

THE GUESTEN HALL ROOF, WORCESTER CATHEDRAL

A Survey by F. W. B. Charles

THE *Guesten Hall*, 1320-1862¹. The roof of the *Guesten Hall* of Worcester Cathedral was removed after the Hall's demolition to the nave of Holy Trinity Church, Shrubhill, Worcester. This church was demolished in 1969-70 and the roof is now disassembled and under repair at the Avoncroft Museum of Buildings, Stoke Prior, Bromsgrove.

The *Guesten Hall* was begun in 1320 on the south side of Worcester Cathedral. It lay north to south, a little to the west of the eastern transept, and the east wall still stands as a ruin. The Hall was a red sandstone building measuring about 70 by 40 feet externally. It was buttressed at the corners and along the side walls, so that the building was divided longitudinally into five bays, each with a pointed Decorated window. The roof, however, was divided into eight bays with nine trusses, the two end trusses being against the external walls of the gables. These gables appear to have been timber-framed, but it is not certain whether both of them were of this construction, or only one—or none. It is likely that the original gables were of masonry throughout and that the timber-framing was a replacement of stone at some later date.

The interior of the Hall was of considerable height, 36 feet to the wall-plate and over 55 feet to the ridge. It was open from the ground to the rafters, and there was evidence of a louvre to let out the smoke from the open hearth. The timbers must nevertheless have been smoke-blackened and the whole roof too dark for a person standing at ground floor level to see much of it

¹ C. Houghton, "The Monastery and *Guesten Hall* of Worcester", *Worcester Diocesan Architectural and Archaeological Society Papers*, vol. 27, part 2 (1904), p. 411 *et seq.* (copy in Worcs. County Archives, St. Helen's Church, Worcester). Houghton refers to other sources of information on the *Guesten Hall*, notably Willis's description in the *Archaeological Journal*, vol. XX (1863), pp. 83-133, 254-72, 301-18.

except its stupendous size. The upper or dais end of the Hall was to the north, and the Hall was built for the entertainment of the guests of the Prior, whose lodgings were part of the same group of buildings. Houghton says of the Guesten Hall that "its interest lies in the evidence of the secular form of profuse and luxurious entertainment which the monks offered to strangers".

In the mid-eighteenth century—the most probable date is 1741—the Hall was made into a three-storey building with a large south-facing dining room on the first floor occupying twenty-four feet in length and the Hall's full width. The importance and style of this room no doubt influenced the architectural and structural alterations to the mediaeval south gable. A sketch of 1861, just before the building's demolition, shows three large windows on the first floor, a centrally-placed door and two shorter windows of the same style as those above at ground-floor level, a parapet wall and a shallow cornice at wall-head level and, most radical of the changes, a hipped roof in place of the gable. The dining room was used for the annual audit of the cathedral Chapter and the building therefore acquired the name of the Audit Hall. Kitchen, brewhouse and domestic offices were on the ground floor, and garret bedrooms were built in among the great timbers of the roof.

Houghton lists, from Willis's plan of Worcester's monastic precinct, no fewer than six important mediaeval buildings destroyed in the 1840's and 50's. In addition, in 1845, when the Dean gave up the old Prior's lodgings attached to the Guesten Hall and moved into the former Bishop's Palace, the ancient Prior's lodgings were also demolished. By 1854 the first task of the newly founded Diocesan Architectural and Archaeological Society was therefore to look into the state of the threatened and rapidly decaying Guesten Hall. G. E. Street's survey commissioned by the Society resulted in a scheme for its complete restoration, estimated at between £900 and £1,000. The Society was unable to raise this sum and in 1862 the Dean and Chapter "took down the walls and gave the timbers to the Rector of St. Martin's".²

² See the 1865 Report of the Worcester Archaeological Society.

The main if not only source of information on the Guesten Hall roof as it was is Street's survey. Neither the R.I.B.A. nor the Victoria and Albert Museum possesses his original drawings and other possible repositories have not been explored. The only reproductions in the Worcestershire archives are two sheets, one giving a longitudinal section of the Hall as originally built (not as it had stood since 1741) and the other a larger scale cross-section and miscellaneous details which do not include the north gable. The more highly finished drawings reproduced by Dollman and Jobbins³ were almost certainly drawn by Dollman from Street's survey. One of these drawings shows the north timber-framed gable, which is also mentioned in the text. There are several discrepancies in detail not only between the two sets of drawings but also between both sets and the actual roof as surveyed. Not all the differences can be attributed to alterations to the roof when it was adapted for Holy Trinity Church. Worth mentioning in particular are the ridge pieces, which must always have been constructed in two sections abutting on each other longitudinally but are shown on both sets of drawings as one timber; and the two upper purlins of each bay which are not carved out of single timbers as shown but have, and apparently always did have, applied and pegged face-moulds. Another drawing (Plate I), an interior perspective of the Hall "as restored," is by H. Eginton, an architect who was probably appointed for the restoration that never took place, or for the roof's removal to the church. This drawing suggests a roof-pitch much steeper than it was but in other respects Eginton is more accurate than either Street or Dollman as, for example, in his drawing of the apex cusping. The mechanically squared rafters and the use of boards for lining the roof are more in keeping with the reconstruction for Holy Trinity Church than with the original roof. Another detail shown by Eginton is a panel of timber filling the spandrel between the principal rafter, the collar beam and the arch brace. This panel is not shown in the other drawings but there is evidence, in the position of certain peg holes in the

³ F. T. Dollman and J. R. Jobbins, *An Analysis of Ancient Domestic Architecture in Britain* (1861-3).

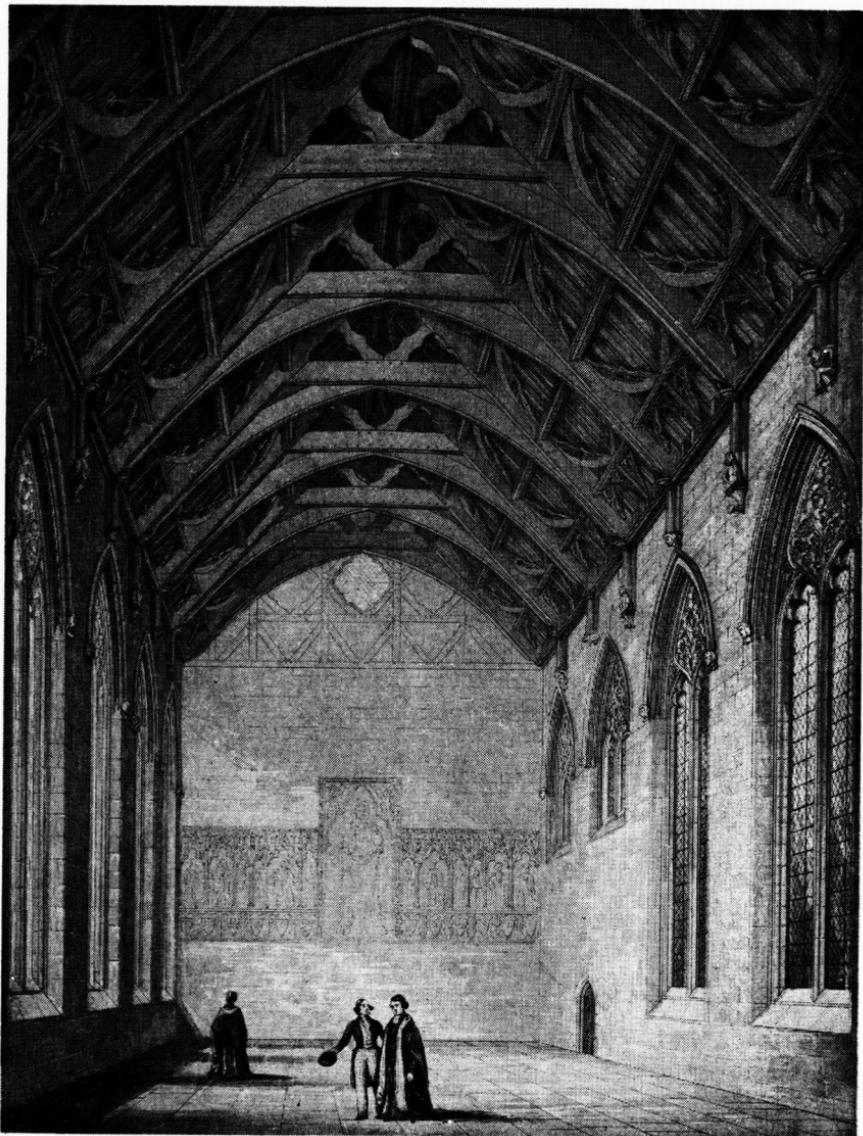


PLATE I. The Guesten Hall, Worcester Cathedral, "as proposed to be restored", drawn by H. Eginton, an architect, between 1854 and 1862.

actual timbers, that such filling pieces existed, though not perhaps in every truss. They did not occur in the roof at Holy Trinity.

Holy Trinity Church, 1865-1969. Holy Trinity Church, designed by William J. Hopkins, was opened in 1865. It was a red sandstone building in Gothic style with apsidal choir, north and south transepts, nave and south aisle; but the western rose window, the transept windows and the transept arcades were of a Cotswold stone. The choir roof consisted of slender scissor-brace trusses springing from angel corbel stones, and its exposed rafters and boarding were painted. The transept roofs were less elaborate and their timbers were varnished. All the roof timbers, including the rafters of the nave, were of pine, which replaced the original oak. In design, elaboration of detail, and painstaking even immaculate craftsmanship the church was typical of Victorian architecture. No less typical, the materials were poor: already the external stone was flaking and crumbling. Further, the roof tiles were machine-made and characterless and a large proportion of them were cracked. Softwood for the whole of the Victorian roofing could only be classed as a temporary material in comparison with the oak of the Guesten Hall roof. Fortunately the repairs and replacements of this roof were all carried out in oak.

The sculptured reredos of Holy Trinity and other features such as the altar rails, columns and capitals, pulpit and font have been photographed in colour as a record of the Guesten Hall roof's setting for the last hundred odd years. This roof was over the nave. The internal dimensions of this nave compared with those of the old Guesten Hall (in brackets) were as follows:

Length, 65 feet 6 inches. (65 feet 4 inches).

Breadth, 29 feet 2 inches (34 feet 3 inches)

Height to the wall-plate, 33 feet 10 inches (36 feet 0 inches).

Wall-plate to ridge, 21 feet 6 inches (19 feet 6 inches).

At the church's opening it was reported that "the most beautiful internal feature of the church is the magnificent roof of the ancient Guesten Hall of the Cathedral Priory, which now covers the nave, and which was restored and adapted to its present position at a cost of £460. The width of the nave being about five feet less than the old Hall necessitated the raising of the pitch

of the roof to receive it, but the effect has been very good".⁴

It might seem from this description that the design for Holy Trinity Church must have been finalised, even if building had not actually begun, by the time it was decided to use the Guesten Hall roof for the new nave. On the other hand, Willis⁵ had written of the Guesten Hall: "the mechanical structure of the hall is extremely bad, chiefly because the principal frames of the roof had a low pitch, and exerted great pressure, in the absence of buttresses at the proper place to receive that pressure". Whether this pronouncement was based on evidence of spread shown by the structure or was merely Willis's reaction to a roof which seemed to defy conventional concepts of Gothic proportions cannot be known. But the roof as it was has been analysed by the engineering firm of Ove Arup⁶ and found to have been mechanically both sound and economical; that is to say, under normal conditions of loading the stresses within each truss member were equally distributed throughout their cross-sectional area. It was also found that the spacing of pegs to resist sheer stress would have been no different had this detail of structural design been determined by modern calculations. The condition underlying these results was that the trusses should be freely supported; in other words, a limited spread at the base of the principal rafters would be permissible but this spread should not have been so great as to affect the stability of the walls, the slight movement being taken up at the wall-plates.

The increasing of the pitch from 48 degrees to $53\frac{1}{2}$ degrees was probably the architect's answer to the problem posed perhaps mistakenly by Willis. But the former may have had other reasons as well, notably the Gothic aesthetic of the nineteenth century and, no doubt, the width of nave required for the intended congregation. Moreover, that the nave was of the exact length required for the roof could hardly have been a coincidence. Add to this the fact that every part of the old structure was in a serious state of decay and that it would have

⁴ Houghton, *op. cit.*

⁵ See Note 1.

⁶ Mr. John Martin, partner of this firm, carried out the preliminary survey of this roof with me in April, 1967, and based his calculations on the drawing made in the light of this survey combined with the drawings by Street.

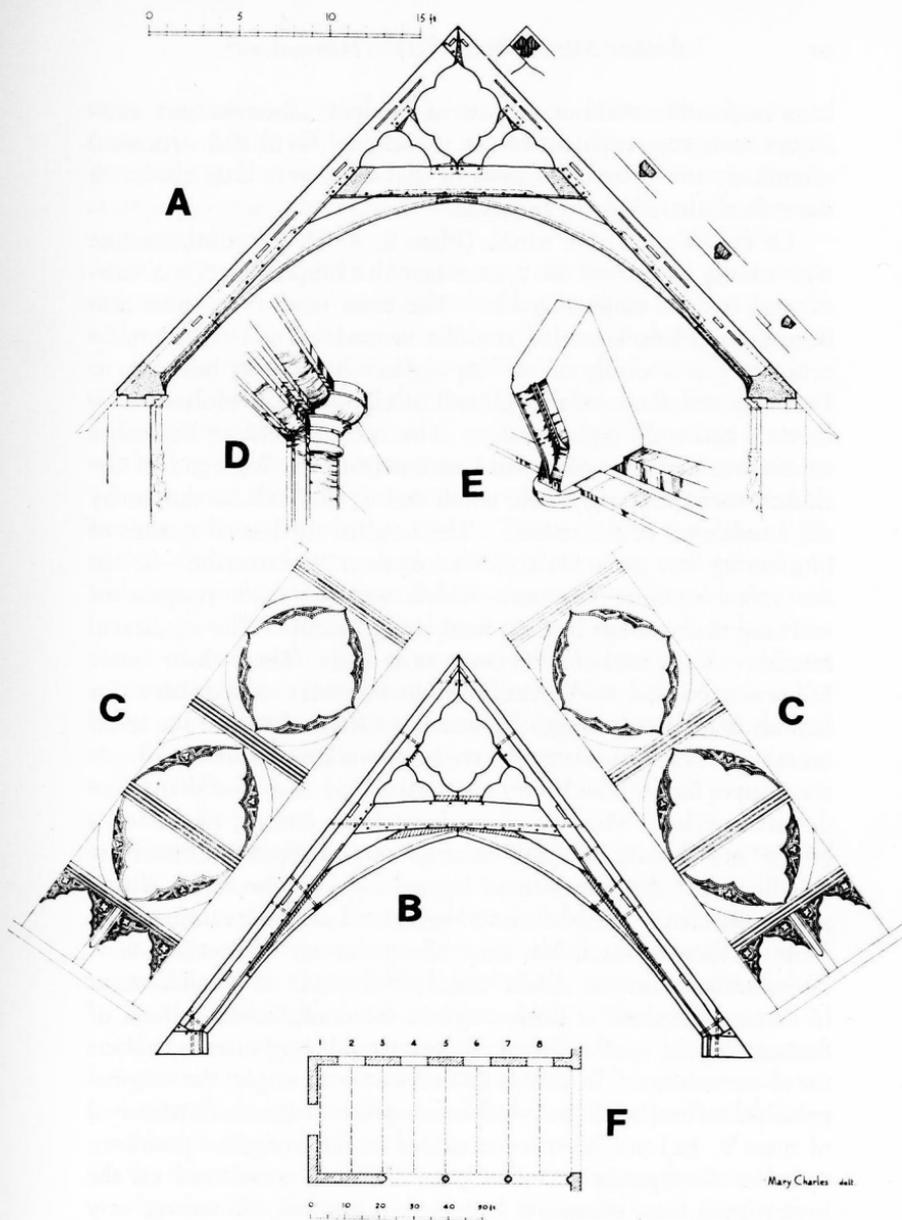


PLATE 11. Details of the Guesten Hall roof, Worcester.

A is a typical truss as it was at the Guesten Hall. The areas shaded were cut from the original members to raise the roof pitch as at B, which shows a typical truss at Holy Trinity Church. To the right of A is a section to show the ridge-piece and purlins. C, on either side of B, shows the wind braces within each bay, D has details of the wall-plate and corbel shaft, and E shows the probable design of the chamfer stop at the foot of the principal rafter. F is a key plan of the nave of Holy Trinity Church to show the numbers and positions of the trusses.

been impossible without the aid of modern adhesives and techniques to restore each timber to its original form and structural soundness, and it becomes evident that there was little choice in the radical alterations to be made.

Of the original nine trusses (Plate II, A, F), the southernmost was wholly destroyed in 1741 when the hipped roof was substituted for the original gable. The truss next to it must also have been at least curtailed at collar beam level and considerably mutilated as a result of the hip rafters having to bear on it. Consequently the roof though still of eight bays at Holy Trinity Church had only eight trusses. The arrangement of the other trusses was the same as at the Guesten Hall, the west end of the church corresponding to the north end of the Hall, as shown by the numbering of the trusses. The original mediaeval system of numbering was generally followed in the reconstruction—not in the actual erection sequence, which was the main purpose of marking timbers, but in their final arrangement. The mediaeval numbers are chisel-cut Roman numerals. These have now become confused with similar style numbers added later for reasons that can no longer be traced. Originally only the main members of each truss would have been marked and those only on their upper face. The Victorian numbers are of no less than three different styles. Most of them have been cut by means of a gouge and consist of small lozenge-shaped digits. Others are chiselled, and the rest formed by an auger. The result is that practically every member now bears at least one number and most of them several, but they all appear on the correct face. Inconsistencies are no doubt mainly the result of misplacement of certain members at some stage in the complicated process of dismantling the roof and then repairing and laying out the timbers for re-assembly. In trusses IV and V, for example, the original principal rafters, with the possible exception of the south principal of truss V, had not been re-assembled in their original positions. Another discrepancy was that truss VIII was numbered on the lower (east) face, because it had been re-erected the wrong way round. On the other hand, such anomalies are occasionally found in mediaeval roofs that have never been altered, so that without further evidence of carelessness or disregard—and there is no

such evidence—it would be wrong to blame the Victorian restorers. Other more minor inconsistencies were numerous, but the numbers as found have given the key not only to the arrangements of the trusses at Holy Trinity but also to the original sequence of erection.

In consequence of the alteration of the roof pitch not a single original mortice-and-tenon joint had survived intact in any of the transverse trusses. Since in timber-framing technique strength is achieved by the exact fitting and pegging of every joint, it is clear that the stability of this roof depended on other means of holding together the timbers of each truss. The system adopted was the typically Victorian one of inserting tie bars and bolts. The outward thrust of the roof as a whole was thus restrained by steel tie-rods at every other truss. These pierced the caps of the corbel shafts and were anchored to the outer wall-plates. In addition, vertical rods threaded through and held up by the arch braces gave intermediate support to the main tie-rods. The thrust of each individual truss was taken by yet another tie-rod concealed within a deep ploughed trench in the soffit of each collar beam, and the separate components within each truss were bolted together, even though vestiges of some of the original tenons still partially engaged their mortices and though these joints were occasionally pegged.

The more radical alterations of each truss in addition to, and chiefly on account of, the change of pitch were that

- (a) the foot of each principal rafter had been cut off and a new oak base substituted in order to obtain the same width of seating across the wall-plates and so the same load distribution on the wall itself as at the Guesten Hall. These bases deprived the principals of their original "chamfer stops", an important refinement of mediaeval carpentry. The most probable original design of this detail has been re-constructed from Street's drawing (Plate II, e).
- (b) the inner face-mould of each principal, leading from its foot to the shoulder from which sprang the arch brace, about four feet above the foot, no longer exists as an integral part of the principal. A new face-mould, following the original design, was nailed on, and this method was adopted not only in those

trusses where entirely new principals had been substituted for the originals but even where the originals had been re-used. The integral face-mould of the latter must have been sawn off and the new Victorian replicas applied. One reason for such drastic mutilation of the original timbers may have been their condition, of which more will be said later, but the over-riding reason was that applied face-moulds fulfilled the purpose of concealing the heads of the inserted bolts which occurred at regular intervals throughout the length of the principals.

- (c) the arch braces, all of which were original members extending from the principal rafter to the collar beam, were altered in length. Moreover, owing to the more acute angle between the principals and collar the arch braces would no longer fit. So packing pieces of elongated wedge shape had to be inserted to close the gaps along the inner edge of the principals and soffit of the collars. The original tenons of the arch braces still partly engaged their mortices but it was a bolt inserted right through the arch brace and principal that secured them.
- (d) the collar beams were reduced in length by about twelve inches at each end and, as already mentioned, a deep trench was cut in their soffit to contain the tie-rod. Generally the soffit of each collar beam was also pared down, partly to compensate for the gap between it and the arch brace.
- (e) the cusped struts in the apex triangles had also to be drastically cut down, re-shaped and finally wedged top and bottom to fit the new angles. Victorian replacements had been used in trusses III and VIII—in the latter because the originals had obviously been destroyed to make way for the eighteenth-century hipped roof.
- (f) the heads of the principals must originally have been jointed, but in the reconstruction these were re-shaped to suit the new angles and simply abutted upon each other. They were held together by a horizontal bolt.

To revert to the main truss members, only four of the sixteen principals that must have been taken down from the Guesten Hall have survived. These principals, apart from the alterations already mentioned, have been extensively repaired. The lower end of that of truss V shows signs of the death-watch beetle and this may

be the clue to why so many of these members were replaced. The death-watch beetle thrives on the larger timbers obtained of necessity from older trees possibly already infected.⁷ The adult insect cannot fly but crawls to other timbers to lay its eggs and re-start its destructive life cycle. The wall-head area, frequently damp, and also the place in such buildings as churches and cathedrals where the largest timbers have to be used, is invariably the area of worst decay. Significantly, the wall-plate at Holy Trinity Church was throughout a Victorian replica of the original. Having regard to the fact that in every other instance, whatever the repair needed, the old timbers were re-used, one must conclude that this replacement of the principals was a matter of necessity, not choice, and that the death-watch beetle was the most likely cause.

The Victorian principals were composite. Each member consisted of an inner section and an outer one laid on top and bolted to it. The advantages of this arrangement were, firstly, that timbers could be used of a smaller cross sectional area than those of the original principals and, secondly, it dispensed with the exacting mediaeval system of the tenoned purlin by which each truss had to be slipped sideways, or reared from a platform at wall-head level, to engage the tenons of the purlins temporarily held in position. With the new system the inner portion of the principal could be erected independently and then the purlins simply laid on with their tenons engaging shallow trenches cut out for the purpose. The outer section of the principal was then placed on top and bolted down. Thus, instead of the strict bay sequence of assembly of the mediaeval roof, from truss I to VIII (or rather IX), in the reconstruction trusses IV and V must have been erected first, since the principals of these were original and properly engaged the purlins, and were followed by the setting up of the other trusses in order of their numbers eastwards, and in reverse order westwards. The placing of the purlins followed the erection of each truss and finally there came the completion of the principals with their upper section bolted on.

The longitudinal structure within each bay (Plate IIc) consisted of three tiers of purlins and a ridge piece divided longitudinally

⁷ H. E. Hickin, *The Insect Factor in Wood Decay* (1963), p. 109.

along the vertical centre line. All these members were moulded. They divided the roof into four tiers of ornamental wind bracing, each tier of a different design from the others. The lowest was subdivided into two panels by a stub intermediate principal rafter extending from the wall-plate to the lowest purlin. These intermediates, like the main principal rafters, stood on a new base and the upper portion of each panel was filled with cinque-foil tracery. The next tier contained quadrant braces springing from the purlin and terminating against the principal rafter on each side. Above was the main purlin with identical wind braces in the tier above but set the other way up. These two sets of wind braces together formed a vertical lozenge divided horizontally by the main purlin. The uppermost tier of wind braces was of similar form but circular instead of lozenge-shaped and there was no purlin dividing this tier horizontally.

All the wind braces were cusped and carved in the manner of fourteenth-century tracery.⁸ There were no less than one hundred and ninety-two of them in the complete roof although a third of their number, or even less, could have fulfilled their structural function in restraining the roof longitudinally. The method of fitting the wind braces was not the same in the reconstruction as in the original assembly, when each bay had had to be completed with all its members before the next could be started. By this method no timber could be removed once the next bay had been fitted. In the reconstruction the mortices for the wind braces were formed in the upper section of the composite principals and were simply placed in position from the top together with the purlins as the final stage of the structural assembly. As a result practically all the wind braces were found to be loose and one of them, in the top tier of bay 7, had at some time fallen out and been lost. Practically all had been patched or otherwise repaired and over seventy wholly replaced.

It is worth noting that the eighteenth-century alterations must have eliminated all the members of bay 8 and several of those in the upper tiers of bay 7. Yet these bays contained at the church

⁸ Illustrated in Dollman and Jobbins, *op. cit.* and thence in M. E. Wood, *The English Mediaeval House* (1965), p. 311.

a high proportion of original members, while bays 1 and 2 had been wholly renewed. This circumstance suggests that the care taken in replacing the trusses in their original arrangement did not extend to the re-assembly of the bay members, practically all of which had had to be repaired.

The church wall-plate (Plate II, D) was Victorian, but of oak and moulded exactly like the original. Instead of the mediaeval joints, however, each section was simply butted against the next and held in alignment by three metal bars or dowels. Longitudinally a dove-tailed wooden connector was let in on the top surface, and here shrinkage had permitted the butt-joints to open.

The corbel shafts, which fulfil only a visual function in unifying roof and wall, had been entirely renewed with the exception of the corner shafts at truss 1. These two shafts differed from the rest in that each, including its capital, was carved in one piece. All the rest not only had separate caps but the face-mould was nailed to the shaft's backing. Moreover, the cap moulding of this truss 1 pair differed in some of its proportions from the others. Unfortunately each of these corner shafts, set in the angle between the side walls and the gable wall, represented in cross-section only a quadrant of a circle and may have been obtained by cutting one normal shaft, representing a semi-circle, vertically from top to bottom. The sculptured stones of the Apostles which supported the shafts were all Victorian and were sometimes named a little quaintly—Jamesless and Barthol, for example. They were poorly sculptured and made no attempt to emulate the mediaeval corbels presumably destroyed or lost before Holy Trinity Church was built. On the north wall of this church Hopkins reproduced the elevation of the east wall of the Guesten Hall, so that the church wall was divided by the windows into five bays. As a result some of the corbel stones of the roof had to be set above the windows and the shafts of these were consequently shorter than the others.

Conclusion. This survey has been primarily concerned with the Guesten Hall roof as it existed at Holy Trinity Church. Its condition following the Victorian reconstruction is summarised by the table below. This shows that two-fifths of the roof's components, excluding its secondary construction, were Victorian.

But the true extent of loss and depreciation as a result of the reconstruction was architectural, not material. These last few remarks therefore are concerned with some of the abstract but all important qualities of the original design. Its theme was contrast. This was achieved not in a "Mannerist" way by apparent contradiction of structure by contrived detail and decoration, but by the completely logical emphasis of function, consistently carried through the entire design. First, this theme was apparent in the two main elements of the Guesten Hall itself. The syncopation of wall and roof bays helped to distinguish the nature of their respective materials as well as their function. Next, the primary components of the trusses, the principals, appeared elegantly slender in contrast with the massive stonework; but as load-bearing members their structural function was seemingly heightened by the elongated arch braces, stretched as it were to their limit by the unusual shallowness of the roof's pitch. This sense of tension within the main load-bearing structure was again heightened by the sheer dead weight of timber within the longitudinal bays, contributing nothing to the roof's strength but nevertheless its essence as the protective covering of the Hall. Hence the emphasis of the decorative treatment on surface qualities. In contrast, the ornamentation of the upper triangles of the trusses by large and crude cusping had the effect of still further increasing the weight, but this time a different kind of weight, supported by the slender primary structure. Lastly, the shortness of the bays between the trusses emphasized the great span of the roof. This span and the flatness of pitch were the recurring dialectic of the roof's architectural character. The reduction of the span at Holy Trinity by nearly six feet degraded it to the category of the safe and conventional, though the size of its timbers remained impressive, as well as its intricacy of detail. If, when the roof is erected, for the third time in its history, as a museum piece at Avoncroft, the height of the supporting walls is reduced to not more than 12 feet, instead of the 30 and more feet at the church, these elements will be clearly seen and felt by the observer.

	Original Timbers	Victorian Timbers	Total
Principals	4	12	16
Collars	8	—	8
Arch Braces	16	—	16
Struts	12	4	16
Ridge Pieces	8	8	16
Upper Purlins	16	16	32
Lower Purlins	11	5	16
Wind Braces	118	73	191
	—	—	—
	193	118	311
	—	—	—