarium CD. Cauterij vtrinque AD, BD, ita transversariæ trabi in AB, et arrectario in D inserti, vt nequaquam inde elabi valeant. Tum ferrea fascia EF media transuersariuam traben AB, a parti inferiori ipsi arrectario connectens, debet autem arrectarij pes vbi C, aliquantulum a stransuersaria trabe distare, ne deorsum ex pondere vergente paulum arrectario ipsam transuersariam premat* (Baldi 1621, 103). See Becchi 2004, 82-85, 182-183, 228.

It is almost certain that Jones did not *own* a copy of Baldi's *Exercitationes*, but it is very probable that he knew Baldi's and Wotton's work, since he had been Wotton's guest in Venice during his 1613 journey. As for Wren, it is not clear whether he had his own copy of *Exercitationes,*[14] but the volume, meticulously read and annotated, was present in his father's library, so it seems safe to assume he knew of it.[15] It is in any case true that the structures of Jones and Wren always show a mortise in correspondence to the king post-tie-beam joint, in open contradiction of Baldi's detailed suggestions. It is thus evident that the structural concept of the trusses adopted by the English architects is not (wholly or directly) derived from Baldi's treatment.[16]

Further, it appears highly improbable (contrary to what has been suggested by, e.g., Campbell 1999, 141-142) that the choice of building a closed joint between king post and tie-beam could have been chance, or the result of a "distracted" study of the Italian exemplars. Jones's interest in this kind of joint is shown, among other things, by one of his marginal notes in Palladio's book appearing beside a chalk sketch on the page where Palladio describes the bridge at Cismone (Jones 1970, bk. III, 15). Here, Jones *redraws* the king post tie-beam joint at a larger scale, as though to study how it works (fig. 6). In accordance with the structural detail later executed by Jones, the king post and the tie-beam are firmly connected to each other with the additional help of a metal band. Although the structure of a wooden bridge and that of a roof

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[14] Baldi's books does not appear in the catalogue of Wren's books put up for auction in 1748 but it needs to be kept in mind that the list is not exhaustive (see "A Catalogue of the Curious and Entire Libraries Of that ingenious Architect Sir Christopher Wren, Knt. And Christopher Wren, Esq; his Son, Late of Hampton Court, both Deceas'd ... Which will be sold by Auction, By Mess. Cock and Langford, On Monday the 24th of this Instant, October, 1748 and the three following Evenings" in Watkin 1972, 3-19).
[15] Weaver 1923, 139.
[16] However, the suggestion that some English designers got from Baldi their idea of comparing the mechanics of a truss to that of an arch is an interesting one (see Yeomans 1984, 46). It must be taken in account that the idea comes originally from Alberti, who is however not directly cited by Baldi in this occasion.

present significant differences, and although the joint considered here is loaded differently in the two cases, there are still fruitful analogies. Above all, it is relevant here to note the architect's interest in the problem of jointing the vertical element with the horizontal, and to assume that when it came to building a roof he carefully choose which solution to adopt for this specific problem.

A book that we know for sure that Wren possessed and is interesting in regard to roof construction is "Il Tempio Vaticano" by Carlo Fontana (1694). Although the main focus of this work is the description of the basilica of St. Peter, it also contains detailed instructions for the correct design of a roof truss and an appeal not to let the "mechanici" do this kind of work on their own, as they work "out of practice" or habit without necessarily knowing the underlying rules and engineering principles. For this reason, Fontana argues for the importance of "professori." The trusses described and drawn by Fontana are all characterised by a connection between vertical posts and tie-beam consisting only of a metal strap. Although Wren surely read these notes with interest, the book will not have affected the way he conceived roof trusses as it was published at a time when he had already done much of his reconstruction work in London.[17]

In addition to simple king post structures in the designs of Jones and Wren, it is possible to see some roofs that have a greater number of vertical members. Among these the most simple (and least effective) show the addition of two lateral posts, detached from the central king post and its diagonals, and mortised into the tie-beam and the rafters. An analogous structure is found at Stoke Bruirne (Northamptonshire), a building that Jones worked on from 1629 to 1636; and other examples are found in some of Wren's work in London, such as St. Clement Danes (probably built in 1682); Christ Church, Newgate Street (1685);

[17] Although most of the roof of St. Paul's cathedral were built after the work by Fontana was published (north transept 1695-96: nave 1704, 1706).

and St. Margaret Patterns (1685, fig. 7). The addition of these lateral elements was not foreign to the English technical tradition. Other, more efficient, structures are those in which additional vertical elements are inserted in correspondence to the apex of the braces that take off from the central king post. An ulterior refinement included the use of an additional pair of diagonals between the lateral posts and the rafters.

Jones and Wren built some structures in which additional elements are present (which have the purpose of relieving as much as possible the load to be otherwise carried by the king post alone), but these are not necessarily entirely satisfactory. The truss at the Banqueting House, designed by Jones 1619-1622, is characterised by lateral posts with diagonals that are not joined to the central king post-diagonals system. Analogous structures can be found in some of Wren's projects, where he built complex trusses in which the posts and diagonals (central and lateral) form collaborating systems (compare, for example, the roof of Trinity College Library, Cambridge, fig. 9).[18] On the basis of these examples, it has been asserted that the complex and more effective structures constitute an innovation on the part of Wren and his collaborators of the basic structural exemplars "imported" from Italian architecture (Campbell 2002, 52-54). In actual fact, this kind of truss has been known since Antiquity (fig. 3)[19] and can be found (albeit infrequently) in various Italian regions. We can assume that through Italian sources Wren would have had the opportunity to familiarise himself with this kind of structure: Baldi (1621, 103) suggests its use in where large spans are required.

This was not unique. The same solution was also mentioned in other writings from the time, and surely present in the technical debate.

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[18] For example, in Emmanuel College Chapel (1671), in Trinity College Library, and in the churches of St. Andrew Holborn, All Hallows the Great and St. Lawrence Jewry.

[19] The diagrammatic drawing does not make it clear whether or not the central diagonals and the lateral posts are connected to each other.

For example, Tibaldi (a technician active especially in Lombardy but also in Bologna, Rome, Ancona, and Ravenna at the end of the 16th century), accurately describes this kind of structure (even though he supplies no illustrations), showing that he has completely understood how it works structurally:

> And in order to reinforce the rafters there are two more diagonals, one on one side and one on the other, that are embedded at the foot of the king post, and one goes in one direction and one in the other to support and aid the rafters so that the load does not make them sink. Sometimes the distance will be such that a diagonal on each side will not be enough. In that case make them three king posts with four diagonals, the diagonals can then be fortified in their turn with more suspended rafters, that go from the king posts to those rafters that support the whole structure (Tibaldi [1590 ca] 1990, 309).[20]

Further, the same kind of truss had already been used by Jones for the roof of St. Paul's Covent Garden, built between 1631 and 1633.[21] Therefore, there seems to be no support for the thesis of an original contribution on the part of Wren; nor, on the other hand, are we necessarily dealing with evidence of a cause-and-effect relationship between Wren's structural choices and Baldi's work, since this type of construction is also addressed in other sources.

Neither does it seem possible to affirm that we are dealing with a later improvement or refinement of a structural type due to a better understanding of how the system works, acquired over time and through experience. If we consider Wren's work as a whole, it is possible to see that the most effective type of structure (with posts and lateral diagonals, connected to the central king post-diagonals system) was executed as early as 1676 in Trinity College Library (Cambridge, with a 12.35 metre span), or 1677 in the church of St. Lawrence Jewry

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[20] As mentioned before it improbable that Wren knew Tibaldi's text as it remained manuscript but it is worth to be mentioned here because it is evidence of an ongoing debate about this kind of structures.

[21] Destroyed in a fire in 1795 but documented in various drawings.

(with a 13.65 metre span), while a few years later Wren would use a structure *without* a second pair of diagonals to cover a similar span (All Hallow's the Great, Thames Street, 1680: 13.65 metre span). The nave of St. Paul's Cathedral (maximum span of 15.78 metres), built in 1704, is roofed by simple king post-diagonals trusses.[22] In fact, in the cases cited, the dimensions of the spaces do not necessarily require a structure more robust than a "simple" king post-diagonals truss, and relatively complex structures are used in cases where the span is rather modest (for example, Emmanuel College Chapel, 1671, 8.895 metres).[23] This reflects the situation observed in Rome where the cited research project has shown a substantial independence, except in cases of particularly large spans, between the degree of complexity of the structure used and the width of the span to cover (see Valeriani 2003, 2029-2031; Valeriani 2006, 129-132).

In the English case there seems also to be no basis for the hypothesis that the choice of typology depends exclusively on a change in the artisans responsible for the project. For example, the roof of St. Lawrence Jewry and that of the nave of St. Paul's Cathedral were both executed by John Longland,[24] who along with his team had already built complex trusses in 1677, and could therefore have done the same in the cathedral, a building which held everyone's attention. The impression is rather that it was Wren as architect who experimented with several types of structure.[25] He was well aware of the fact that a

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[22] The tie-beam in this case is made up of two beams joined to each other.
[23] In the buildings in the area of Rome analysed by the present author, for example, are found spans as large as over fourteen metres covered by trusses of this type.
[24] See Bradley/ Pevsner 1998, p. 95.
[25] This aspect needs in any case to be studied more thoroughly. In particular there remains to investigate the possible relationships between the choice of the type of truss to be used, the function of the space under the roof, and/or the presence of ceilings of an especially large weight, elements that could have determined the necessity of a more resistant structure.

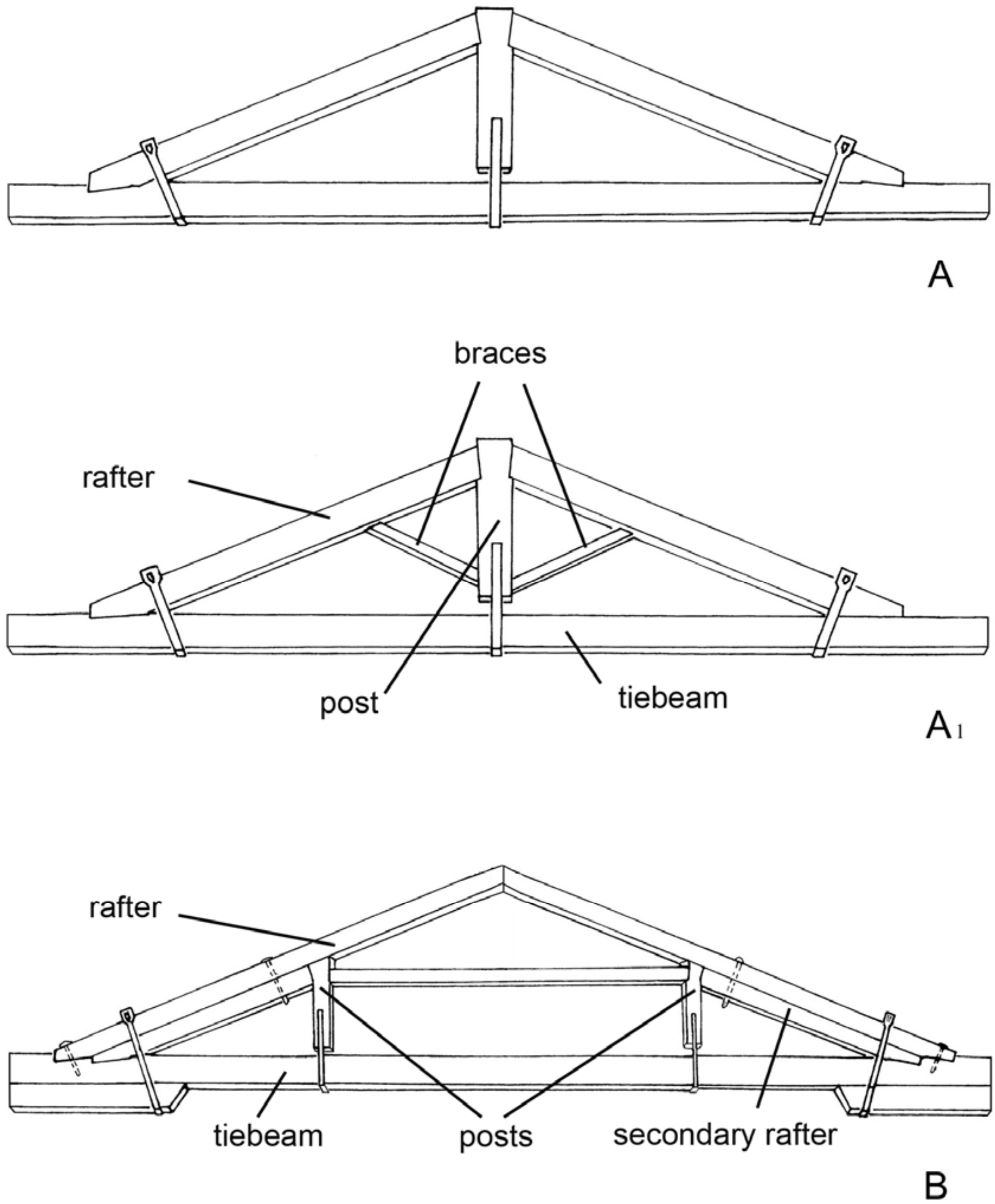


Fig. 1: Simple king post truss (A), king post truss with braces (A_1) and queen post truss (so called "palladian" truss, B).

Fig. 2: Bātūta (5th century A.D.), pediment of porch with a bas-relief representing a king post truss where the post is mortised into the tie-beam (Butler 1929, p. 201).

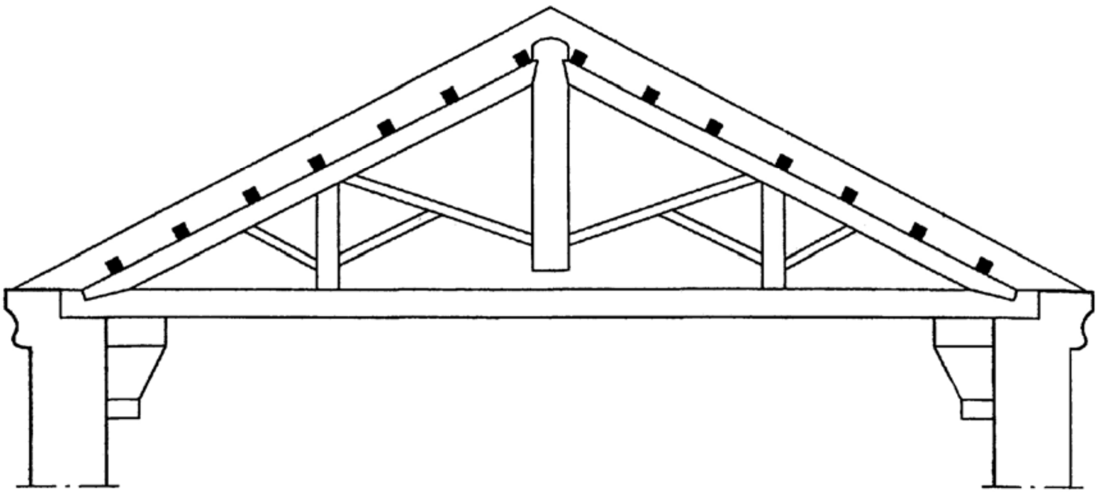
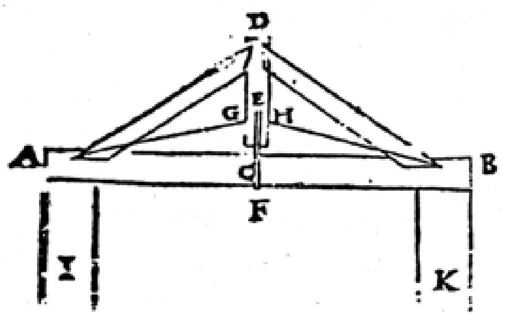


Fig. 3: A diagrammatic representation of a bas-relief found in Brâd (Syria) datable to the fifth century A.D. The roof structure shown includes both a central king post not connected with the tie-beam and to which braces are attached as well as lateral posts resting on the tie-beam (mortised?) and from which other transversal elements take off (Lauffray 1998, p. 230).

tio autem validitatis patet; premente enim grauitatis cē-
tro in G, fulcra hincinde ſuccurrunt CE, DF, quæ cum ſe-
ipſis fieri non valeant breuiora, ne corpori detur penetra-
tio, reſiſtunt & robuſtiſſimè ipſi ponderi ſuperimpoſito
contranituntur. Videntur autem in hoc opere duo con-
ſiderari vectes, GH, GB, quorum fulcimenta EF, potentia
premens vtrinque G. Pondera autem parietum partes ca-
pitibus trabis impoſitæ in A & B. Quoniam igitur parua
eſt proportio GE ad EH, parua potentia premens in G,
maximè autem pondus in A, fieri non poteſt trabem fran-
gi aut muros vtrinque diſſipare in AB. Poſſunt etiam to-
tius trabis tres partes conſiderari AE, EF, FB, quarum ful-
cimenta quatuor A, E, F, B, Diuiſo igitur pondere & mul-
tiplicatis fulcimentis impoſſibile eſt trabem conuelli &
vitium facere.

Sed & tectorum contignationes imbecillaq; tranſ-
uerſaria Mechanici corroborare ſolent, additis nempe
arrectaria trabe atque cauterijs.



Eſto enim tranſuerſaria trabs AB parietibus vtrinque fulta I, K, arrectariū CD. Cauterij vtrinque AD, BD, ita tranſuerſariæ trabi in AB, & arrectario in D inſerti, vt nequaquam inde ela-
bi valeant. Tum ferrea faſcia EF mediam tranſuerſariam
trabem AB, à parte inferiori ipſi arrectario connectens.
Debet autem arrectarij pes vbi C, aliquantulum à tranſ-
uerſaria trabe diſtare, ne deorſum ex pondere vergente
paululum arrectario ipſam tranſuerſariam premat. His i-
gitur

Fig. 4: Bernardino Baldi: king post truss with the king post separated from the tie-beam (Baldi 1621, p. 102).

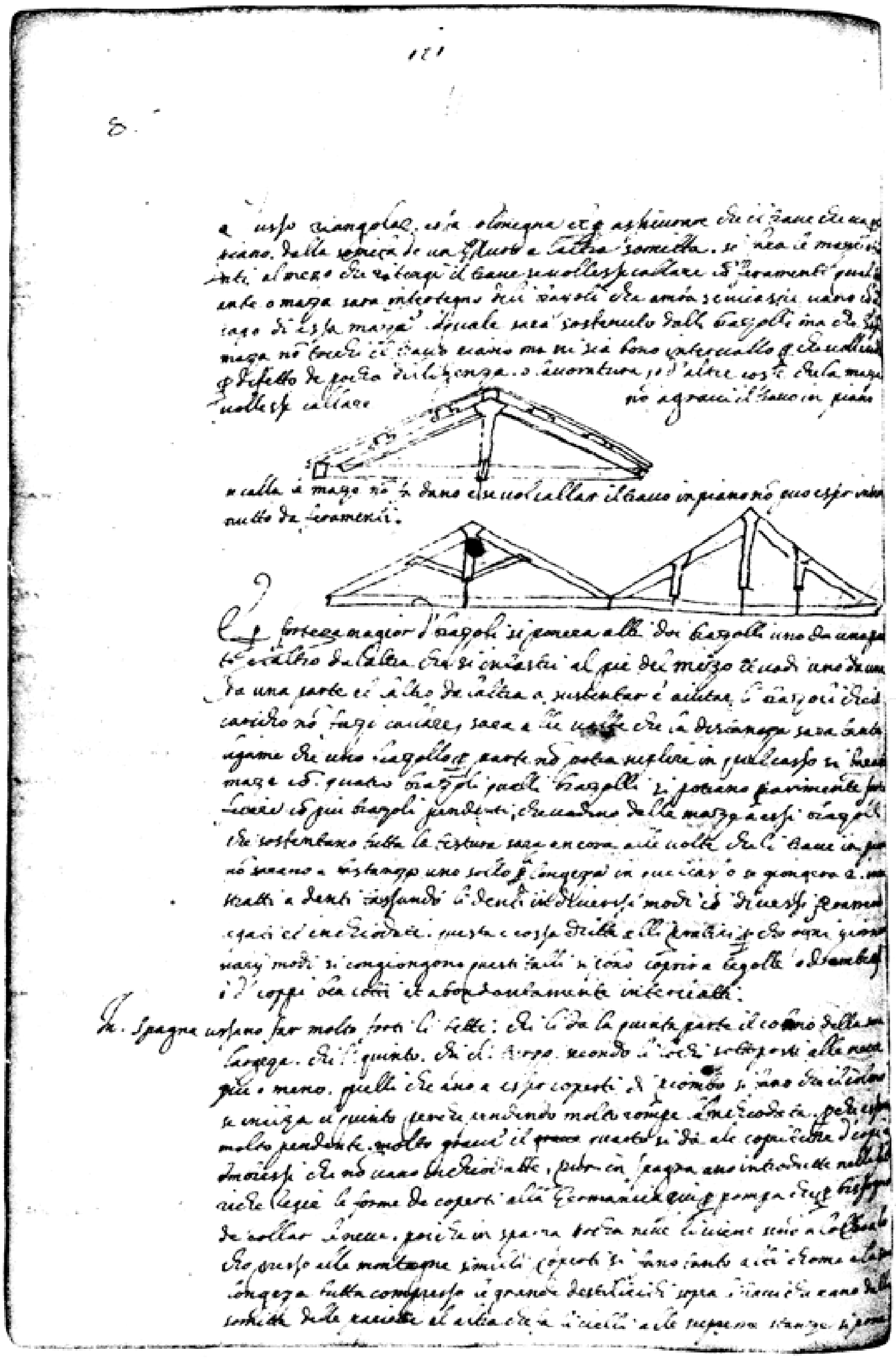


Fig. 5: Manuscript page by Tibaldi where various kinds of trusses and their uses are described (Tibaldi [1990, fig. bet. 308-309]).

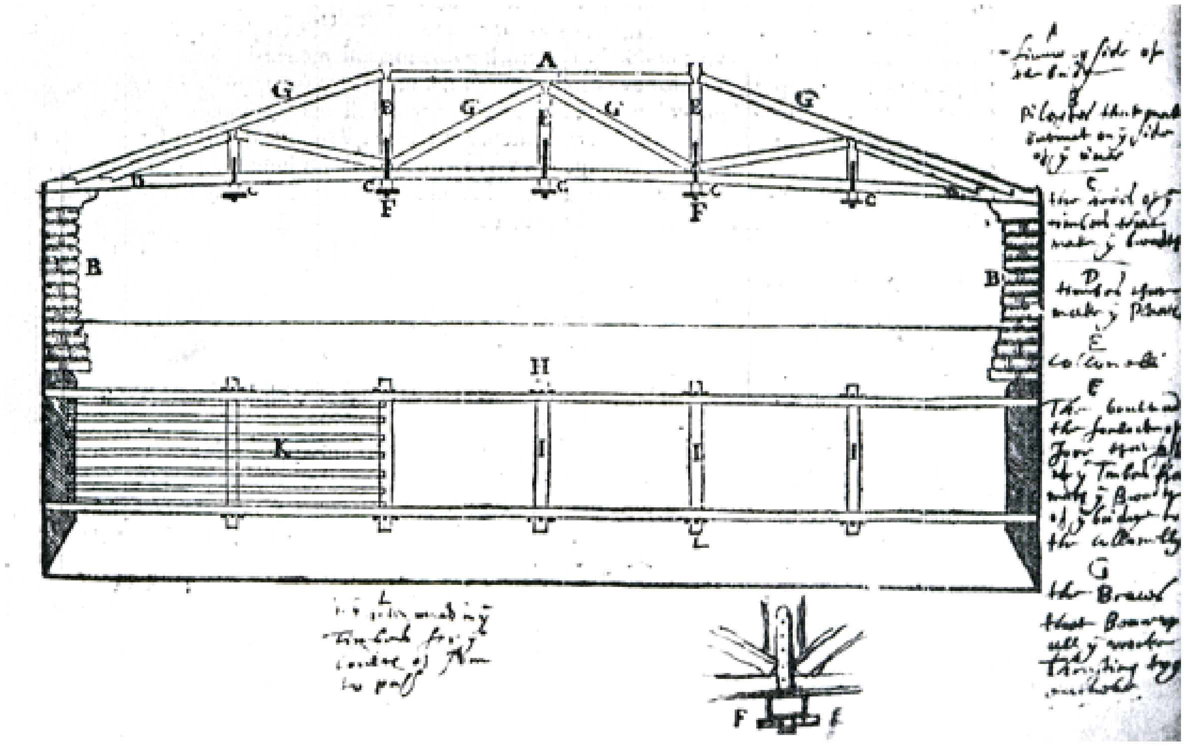


Fig. 6: Page from Palladio's *I quattro libri dell'architettura* with the bridge at Cismone annotated by Inigo Jones. Note, below, the sketch to study the king post-tie-beam joint (Jones [1573-1652] 1970, Book III, p.15).

Fig. 7: St. Margaret Patterns.

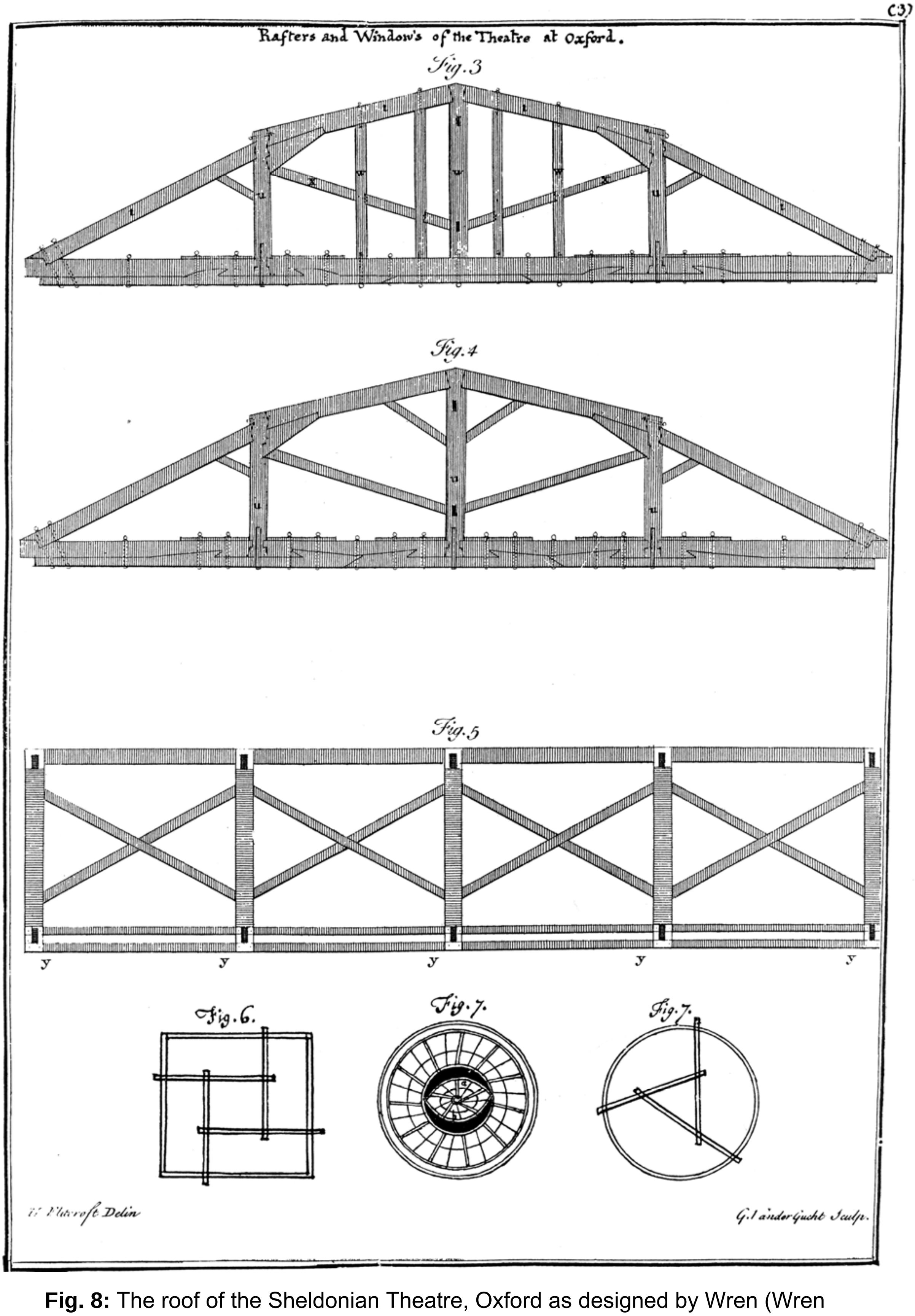


Fig. 8: The roof of the Sheldonian Theatre, Oxford as designed by Wren (Wren 1750, sect. XII, between p. 336 and p. 337).

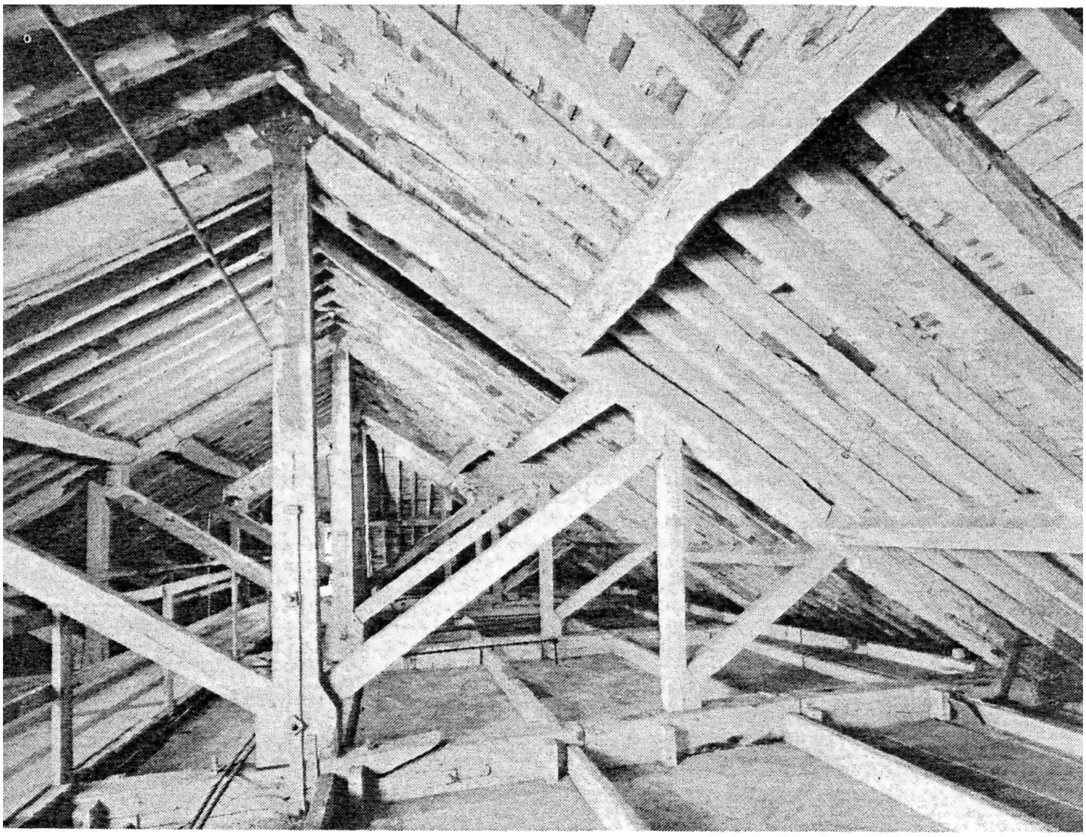


Fig. 9: Trinity College Library, Cambridge: roof truss designed by Wren (1676) with central and lateral posts, braces and diagonals forming a collaborating system (Yeomans 1985, p. 76).

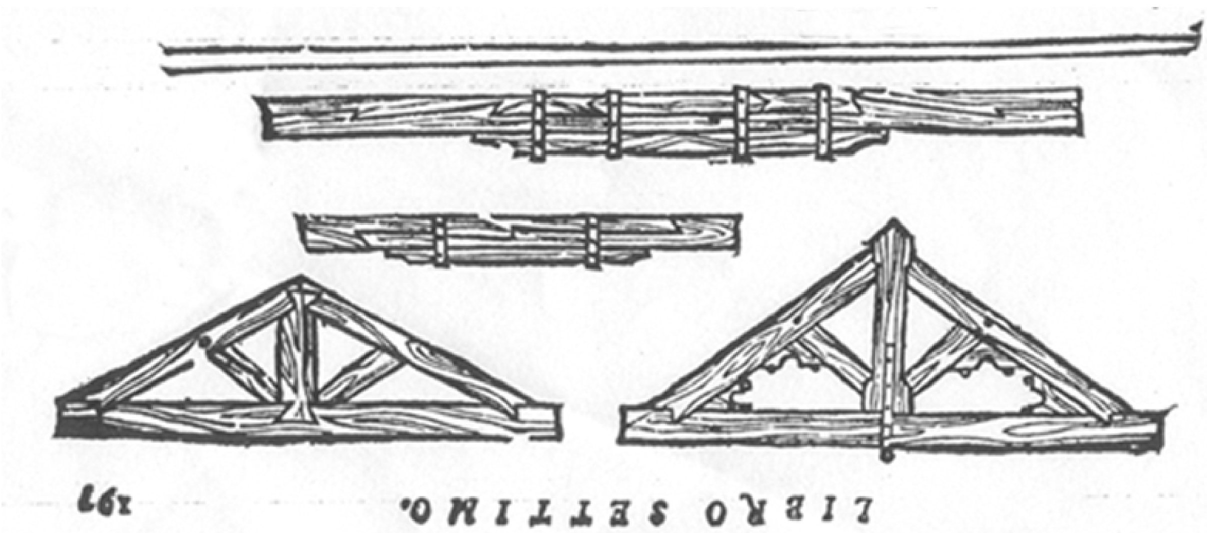


Fig. 10: Various types of trusses according to Serlio (Serlio [1537-1575] 2001cap. LXXIII, p. 197, detail, and inverted for clarity). Note especially the composite tie-beam, at the top of the figure, similar to that used by Wren for the roof of the Sheldonian Theatre.

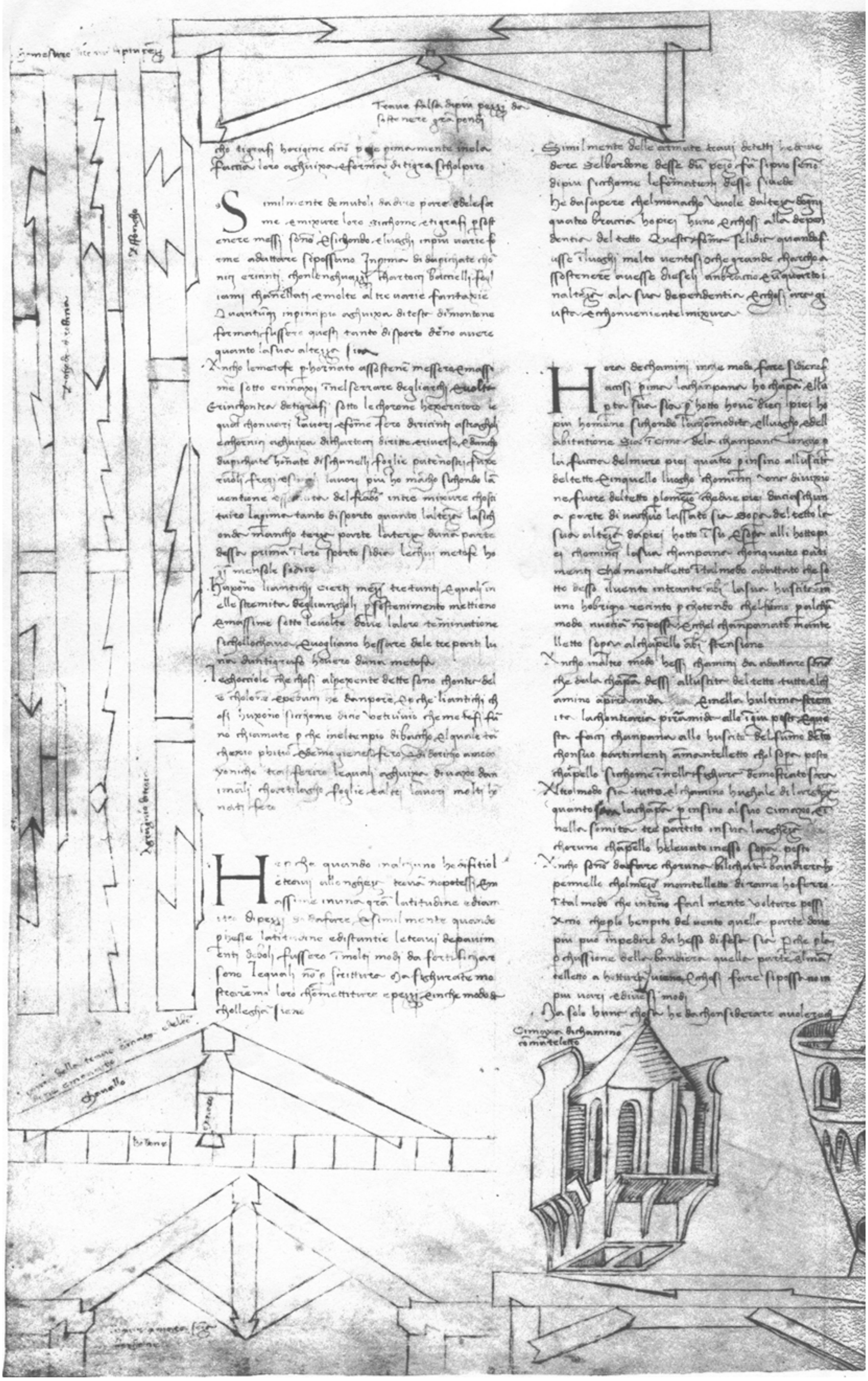
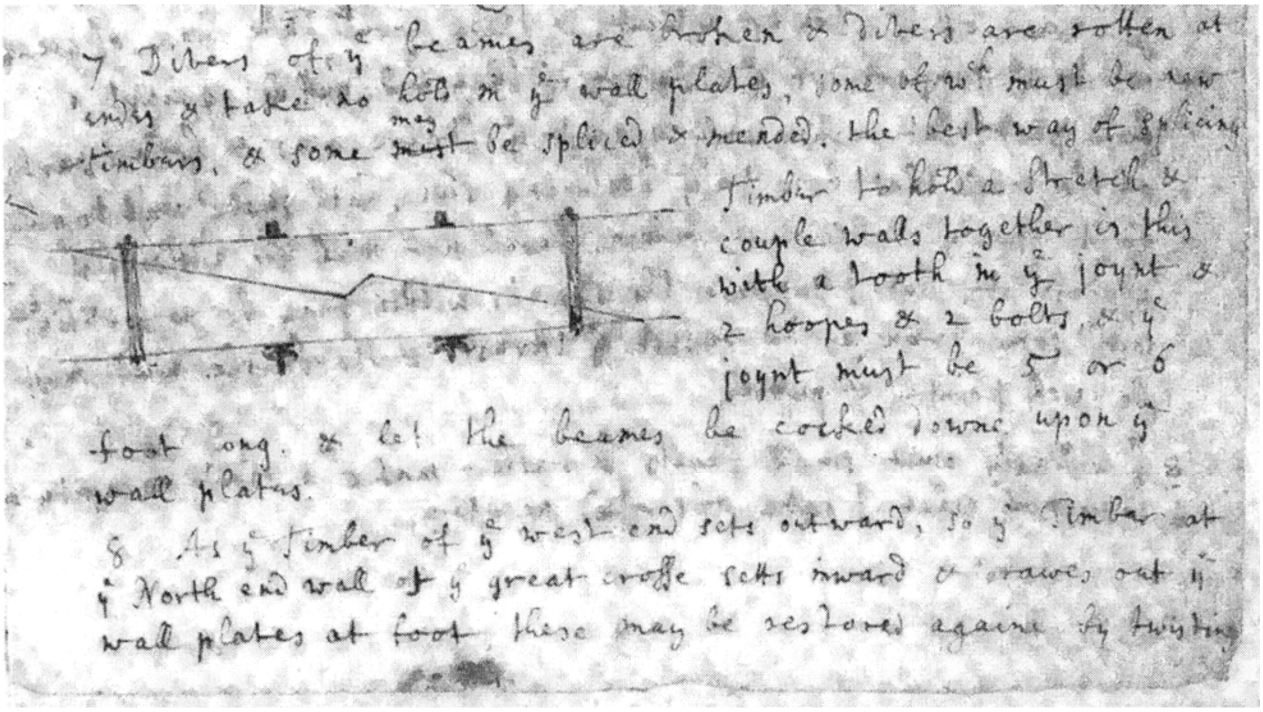


Fig. 11: Francesco di Giorgio Martini, various methods for increasing the length of horizontal beams (Martini [1470–1490] 1967, Tomo 1, p. 96).



7 Tibers of ye beames are broken & Tibers are rotten at ends & take no hold in ye wall plates, some of wch must be new timbers, & some may be spliced & mended. the best way of splicing timber to hold a Stretch & couple walls together is this with a tooth in ye joynt & 2 hoopes & 2 bolts, & ye joynt must be 5 or 6 foot long. & let the beames be cocked downe upon ye wall plates.

8 As ye timber of ye west end sets outward, so ye Timber at ye North end wall of ye great crosse setts inward & drawes out ye wall plates at foot, these may be restored againe by twisting

Fig. 12: Salisbury Cathedral. Wren's drawing of how to splice timber (Salisbury Cathedral MS 192, fol. 8r, from Wren Society, vol. XI, Pl. VII).

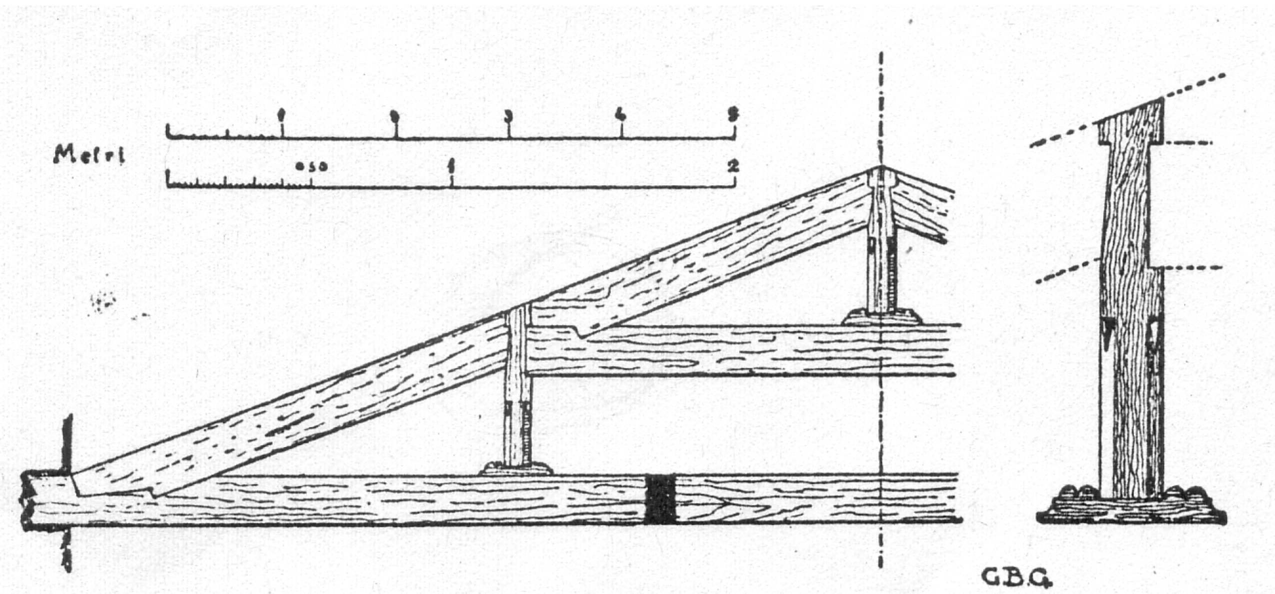


Fig. 13: Variations of the queen post truss in which the posts are embedded in the tie-beam and interrupt the rafters. Here we are not dealing any longer with a unitary structure but with a sort of truss with the king post resting on a trestle. This kind of roof – shown here in a survey undertaken by Giovenale in the Church of S. Domenico in Recanati – is defined as "Tuscan" (Giovenale 1927, p. 343).

Fig. 14: Recanati, Church of S. Domenico, detail of the structure shown above.

more complex structure of the kind described above was more resistant than the simple ones, but at that time there were no means to precisely calculate to what extent this would benefit him, nor there was a developed idea of structural optimisation in the modern sense.

We can say that in the case of the “post-to-tie-beam problem” it seems that technical knowledge and structural solutions did travel quite well through both time and space, and led to the introduction of new kinds of trusses in England. The influence of structures already employed elsewhere in English architecture seems to have been more direct than the literature would have it: the solutions Wren and Jones used were not simply developed from imported designs, but involved the adoption of solutions already common in other contexts, and known to Wren and Jones through the study of mainly literary but also material sources. It seems also that these different “facts” about roof construction existed simultaneously, and structural forms that we see today as being a more *advanced* solution to the proposed problem were used at the same time and in similar circumstances.

(ii) The use of metal connecting elements

Another characteristic that the literature has indicated several times as peculiar to the structures adopted by Wren (and more generally to the seventeenth century: see Campbell 1999, 152; 2000, 52; Yeomans 1985, 72) is the use of metal elements to reinforce the wooden members and especially the metal bands that connect the king post to the tie-beam. In actual fact, although such practice was foreign to traditional English woodworking, it was in common use south of the Alps since Antiquity. Vitruvius himself described a technique for “hanging” the light roofs of the *thermae* from the covering structures by means of metal rods, and such use is documented for other building types as well. Beginning in this tradition, Italian woodworking has always been characterised by the use of metal elements, so much so that in many treatises (including those of Serlio, which Wren owned),[26] the collaboration of metalworkers and woodworkers for the construction of roofs is assumed as a matter of course (see fig. 11). In this regard it

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[26] Serlio 1575, Ch. LXXV, 200. Wren owned an edition of Serlio published in Venice in 1663 (probably *Architettura di Sebastian Serlio bolognese, in sei libri diuisa, ... Nuouamente impressi in beneficio vniuersale in lingua latina, & volgare, con alcune aggiunte. Sebastiani Serlij Bononiensis, De architectura libri sex. ...*, In Venetia: per Combi, & La Nou, 1663). As yet, it has not been possible to clarify if he knew the seventh book, where the most interesting notes and drawings as regards roof structures are found. It is in any case probable that he had seen it, considering that Jones, for example, owned a complete edition of Serlio’s works (*Tutte l'opere d'architettura, et prospetiua, di Sebastiano Serlio bolognese*, ..., in Venetia: appresso Giacomo de' Franceschi, 1619).

is appropriate to recall the Venetian and Florentine woodwork which, since at least the fourteenth century, has shown king post-tie-beam mortised joints reinforced by metal bands.[27]

Another point in which the addition of metal elements usually turns out to be essential is where the rafters (and secondary rafters) rest on the tie-beam. The joint is reinforced in Italian woodwork (starting at least with the fifteenth century) through the use of so-called *staffoni*, U-shaped metal elements having, at the two ends, eyelets into which are inserted, when the band is fastened, shaped metal blades and wedges required to put the system into tension.[28] Such elements, in addition to being documented by material sources, are also described in architectural treatises, as well as in the sketches of many Renaissance architects. It can therefore be supposed that Wren had drawn his inspiration from those in designing the tie-beam-rafter joint, even if in the English examples, instead of *staffoni*, there are U-shaped metal bands nailed to the wooden members whose joints required reinforcing.

Given that the use of metal connections between wooden elements was an unusual practice in England until the seventeenth century, it seems evident that we are facing the adoption of a system from another geographical context (this being the general idea of

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[27] These examples appear to be especially pertinent because they concern solutions of a closed joint, in which the connection between king post and tie-beam is in any case given by the embedding of mortise and tenon. The metallic element is therefore an “adjunct”. The collaboration between metalworkers and woodworkers in Italian carpentry is evident also in the case of the so called “Palladian trusses” where the rafter and the secondary rafter were prevented from sliding on each other by the use of a bolt that held them together.

[28] In the area of Rome, *staffoni* are present in all of the historic roofs preserved today; in any case, none are older than fourteenth century. It is very likely that such elements were in use previous to that. They are located perpendicular to the incline of the rafters, and are sometimes held in place by nails hammered into the lower face of the tie beams. When corbels are present, as a rule the *staffoni* embrace them, taking advantage of the shape in order to guarantee stability. In some cases the joint between rafters (secondary rafter) and tie-beam is guaranteed by a long nail, the effectiveness of which has been, over the course of centuries, the object of discussions between experts.

reinforcing the wooden joints through metal elements) but that the *details* of the single solutions where adapted locally.

(iii) "Composite" beams

The literature places considerable emphasis on what is presumed to be an innovation by Wren in the area of building horizontal beams composed of more than one wooden element joined together. Paradigmatic of this are those composite beams found in the complex roof structure of the Sheldonian Theatre in Oxford (open to the public in 1669, see fig. 8), which caused great curiosity among Wren's contemporaries.[29] Attention was given mainly to the "geometrical flat floor structure" (a device that made it possible to cover large spans with short timbers mutually sustaining each other). This problem had been studied already by Serlio (Serlio [1537-1575] 2001, Lib. I, De Geom., cap. I) and in England by (among others) Wallis (Wallis 1670).[30] But attention was given also to the solution adopted by Wren for the realisation of the composed tie-beam of the trusses used in the Sheldonian Theatre. In this case, though, the literature minimises the links with Italian sources. To demonstrate that influence, we can refer to Serlio, who shows a tie-beam composed of several elements: a design identical to that used by Wren in the roof of the Sheldonian Theatre (figs. 9 and 10). The only difference here is in the kind of metal connections used to secure the joint. While in Serlio's drawing the metal straps "wrapping" the beams are clearly to be seen, Wren chooses to hold the pieces together through passing bars. This drawing was

[29] Particularly Plot 1677, Chapter IX but also underlined in Wren [1750] 1965, pp. 335-342. See also Campbell 2002, 55; Yeomans 1985, 74.
[30] This book was in Wren's library, but he surely already knew Wallis's work, as Wallis was appointed as the Savilian Professor of Geometry at Oxford in 1649; the same year Wren arrived there as a student (see Taylor 2005). Obviously, the work of De l' Orme also needs to be cited in this context.

published in the treatise by Serlio but not as the flat floor design cited above in the first book (in the part dealing with geometry); it is instead to be found in the seventh book, dealing more directly with architecture and (specifically) with roofs.

Indeed, the problem of joining diverse timbers in order to obtain tie-beams (and in some cases rafters) of adequate length to cover large spans was studied since antiquity. In Renaissance manuscripts as well as printed texts, there are recurring suggestions. Without going into a detailed argument, already taken up elsewhere,[31] it is sufficient to recall a few of the more significant examples: sketches contained in Leonardo da Vinci's manuscripts relative to reinforced beams and their prestressing (Codex Atlanticus, 91v., 139r., 17 c-r); the notes by Leon Battista Alberti (1966, bk. III, ch. xii, 230),[32] which compare the action of joined beams to those of the voussoirs of an arch; the manuscripts of Francesco di Giorgio Martini ([1470-90] 1967, f. 22v, pl. 40, see fig. 11); and the notes by Scamozzi in *L'idea dell'architettura universale* (1615, bk. Viii, ch. xii, fac. 344). Here again, we cannot say with certainty that Wren knew the manuscripts, but he was surely aware of the ongoing discussion: he owned a copy of Alberti's book, and Scamozzi's treatise was popular in England at the time.[33] For these reasons it cannot be assumed that this type of composite beam was an independent invention by Wren. Far more likely is the suggestion that he carefully studied the sources available and used the solutions that others had already found for the problem he was addressing. The fact that he looked for inspiration to the Italian literature is in this case even more probable, as the Sheldonian explicitly imitated a classical Roman theatre. We have here a case in which the imitation of the architectural style and the spatiality of the building also involves importing the

[31] See Valeriani 2006 and the literature cited therein.
[32] Alberti's book was present in Wren's library.
[33] Burns 2003.

specific *technical* knowledge necessary to solve the associated structural problems.

In the other buildings designed by Wren (for example in the case of the restoration of the roof of Salisbury Cathedral [see fig. 12] but also in the city churches, in St Paul's, etc.) the type of joint proposed for increasing the length of beams, is a simple joggle reinforced by metal elements. This type of connector is not unusual and entirely consistent with those employed in the same period (and even earlier) in Italy. Some literature suggested that they are "unusual in relying almost entirely on iron to provide their strength" (Campbell 2002, 55) but this was the solution commonly adopted by Italian architects and carpenters: again a hint towards the proof that it is indeed a case of travelling facts about carpentry.

(iv) Roof structures with discontinuous rafters

A further line of research into Wren's work, and the possible influences that the construction techniques of other countries could have had on his woodworking designs, regards the use of structures with discontinuous rafters; that is, where the rafters consist of two pieces which usually have two different pitches. As regards the use of rafters composed of two pieces of timber, it seems appropriate to note that at that time in Italy a type of truss was used that included this detail, with the aim of achieving considerable spans with the use of relatively short beams. Examples of such structures – not very widespread in Italy and largely neglected up to now – are found in several buildings in Venice (Piana 2000, 78) as well as in Bologna,[34] in

[34] S. Petronio. The date of this structure is unknown, but probably goes back to the fifteenth century; see Sciuto/Vaccari 1999; Adamoli 1994.

the Marches,[35] and (at a later date) in the Palazzo della Ragione in Milan.[36] One such structure has been documented in Palladio's Villa Badoer.[37]

At this point in the research it is difficult to confirm if and through what channels Wren came to know of these structural solutions, but they were certainly well suited to the situation in which he had to work, characterised as it was by an already marked timber shortage, exacerbated by a huge demand for timber for ship construction – a sector that tended to use up a large portion of available timber.[38]

It seems logical to suppose that Wren drew some inspiration from the French designs, finally realising usable spaces beneath the roofs.[39] Such a hypothesis is made more plausible by Wren's interest in French architecture. It should be remembered that Wren made a journey to study the architecture of France and was in Paris between 1665 and 1666, and that during this journey he visited many buildings and construction sites:

> I have busied myself in surveying the most esteem'd Fabricks of Paris, and the country round; the Louvre for a while was my daily Object, where no less than a thousand Hands are constantly

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[35] For example in the church of S. Domenico in Recanati (Giovenale 1927, 343; see fig. 7).

[36] Truss designed by Antonio Quadrio in 1726 (see Grimoldi 1983, 81-82). In this case the shortage of timber for construction was very serious and the design patently reflects that, both in the choice of the type of structure to use and in its including the re-use of still-viable parts of the structure that the new roof was intended to substitute, as well as of the temporary centring for the new one. In Leonardo's sketches as well there is a similar example; see the Foster Codex, f. 72v (Leonardo 1992).

[37] The overall design of the building is without a doubt Palladio's own, but it is uncertain whether the architect was also concerned with the design of the details, including the woodworking as well as the direction of the work (see Parmeggiani 1999).

[38] The second war between England and Holland took place precisely between 1665 and 1667, and was fought primarily by sea. The enormous English losses during the Four Days Battle, fought during the very year of the Great Fire are legendary. In 1672-1678 there was yet another war between England and Holland.

[39] For example, the influence of French architecture on Evelyn and Pratt is noted. This last carefully notes the slopes of the mansard roofs and makes observations on the domes of Paris. The dome of the Sorbonne, in particular, was taken into consideration by both Pratt and Wren (Yeomans 1992a, 34).

> employ'd […] in the Works […]. Which altogether make a School of Architecture, the best probably at this day in Europe (*Wren Society* XIII, 40-42).

From his letters it seems evident that Wren had a high opinion of contemporary architecture in France. Foremost were figures such as Bernini and Mansart, whom he had panned to meet before he departed for Paris,[40] but Wren spoke highly even of less major figures:

> I hope I shell give you a very good account of all the best Artists of France […] Of the most noted Artisans within my Knowledge of Acquaintance I send you only this general Detail, and shell inlarge on their respective Characters and Works at another time (*Wren Society* XIII, 40-42).[41]

Although the question about possible influences of French architecture on Wren's roof designs is an intriguing one, this needs to be studied in more detail and will have to be answered in another paper.

Conclusions

These brief notes have made clear how a subject that appears to have already been thoroughly studied, such as the works of Inigo Jones and Christopher Wren, has still shadowy areas, above all regarding the importation of technical solutions. In this paper it has been argued that both Wren and Jones used the technical "resources" coming from abroad, sometimes adapting them to their specific needs (particularly roof structures built or designed in Italy and France either at that time or in antiquity, and known to them either from personal visits to those countries or through written treatises).

This was first demonstrated using a case regarding the general problem of the "post-to-tie-beam". In this regard up to now the influence of some works, such as Baldi, has been distorted. On the one hand, there has been no recognition of the substantial *divergences* in Baldi's

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[40] Wren Society V, 14; see Whinney 1958, 230-231.
[41] See Whinney 1958, 235-238, where the people listed by Wren are identified.

and Wren's structural preferences. On the other hand, Baldi's role in developing particular construction techniques has been exaggerated, with unwonted attribution given to Baldi for the paternity of construction techniques that were in fact widely discussed, and successfully applied in buildings that Wren would surely have known about.

Another case analysed to illustrate the particular relationship between Wren and the resources he used to develop his "new inventions" regards the designs for beams composed of several elements and their relative joints. Gaps in the identification of exemplars of reference are evident in the historiography relative to this issue. Yet this was a common topic in the scientifico-technical debate of the time and a discussion which Wren must have known of. Therefore is to be assumed that he availed himself of the results of this ongoing debate for the development of his own designs. This is one case that supports a more general claim about imported architectural forms; where the imported form brings not only aesthetic but also structural solutions which are adapted in the new context to solve both old and new technical problems.

The way in which facts about construction travelled both across Europe and through time (at least in the cases above), seem to be more complex and diverse than hitherto described in the literature. If on the one hand it is true that new structural forms were more likely to travel as a "general concept" and subsequently be adopted, developed, and implemented in the new context, this cannot be generalised. In fact some examples of very detailed copies have been described in this paper (e.g. composite beams). On the other hand, it is the case that also in terms of general structural ideas some essential concept did not travel. Scientific texts that have been considered as the source of the innovation taking place in England are in fact contradicted in their essence by the structures built in the new context (e.g. post to tie-beam problem). In general terms, however, it seems to be the case that a far more extensive and complex “travelling” of technical knowledge was going on at the time in the context studied and that some existing claims about “innovation” should be revised.

Works Cited

Baldi, Bernardino. 1621. *In Mechanica Aristotelis Problemata Exercitationes*. Moguntiae: Viduae Ioannis Albini.

Becchi, Antonio. 2004. *Q.XVI. Leonardo, Galileo e il caso Baldi: Magonza, 26 Marzo 1621*. Venezia: Marsilio.

Bradley, Simon / Pevsner, Nikolaus. 1998. *The buildings of England. London: The city churches*. New Haven and London: Yale University Press.

Butler, Howard Crosby (edited and completed by Baldwin Smith). 1929. *Early Churches in Syria – Fourth to seventh century*, Princeton: Princeton University.

Campbell, James W. P. 1999. *Sir Christopher Wren, the Royal Society, and the Development of Structural carpentry 1660-1710*, Doctoral Thesis, Department of Architecture, University of Cambridge, Trinity College.

Campbell, James W. P. 2002. “Wren and the development of structural carpentry 1660-1710,” in *Architectural Research Quarterly*, Volume 6, Issue 01. March 2002, pp. 49-61.

Fontana, Carlo: 1694. *Templum vaticanum et ipsius origo. Cum Aedificiis maximè conspicuis antiquitùs, & recèns ibidem constitutis; editum ab Equite Carolo Fontana Deputato celeberrimi ejusdem Templi Ministro, atque Architecto*, Roma: Francisci Buagni.

Harris, John; Orgel, Stephen; Strong, Roy. 1973. *The King’s Arcadia: Inigo Jones and the Stuart Court*, London: Arts Council of Great Britain.

Higgott, Gordon. 1983. “Inigo Jones in Provence” in *Architectural History*, 26, pp. 24-34.

Jones, Inigo. [1573-1652] 1970. *Inigo Jones on Palladio: being the notes by Inigo Jones in the copy of I quattro libri dell’architettura* *di Andrea Palladio, 1601, in the library of Worcester College, Oxford*, Newcastle upon Tyne: Oriel Press.

Lauffray, Jean. 1998. “Contribution à l’histoire de la charpenterie une représentation de ferme à poinçon suspendu en Syrie du nord au VI[e] siècle,” in *Syria: Revue d'art oriental et d'archéologie*, LXXV, pp. 225-230.

Leonardo da Vinci. 1992. *I Codici Foster del Victoria and Albert Museum di Londra*. Firenze: Giunti-Barbèra.

Newman, John. 1988. “Italian Treatises in Use: the Significance of Inigo Jones’s Annotations,” in Jean Guillaume (a cura di), *Les Traités d’Architecture de la Renaissance*, Actes du colloque, Paris: Picard.

Martini, Francesco di Giorgio [1470–1490] 1967. *Trattati di architettura, ingegneria e arte militare*, edited by Corrado Maltese, Milano: Il Polifilo.

Plot, Robert: 1677. *The natural history of Oxford-shire : being an essay toward the natural history of England, being an essay toward the natural history of England.* Oxford : Printed at the Theater in Oxford, and in London at Mr. S. Millers.

Serlio, Sebastiano. [1537-1575] 2001. *L'architettura. I Libri I-VII e Extraordinario nelle prime edizioni*, Milano: Il Polifilo.

Shepherd, Elisabeth. 1989. “Concamerationes in ferro nitentes- Una regola vitruviana applicata nelle terme Romane di Piazza della Signoria a Firenze,” in *Mitteilungen des Deutschen archäologischen Instituts römische Abteilung*, Band 96, 419-431.

Taylor, Paul H: 2005. “John Wallis and the Roof of the Sheldonian Theatre - Structural Engineering in Oxford in the 17th Century,” newsletter of the Society of Oxford University Engineers (unpaginated). Online at 15 Aug 2006 at: http://www.soue.org.uk/souenews/issue4/wallis.html

Tibaldi, Pellegrino. [1590 ca.] 1990. *L'architettura*, Edizione critica a cura di Giorgio Panizza, Milano: Il Polifilo.

Valeriani, Simona. 2003. "Historic Carpentry in Rome," in Santiago Huerta (Hrsg.), *Proceedings of the first International Congress on Construction History* (Madrid, 20th-24th January 2003), Madrid: Instituto Juan de Herrera, Escuela Técnica superior de Arquitectura, vol. 3, p. 2023-2034.

Valeriani, Simona. 2005. "Monaci, dardi e colonnelli. Genesi e caratteristiche delle capriate italiane," in Santiago Huerta (Hsrg.): *Actas del Cuarto Congreso Nacional de Historia de la Construcción*, Cadiz, January 2005, Madrid: Instituto Juan de Herrera, vol. 2, p. 1039-1049.

Valeriani, Simona 2006. *Kirchendächer in Rom. Zimmermannskunst und Kirchenbau von der Spätantike bis zur Barockzeit – Capriate* Ecclesiae*. Contributi di archeologia dell'architettura per la storia delle chiese di Roma*, Petersberg: Imhof Verlag.

Viola Zanini,Gioseffe. 1629. *Della architettura di Gioseffe Viola Zanini … libri due*. Padova: Francesco Bolzetta.

Wallis, John: 1670. *Mechanica: sive, De motu, tractatus geometricus*. Londini: typis Gulielmi Godbid; impensis Mosis Pitt.

Watkin, David John (ed.). 1972. *Architects*, vol. 4 of "Sale Catalogues of Libraries of Eminent Persons," London: Mansell.

Whinney, Margaret. 1958. "Sir Christopher Wren's visit to Paris," in *Gazette des Beaux-Arts*, per. 6, LI, Apr. 1958, p. 229-242.

Wotton, Henry. 1624. *The Elements of Architecture collected by Henry Wotton Knight*, *from the best Authors and Examples*, London: Iohn Bill.

Wren, Christopher: [1750] 1965. *Parentalia: or, Memoirs of the Family of the Wrens; Viz. of Mathew Bishop of Ely. Christopher Dean of Windsor, but Chiefly of Sir Christopher Wren, Late Surveyor-General of the Royal buildings, President of the Royal Society &c.*

In which is contained, besides his Works, A great Number of Original Papers and Records; on Religion, Politicks, Anatomy, Mathematics, Architecture, Antiquities: and most braches of Polite Literature. Compiled by his Son Christopher; Now published by his Grandson, Stephen Wren..., [London: Osborn] Farnborough, Hants: Gregg Press.

Wren society. 1934. *Wren Society. Beeing designs by Sir Chr. Wren for Westminster Abbey, the new dormitory Westminster school, works at Westminster palace for the houses of parliament, and the house, library and garden of Sir John Cotton; also for Sir John Moore's school at Christ's hospital, Newgate street, and for his school at Appleby in Leichestershire*, Oxford: University Press.

Yeomans, David T. 1984. "Structural design in the eighteenth century: James Essex and the roof of Lincoln Cathedral Chapter House," in *Design studies*, vol. 5, 1, p. 41-48.

Yeomans, David T. 1985. *Historic development of timber structures*, in: *Timber in construction*, edited by John Sunley and Barbara Bedding, London: Trada.

Yeomans, David T. 1986. "Inigo Jones' roof structures" in *Architectural History*, 29, p. 85-101.

Yeomans, David T. 1992a. *The Architect and the Carpenter*. London: RIBA Heinz Gallery.

Yeomans, David T. 1992b. *The trussed roof: its history and development*. Aldershot: Scolar Press.

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