The Spire of All Saints' Church Maldon, Essex

by

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and

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The Romanesque timber-frame spire of Maldon church is unique in England. Not studied in detail until 1992, this hexagonal shingled spire with its three spirelets, set on the triangular plan of the tower walls, has proved to be unequalled in quality of design, constructional detail, lasting quality of form, and technical excellence. Other, comparable, Essex spires are also considered and a typological and chronological sequence suggested on the basis of stylistic dating and the study of the evolution of timber joints.

MALDON TOWN

Maldon, with over 1000 years of history, stands on a promontory running east-west in relatively flat country on the river Blackwater. Now a minor Essex town, Maldon was once much more important; it was a market town in the 1100s and a mint is recorded from AD 958 to 1100.

Whereas today there is a single, combined, parish of All Saints and St Peter, formerly there were two, that of All Saints'—the 'market church', standing at the eastern end of the market place, near two ancient streets, Market Hill and High Street—surrounded by the larger parish of St Peter. All Saints' church was already in existence by 1170, serving a parish of only fifty-seven acres, which closely followed the earthworks probably to be associated with the tenth-century *burgh* (this arrangement may be compared to that of St Peter Mancroft, Norwich; All Saints', Pavement, York; St Runwald and St Nicholas, Colchester; and Great St Mary's, Cambridge). By 1189 All Saints' was in the hands of the canons of Beeleigh Abbey, established earlier in the century by Robert Mantell.[1]

The wealth of medieval Maldon is shown by the changes to the fabric of the church, such that very little is now left of the original building. The south aisle is of mid fourteenth-century date, probably built as a guild chapel, an exceptional piece

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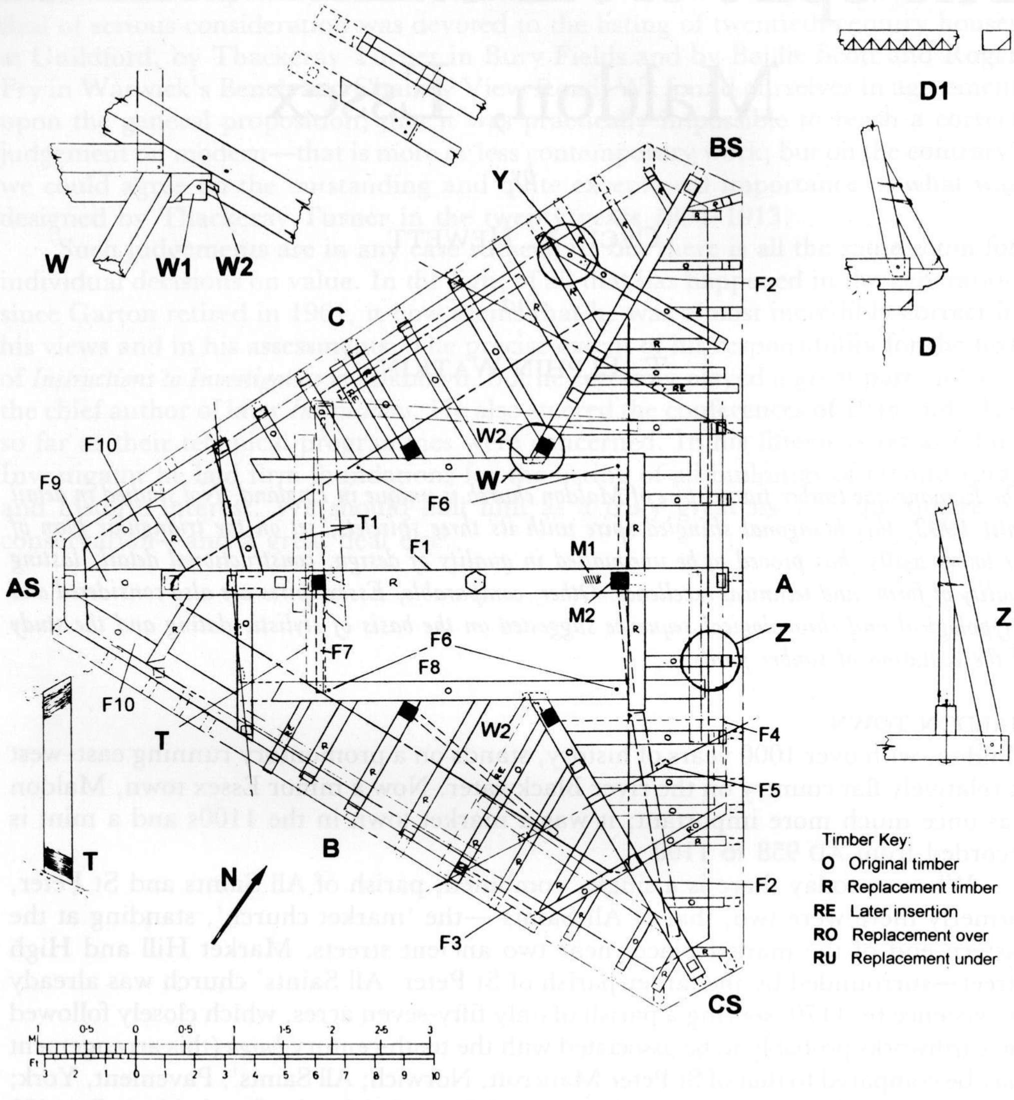

Fig. 1
Plan of Maldon Spire
T. Elphin Watkin

Legend

A-AS, B-BS, C-CS. These are the three standard references used throughout the article for the three planes of the spire

D. Detail of soffit construction as existing now

D1. Detail of added wood frieze—bolted up to the floor and rafter joists

F1. Main spine of spire floor-frame

F2. Angular side-spines

F3. Remnant of a possible outer sill-frame to the spirelets
F4. Floor-beam, a later reinforcement to the floor-joist—bolted in place
F5. Rafters in the intermediate positions, at the entry to each spirelet, mounted on an inverted 'V'-frame, from the meeting point of the main intermediate rafters and spirelet rafters, down to each corner rafter
F6. Pegs to fasten, and locate, the floor-frame of the spire to the under-frame in the tower
F7. Line of the later shoring-brace, which replicates braces on A'-A' in figure 3 where it is shown as A1
F8. Base positions for the six vertical posts in the spire framework
F9. A possible remnant of the original main spire, buried in masonry. A similar piece exists at the opposite end, under present spine
F10. Large plank timbers forming the base of the west spirelet
M1. A carpenter's mark on the underside of the replacement spine, most likely intended for an intermediate under-frame post
M2. An empty mortise on the underside of the replacement spine, most likely intended for an intermediate under-frame post
T. Timber set in masonry, approximatyely 0.94m (3' 1") below the underside of the spire floor. The top face has unweathered shadows of large timbers, approximately parallel to the tower walls
T1. Old timbers used to bolster one of the vertical posts in the spire framework
W. Detail of joint construction at the meeting point of the angular side-spines and the side-spines of the floor-frame
W1. Secret notched lap-joints for a brace to the corner-post of the under-frame
W2. Plugged extended mortises for the joint between the angular side-spines and the side-spines
Y. Detail of an original scarfed end of one of the floor-joists
Z. Typical detail of applied bolted timbers, mostly parallel to the walls from which nailed ashlar-pieces rise to the rafters

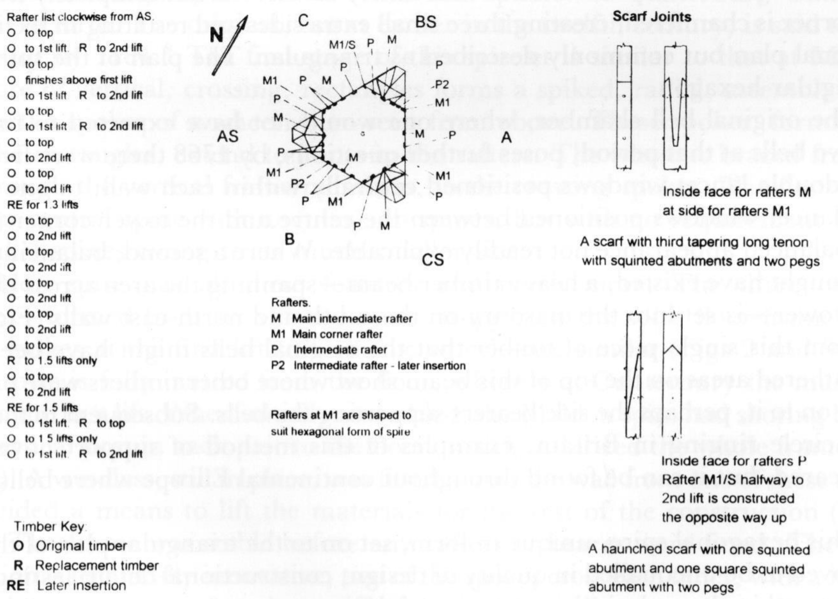

Fig. 1a
Rafter details
T. Elphin Watkin

of decorative architecture, witness to considerable prosperity. In the fifteenth century the wealth of the D'Arcy family led to the building of a chapel. In 1728-9 the original nave and the north-west walling were lost in a re-ordering, typical of the period, designed to provide a greater preaching space. This is now spanned by a single roof, there being few clues to the previous layout. One feature has survived the centuries of change—the tower, itself constructed using many reused items of masonry (Fig. 5).

TOWER AND SPIRE

The west tower is of triangular form. Constructed of rubble stone—with huge flints and rubble on the outside—and generally agreed to date to the thirteenth century, the tower nevertheless contains a considerable amount of reused twelfth-century or earlier material.[2] Inside there is twelfth-century stonework (Fig. 1). Pevsner has described the tower as 'unique in England in that it is triangular—a hexagonal shingled spire, and three spirelets'.[3] The south wall of the tower follows the line of the aisle pillars of the south wall of the nave, and its north-west wall follows the existing road line. The north-east wall has a large thirteenth-century arch opening on to the nave. Whatever the constraints governing its shape, the result is a unique structure.[4] The tower has three storeys of Early English style, but the storey below the bell turret has three rounded Norman openings, the original tower windows. Reused carved stones used in the windows have chevron mouldings (Fig. 8). The tower wall facing the aisle has a break, also visible on the Market Hill wall, where a stone rubble wall—about forty feet long with a doorway—must be part of the original tower as the quoins start above this wall. The tower—forty-one feet high and seventeen feet wide which, when the height of the spire is added totals ninety-six feet—is not completely triangular; each corner is chamfered, creating three small extra sides and resulting in the irregular hexagonal plan but commonly described as triangular. The plan of the spire is that of a regular hexagon.

The original bell chamber, where one would not have expected to find more than two bells at that period, poses further questions; by 1768 there were five bells.[5] It has double lancet windows positioned centrally within each wall; to one side are single lancet windows positioned between the centre and the tower corner (Fig. 4), an unbalanced appearance not readily explicable. Where a second, balancing, single lancet might have existed, a heavy timber beam—spanning the area across the inside of the tower—is set into the masonry on the south and north-east walls (Fig. 1, T). It is from this single piece of timber that the original bells might have been hung. Unweathered areas on the top of this beam show where other timbers were originally housed on to it, perhaps the side bearers supporting the bells. Subsequent to the change to full-circle ringing in Britain, examples of this method of support have largely disappeared, but it can be found throughout continental Europe where bells are still tolled.

This hexagonal spire, unique in form, set on to the triangular plan of the walls, has proved to be unequalled in quality of design, constructional detail, lasting quality of form, and in the technical superiority of the master craftsman responsible. It was first subjected to detailed study in 1992.[6] Shingle-covered, the spire stands straight and true (Fig. 1). It has been suggested that one of the reasons for the decline in the use of shingles on spires was because the shingles caused them to twist.[7] We believe that it is rather the design of the frame which is the governing factor, not the type of covering. Most spires have a frame design that offers very little resistance to twist; natural movement of the timber produces the twisted and bent forms of so many wooden spires seen today (Figs 2–4).

The floor of the spire is set upon the tower walls (Fig. 1) which, as we have noted, has chamfered corners, complicating the base structure. This floor-frame consists of a main spine from one corner to the centre of the opposite wall (Fig. 1, F1) to which two parallel sub-spines are jointed by cross timbers; angular spines run out to the two other corners (Fig. 1, F2). The hexagonal base is formed by dividing each wall into three parts, the centre part forming one face of the hexagon, the other faces being formed by linking these across the corners. Perspective drawings of the spire frame—based on measured survey—attempt to show the spire as it was originally built (Fig. 25). The position of some parts of the floor-frame remains uncertain as the main floor-spine has been replaced, along with certain other timbers (Fig. 3). The general consensus of opinion is that these perspective drawings represent the structure very closely to its original form.

Church towers appear to date from the tenth century onwards and spires of various types first appeared a little later, a period when there was much timber construction throughout Europe. Similar, cross-braced, structures are known in the twelfth and thirteenth centuries (Fig. 4), as at Mamble (Hereford and Worcester)—an area of significant late twelfth- or very early thirteenth-century buildings—and at Brookland (Kent), possibly earlier.[8] Only one other spire of the period displays similar construction techniques, the small south-east spirelet of Canterbury Cathedral, octagonal in form. The original, burnt earlier in the twelfth century, is said to have been rebuilt by 1184.[9] The first stage of this spirelet is similar to that at Maldon; a base core of vertical, crossing, rectangles forms a spiked, radial, assembly which looks like the spokes of a wheel when seen from above. These spokes, forming the tops of the rectangles, extend to joints in the rafters. The whole is braced from the floor, through the vertical frame-members, to the crossing spokes. The floor-frame also has a central spine with angular sub-spines, but with no requirement for the two parallel spines owing to its much smaller size.

Maldon spire has all these features and much more. The three crossing rectangles—formed from six vertical posts rising from the spire floor-frame to the crossing spokes at the first lift to form the wheel—are similar (Figs 2 and 9). The Maldon spire is fully masted from the floor, whereas at Canterbury the mast rises only from the first lift. When initially assembled, the Maldon spire had shoring braces, from a vertical post in each pair to the floor, which stabilized the whole frame (Fig. 3, A'-A'). A windlass, still in place, was fitted across the wall from one of these frames and provided a means to lift the materials for the rest of the construction (Figs 3 and 10). The frame was stable before any rafters or braces were fitted. The wheel construction is technically innovative, two of the spokes cross each other, with a halving joint at the centre; they are then stiffened—and laterally controlled—by housed, horizontal, bracing across the angles formed at the centre, fully controlling their position (Fig. 2). The final two spokes are then mortised and tenoned into these braces to

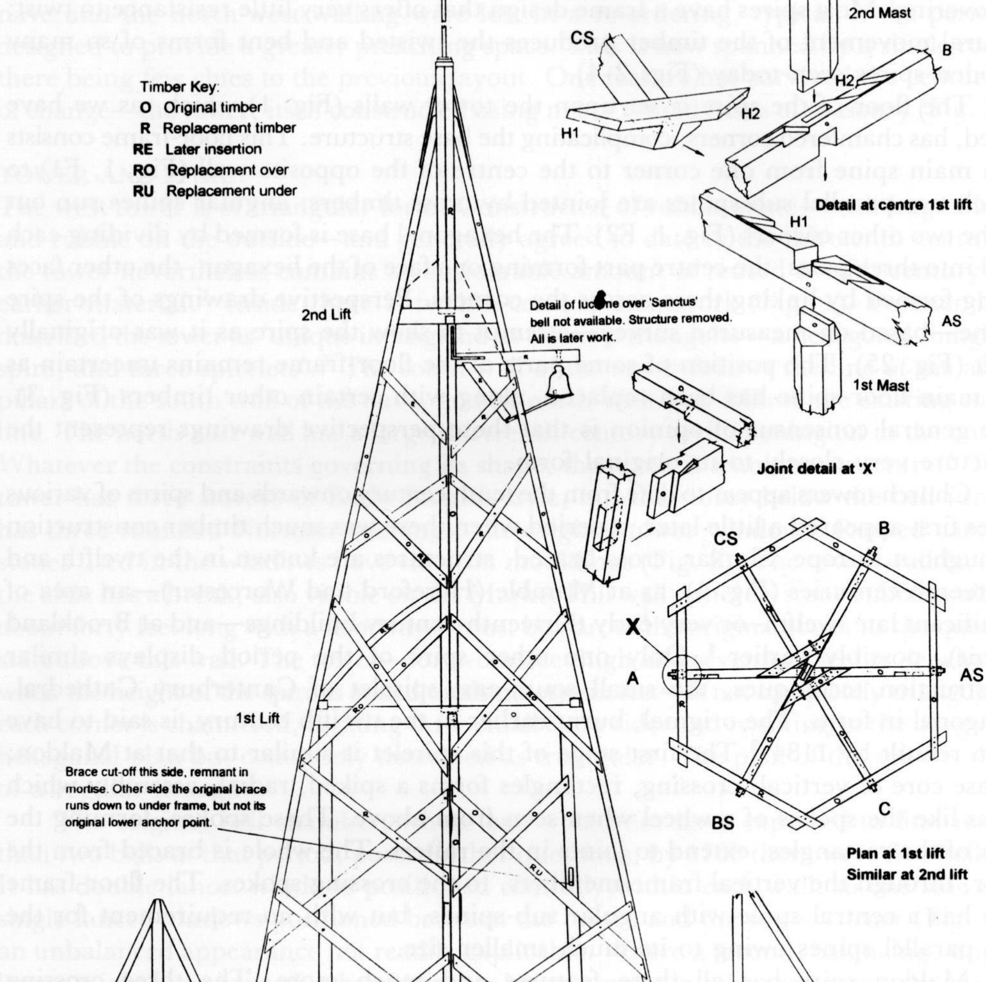

Fig. 2
Maldon spire
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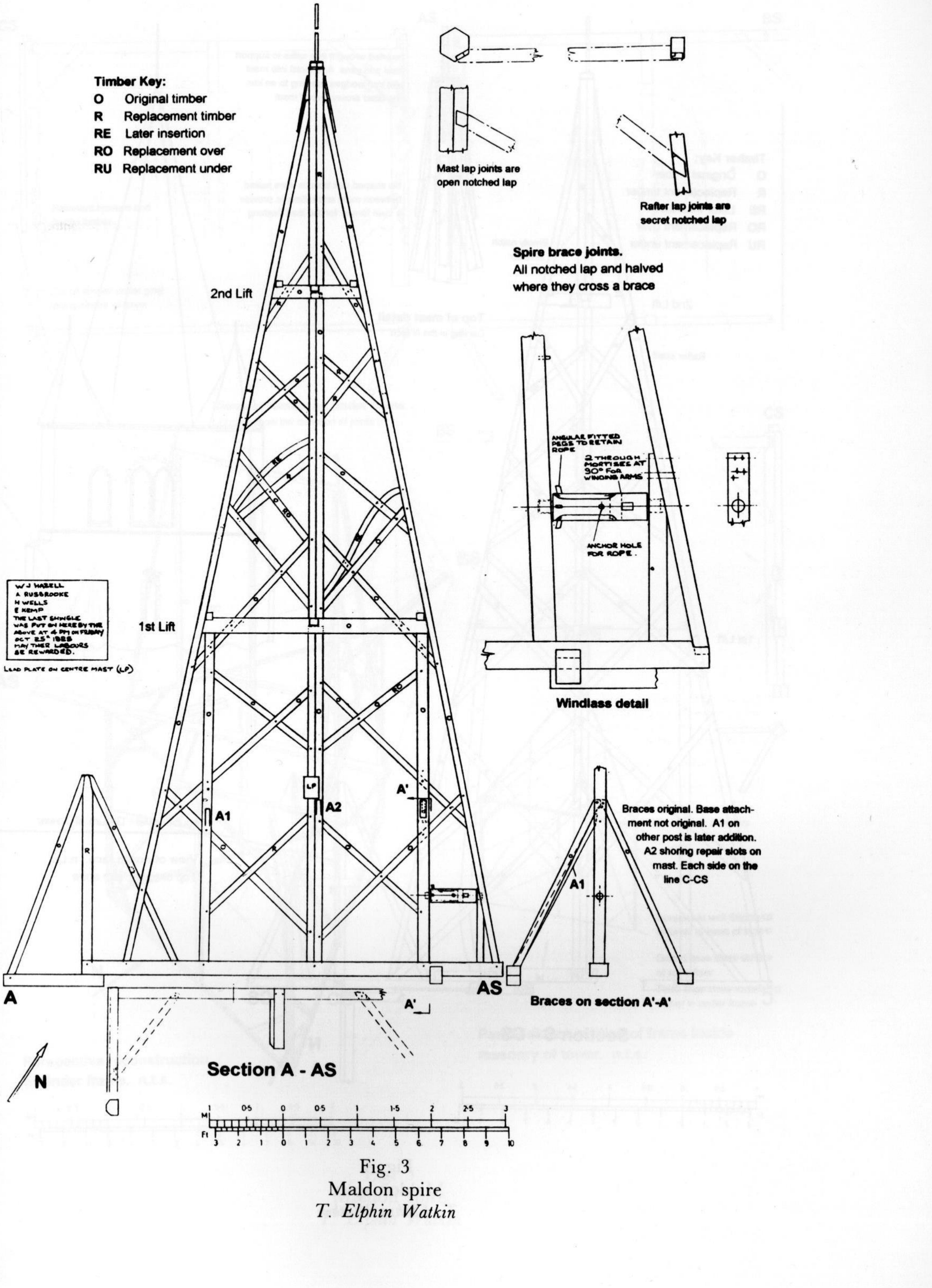

Fig. 3
Maldon spire
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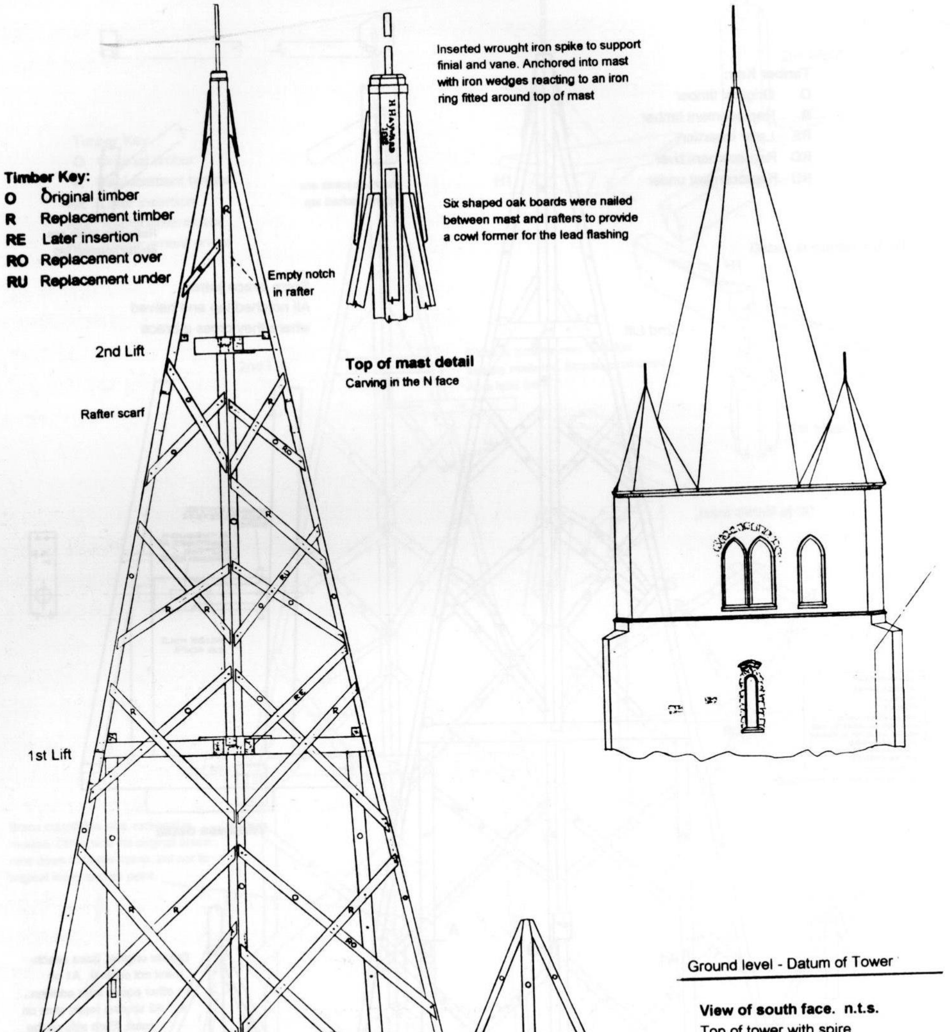

Fig. 4
Maldon spire
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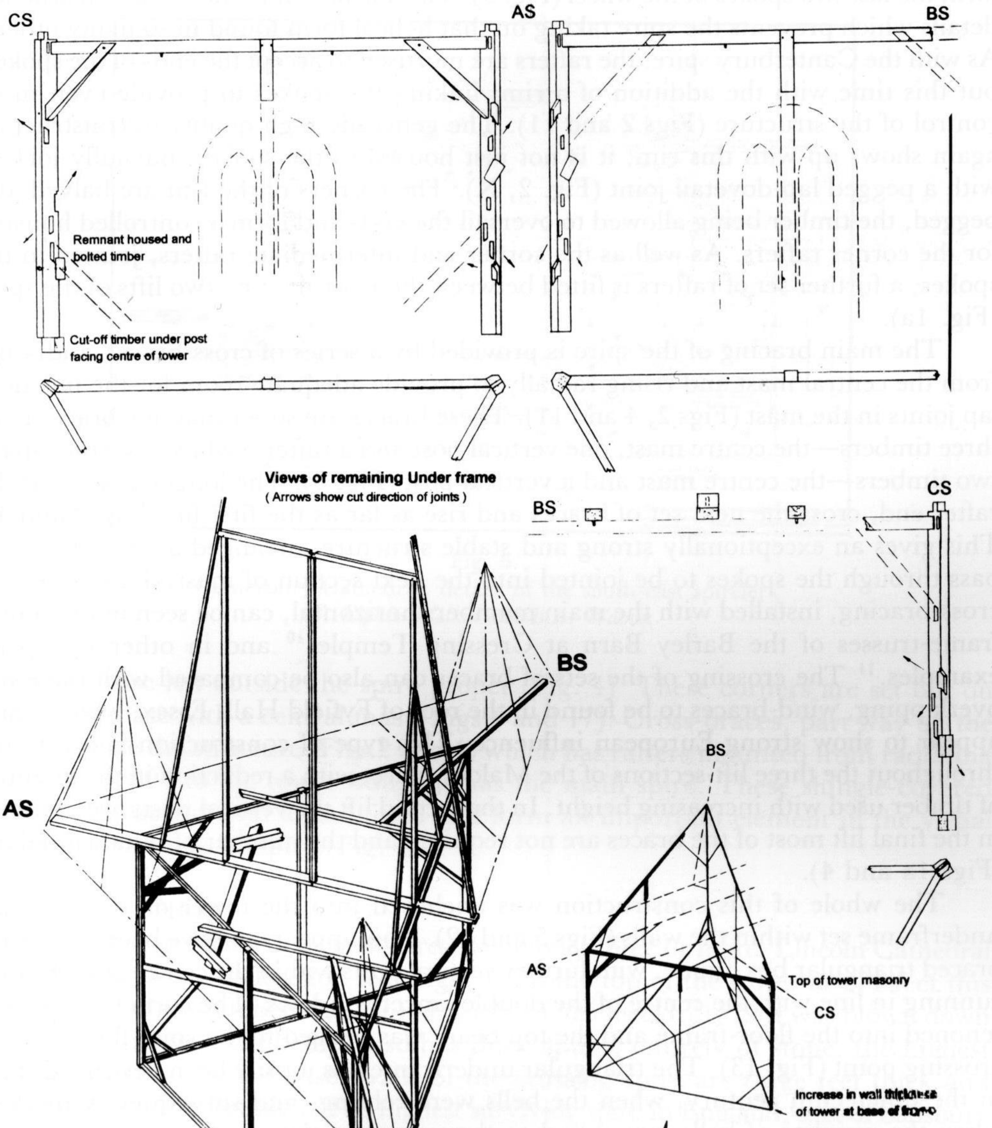

Fig. 5
Maldon spire
T. Elphin Watkin

form the last two spokes of the wheel (Fig. 9). This formation is one of the construction details which prevents the spire taking on that helical form found in so many others. As with the Canterbury spire, the rafters are mortised to accept the ends of the spokes, but this time with the addition of a rim, linking the spokes to provide even more control of the structure (Figs 2 and 11). The generally high quality of construction again shows up with this rim; it is not just housed to the spokes, but fully jointed with a pegged lap-dovetail joint (Fig. 2, X). The corners of the rim are halved and pegged, the timber being allowed to oversail the ends and form a controlled housing for the corner rafters. As well as the corner and intermediate rafters, jointed to the spokes, a further set of rafters is fitted between these for the first two lifts of the spire (Fig. 1a).

The main bracing of the spire is provided by a series of cross-braces, radiating from the central mast and rising radially to provide adequate room for the notched-lap joints in the mast (Figs 2, 4 and 11). These braces are so set that one brace spans three timbers—the centre mast, one vertical post and a rafter—whilst the other spans two timbers—the centre mast and a vertical post (Fig. 3). The longer braces, at the rafter end, cross the next set of braces and rise as far as the first lift (Figs 2 and 4). This gives an exceptionally strong and stable structure, arranged at the first lift to pass through the spokes to be jointed into the next section of mast. This system of cross-bracing, installed with the main members horizontal, can be seen in the centre frame-trusses of the Barley Barn at Cressing Temple,[10] and in other European examples.[11] The crossing of the sets of braces can also be compared with the long, overlapping, wind-braces to be found in the roof of Fyfield Hall, Essex, which again appear to show strong European influence. This type of construction is continued throughout the three lift-sections of the Maldon spire, with a reduction in the quantity of timber used with increasing height. In the second lift the vertical posts are omitted; in the final lift most of the braces are not required and the number of rafters is halved (Figs 1a and 4).

The whole of this construction was anchored into the tower on a triangular underframe set within the walls (Figs 5 and 12). This appears to have been a heavily-braced triangular box-frame, with further vertical posts within the centre of each wall, running in line with the centre of the double lancet windows. The corner posts were tenoned into the floor-frame and the top beam was pegged to the spire floor at each crossing point (Fig. 13). The triangular underframe has mostly been destroyed, first in the nineteenth century, when the bells were rehung, and subsequently in 1922 when the number of bells was raised to the present eight.

The joints used for the bracing within the spire and underframe are a mixture of notched lap-joints, secret notched lap-joints and mortise-and-tenon joints, depending on the position within the frame (Fig. 14). The open notched lap-joints are only used where the braces leave the mast at an angle (Figs 3 and 15). These braces have the lap cut at an angle to the inner face of the timber and are not cut through as might be expected. When fitted, this method covers the notched cutout on the mast to give the visual impression of a secret notched lap-joint (Fig. 16) as found where the braces meet the rafters or vertical posts.

Each corner of the tower was filled by constructing polygonal spirelets on the

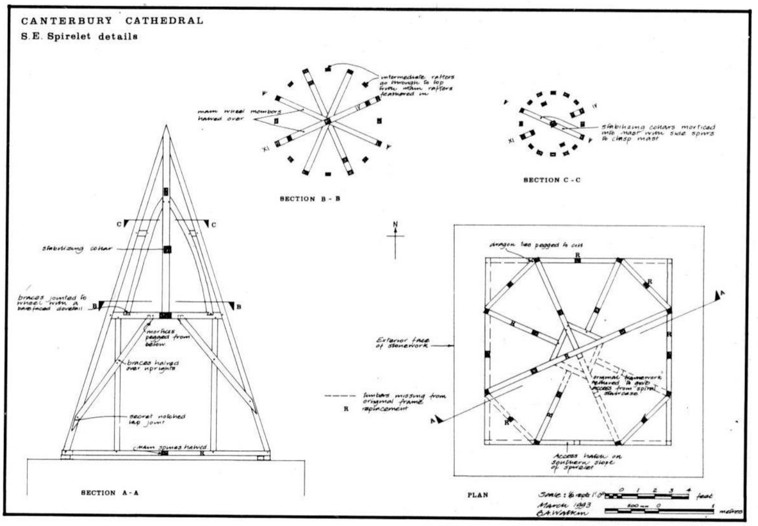

Fig. 6
Canterbury Cathedral: details of the south-east spirelet
T. Elphin Watkin and B.A. Watkin

trapezium base left outside the spire proper (Fig. 4) These corners are set out on a cruciform base with a central mast (Figs 1 and 17). Cross-braces, part way up the mast, stabilize the structure (Figs 2 and 4) which has rafters mounted from radiating beams set at 90° to the tower walls, as has the main spire. These shingle-covered spirelets are capped with a lead finial and form an important element in the visual impact of this unusual spire (Fig. 18).

SOME EARLY SPIRES

Many churches and cathedrals had spires, sometimes three or more. Lincoln Cathedral had three spires, the tallest 254 feet high. With the top of the tower at 271 feet this resulted in an almost unbelievable total height of 525 feet. In 1579 it was blown down in a storm. Lichfield Cathedral also has three spires, entirely of stone, the highest over the crossing. At the base, walls of the crossing spire are three feet thick and taper to the top, 258 feet high. The highest surviving spire in England, that of Salisbury Cathedral, is clad in stone, but has internal timberwork acting as a tensioning system.[13] The total height is 404 feet, of which the spire comprises 180 feet. After the first twenty feet the wall thickness is only eight inches for the whole of the remaining height. It is the only spire in England which can still be 'tightened up'. Its date is uncertain, but the Cathedral foundation stone was laid on 28 April 1220 and the spire was most likely built between 1280 and 1320; it was certainly complete by 1328.

The building of wooden spires by carpenters is a specialized and interesting subject. The timber was worked from green oak, the master carpenter usually choosing the living trees which were then felled and taken to his place of work where they were cut to the required sizes. Long tapering rafters were scarfed to make up the length needed. Maldon spire was first constructed on the ground, but not pegged until it

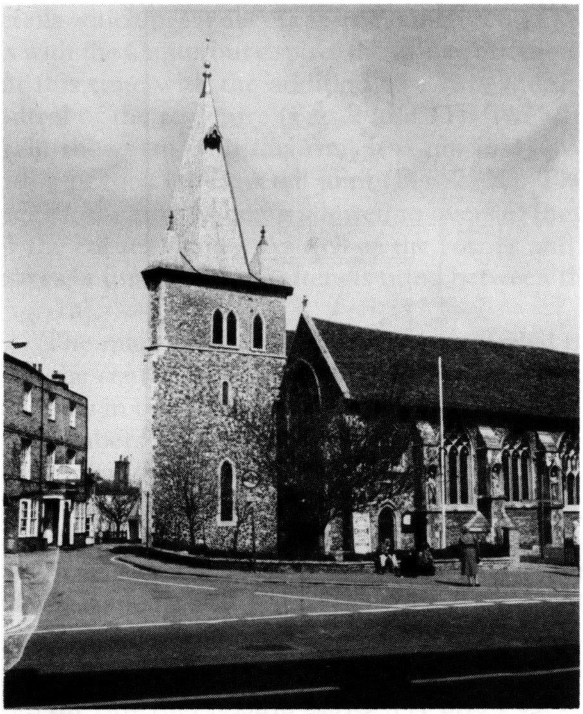

Fig. 7
All Saints' church, Maldon

Fig. 8 *(below)*
Reused chevron carving on window

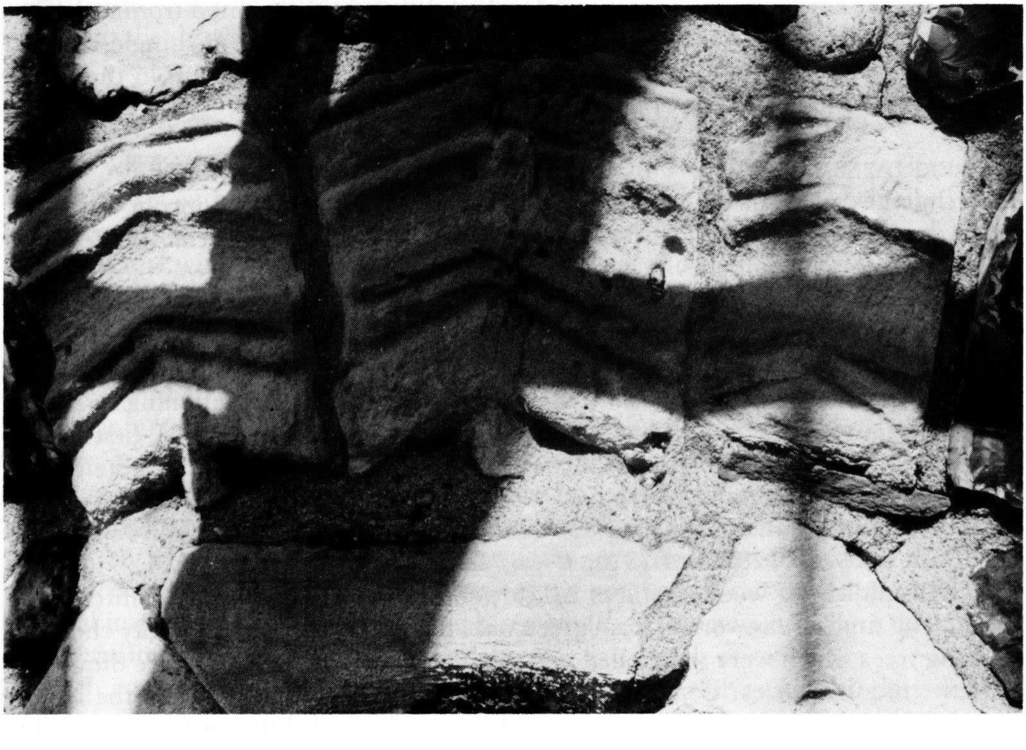

Fig. 9
View to the centre of the wheel at the first lift, from between the two crossing spokes. Housed cross-braces are shown with two other spokes, most joints and braces passing through the first lift

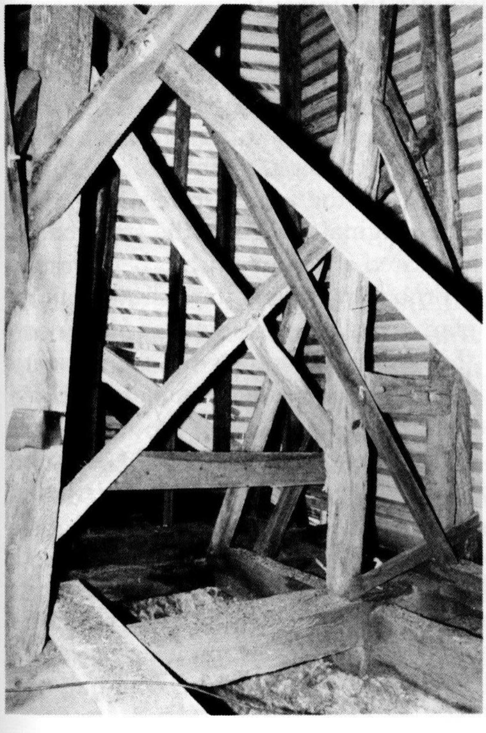

Fig. 10
Spire frame to the north-east showing the mast, one vertical post, rafters and braces, with windlass and shoring

was actually assembled on the tower. The girded-purlins were, of course, made on the bench and assembled when the first mast and the six prick-posts were all in place (Fig. 9).

BUILDING MALDON SPIRE

Starting from the tower plan the master carpenter drew the complex structure required to support the spire. At Maldon, the three chamfered corners were covered by producing the three spirelets on the polygonal plans (Fig. 20). Had they been hexagonal they would not have fitted when placed against the main spire. This suggests that the tower was constructed by the same master carpenter; the drawing also shows the method of construction used to overcome the problem of the triangular shape. There are three tie-beams (Fig. 21), which have two square pieces tenoned and halved and two diagonal pieces tenoned into the three tie-beams. Two diagonal tie-beams were then tenoned into the outer tie-beams, producing three central tie-beams which run into each of the corners (shaded on the drawing). The nineteen main sole-pieces were mortised to the rafters and the three spirelets had rafters mounted on smaller sole-pieces to produce the base for the four roofs.

The triangular timber construction for the upper tower is shown in figure 22. This has three corner posts (one now missing), three middle posts (now all cut off) and six long timbers fixed horizontally between their tops, all mortised and tenoned together. Between one corner post and a middle post (now cut off) was a straining beam, mortised and tenoned to them, put together and diagonally braced, using secret notched lap-joints. This would be constructed just above the tower walls. Once assembled and pegged it would be slipped down into the tower to sit on stone bases. The construction was then completed by fitting the diagonal ties to each corner, with mortise-and-tenon joints to the posts, secret notched lap-joints to the beams and securely pegged in position. The three corner-posts also have mortises for original diagonal ties, going downwards. Surviving evidence is insufficient to permit a complete reconstruction of the frame. Figure 3 shows many, now missing, members, including the three long angle-ties required to hold the floor for the upper spire.

The perspective drawing (Fig. 21) shows the original design of the spire base, or 'floor'. This is a unique, complex and sophisticated structure. It has been much restored and altered, but the drawing shows the probably original underframe of the spire. This frame is of an irregular hexagonal plan, usually referred to as triangular. Of the five tie-beams, the middle one is the thickest and supports the spire mast; the outer two beams make an oblong shape, with square and squinted timbers holding them together. Then there are the two diagonal tie beams, mortised for the sole-pieces as shown in the drawing. These sole-pieces are mortised for the rafters. One rare scarf was used in the underframe, a haunched scarf with one squinted abutment and one square abutment.

At this point, the master carpenter cut the girded purlins of the hexagonal wheel at the first lift (Fig. 23). Because only two collars can pass through the centre, where the mast is jointed, the other two collars are mortised and tenoned into two bracing-pieces housed across the main collars. This may be the first such example in England. Girded purlins were lap-dovetailed to the collars, crossing each other, with halving joints to provide a seat for the intermediate principal rafters. This frame was not cut and prepared by ordinary carpenters; the work was beautifully done and has remained *in situ* at Maldon since its construction sometime between 1213 and 1259.

Figure 19 illustrates the most difficult moment in fitting the first part of the spire. The first spire mast is fourteen feet six inches high, and this, with the six collar beams forming the hexagon, have to be fitted at the top of the tower and pegged in place. All were first fitted on the ground and drilled in readiness for pegging. They were then lifted up to the floor of the spire, fitted and pegged on the floor, including the pre-assembled hexagonal girded purlins. Using a long, strong post with tackle, the assembly was raised to the position shown in the drawing. Once raised, three of the six prick-posts were braced downwards into the floor and the six principal rafters put in place and pegged. This was now strong enough to hold them against the wind, and they were ready for further assembly.

The next stage is shown in figures 23 and 24; the second assembly, smaller but of the same design with the hexagonal girded purlins, was put in place, along with the six intermediate principal rafters. All mortise-and-tenon joints had been pre-cut when the second stage was fitted and pegged. Then the crossing wind-braces could be fitted by notched lap-joints and pegged into position. Some of the rafters were not long enough and were scarfed (Fig. 25). The joints were made in the bottom ends of the rafters, the strongest place for a scarf joint. The joint as used on the principal rafters is shown at figure 25. It is a scarf with a tapering long-tenon with a squinted abutment having two pegs. (Figure 24 shows the scarf used for one principal rafter and all the infilling rafters.)

The spire with its three spirelets is shown in figure 26 (the principal rafters are included but the other twenty rafters are omitted for clarity). The spirelets, being from the original design, have masts about eight feet high, with collar-beams halved through the mast and housed into the rafters. On the east, principal, intermediate rafter near the bottom, a windlass is fitted. This is an original design and was usually used for hoisting the bells, and, in this case, possibly also during the actual construction of the spire.

THE DATING OF SPIRES

The origins of the spire of All Saints', Maldon, are far from clear. Neither documentary evidence, nor that of surviving standing buildings is sufficient to answer the many questions concerning the date of the spire and the identity of the carpenters. Church towers began as separate structures, sometimes fortified and used to store the wealth of the church. By the eleventh century they had generally become an integral part of the main body of the church; whilst found in a number of positions in relation to the nave and chancel, the western position is the most common. The addition of a spire may be seen as a natural extension of the conical or pyramidal roofs. An early example with nine spires is the Abbaye-aux-Hommes at Caen, built 1066–77; the spire of Chartres was completed a little earlier.

Further north, and even earlier, another variation is evident. Russia saw the arrival of Christianity in the tenth century, in areas where construction was confined to the use of timber. The churches, usually octagonal in shape, were variations in

Fig. 11
View up the spire to the first lift, showing the halved-over joints of the wheel-rim and the cross-bracing up the spire

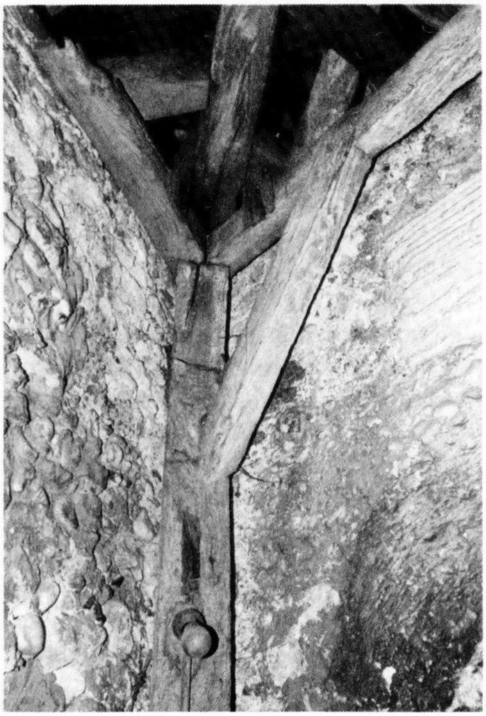

Fig. 12
Upper portion of the east post showing original brace, the other empty brace mortise and top-beams tenoned into the post. The fish-plates must date from the cutting away of most of this under frame

Fig. 13 *(above)*
The north-west tower wall showing top of window with cut-off centre-post above, rafter beams into floor-frame side-spine and angular side-spine to the north spirelet. The cut-off under-frame beam is jointed to the cut-off centre-post and the secret notched-lap joint for the brace to the missing corner-post

Fig. 14
The west post with square and angle mortises, and a secret notched lap-joint for the up-brace to the centre of the main spine

Fig. 15
The spire mast showing an open notched lap-joint with the angular face of the brace cut to fit and to appear—when fitted—to be a secret notched lap-joint

Fig. 16
The junction of the north angular side-spine to the floor-frame side-spine, showing an over-size mortise joint, the base of the vertical frame-post on the angular spine, and an empty secret notched lap-joint for a rising-brace from the corner-post

Fig. 17 *(above)*
The north spirelet base-frame showing both the original and the replacement timber, the end of the scarf-joint on a cruciform base, the spirelet mast, spirelet, and main spire-rafters

Fig. 18
The spirelet, after renovation, showing the junction with the spire, the start of the lead valley, and the new lead finial to the spirelet

watch-tower construction and capped by a polygonal roof, known as a tent roof.[13] The eight-sided roof (occasionally hexagonal, as at Maldon) was extended to a steeper pitch on churches to use the maximum length of timber available. The use of whole trees for each piece determined the length of a wall, or height of a roof, when the builder was aiming at maximum effect. By the thirteenth century this height was again extended by the development of the now familiar onion domes.

Maldon spire must be studied in the context of other known spires. Spires are difficult to date and cannot usually be dated by dendrochronology as the pieces of oak are not thick enough. At least eighty rings are generally needed for dating by this technique and the rafters have only about eighteen rings. Both mouldings and comparative windows can be important pointers, but most have been cut away by the Victorians. In Essex there are six churches with wooden windows, three are placed very high and, from the outside, usually impossible to see. Just one, at Stock church in Essex, is used for this study. Here the belfry has its original windows and doorway. Datable thick timbers survive on the western side, carved in the curvilinear style of *c.*1300–*c.*1350 (Fig. 27). At Stock and West Hanningfield churches, arch-braces have examples of cusps in their decoration. These rare examples of chamfer-cusps appeared as early as the Lancet period but are all exclusively in curvilinear style dated to *c.*1300–*c.*1350 (Fig. 28).

One of the best ways is to study the changes and variations in the joints used by the carpenters. Evolution of joints is not by 'style', but results from progressive evolution as joints were modified to improve their strength. An important joint is the notched lap-joint which has three stages of development in England, between 1155 and 1259, covering four styles and some changes in carpentry techniques. The archaic notched lap-joints were used in Peterborough Cathedral between *c.*1155 and *c.*1177, and in Wells Cathedral between *c.*1180 and *c.*1209, during the Interdict, there appear to be open—or archaic—notched lap-joints. One change was the refined angle of entry, offering maximum resistance to withdrawal. This was used until 1230 in the south transept of Wells and diminished in depth toward the notch. On the west nave the architect, Adam Lock, started to use 'secret' notched lap-joints after 1213, when the Interdict was finished. During this time, Master Alexander, the King's carpenter from 1259 to *c.*1269 and, prior to that carpenter at Westminster Palace and Abbey—at least from 1234—may have invented this joint. Possibly the best architect in England at the time, he used the joint until at least 1259. These changes in type of jointing are invaluable for dating purposes.

Other changes, such as in the type of timber framing, which can be complex, are also helpful. Bradwell-juxta-Coggeshall church is Norman and has a spire of the same style that can be dated to *c.*1100–50; it is in the west nave and has two posts on wooden pads.[14] This is a box-like turret having central studs with saltire braces, all straight. They are secured by archaic open notched lap-joints at their ends. The top-plates are not on jowl-posts, they were on top of four quasi-jowled joints (Fig. 29), jointed with mortise and tenon joints. The archaic notched lap-joints seem to date from *c.*1150, near the end of the Norman period.

Upminster church has a stone tower and timber spire with straight braces and archaic notched lap-joints, but without criss-cross bracing. The last use of this type of joint is at Lincoln Cathedral, in St Hugh's Choir, *c.*1192–1200. The mast has two ways of meeting its rafters: two members may be halved through the mast and then single-dovetailed to the rafters; or at the middle of the mast, mortise-and-tenoned collar beams hold the four principal rafters, with eight short purlins to support another eight rafters (Figs 30 and 31). The whole spire is shown in figure 32.

Navestock church has a complete belfry, with a high spire, meeting the south arcade which is in the Early English style. Its braces have archaic notched lap-joints with mortise-and-tenon joints to the base, implying an earlier date (Fig. 33). The spire has quasi-girded purlins, with eighteen rafters (Fig. 34). This holds sixteen rafters, just pegged together, made with eight timbers, producing a thick girded-purlin.

Maldon spire has braces, and wind braces, with secret notched lap-joints. It has two collars halved between the mast, with two collars carried by, and tenoned into, two cross-pieces. Above are hexagonal girded-purlins, the first such example we have noted. The complete assembly of collars and girded-purlins is carried by six prick-posts, about fourteen feet six inches long (Fig. 26).

Aythorpe Roding church has a west tie-beam across the nave to carry the spire. This has four posts, four middle studs and curved saltire bracing between, with mortised-and-tenoned ends. It has a 'Bradwell' square bell-frame (Fig. 35). The top-plates are mitred and the tie-beams tenoned into a jowl, the earliest full-jowl known. The top plates of all spires need to be on the same level, all horizontal. Various devices were used in order to achieve the desired jointing. Examples such as those of Bradwell spire (Fig. 29) and at Stock (Fig. 36) where a later and even better joint was used. Later still, Aythorpe Roding church had mitred top-plates, which were even more efficient and cheaper to produce. This is shown in Navestock church, when later top-plates were also used with the mitred joints.

At Laindon church, also in Essex, a timber construction—usually called a belfry—stands inside the west bay of the nave. Bells and spire are independent of each other. The tie-beams near the bottom have double tenons and carry the bells, perhaps the earliest such example. The mast starts very high up, accounting for only one third of the whole spire. Tenoned into eight rafters, a criss-cross frame with halved collar-beams, girds and misses the mast and is illustrated in figure 37.

Wingham church, in Kent, has an octagonal spire, sixty feet high and fifteen feet wide. Instead of the usual long mast it has four prick-posts, each forty feet high, at the top of which there is a mast fifteen feet high (Fig. 38). Being so long, the prick-posts are scarfed twice, the scarf-joints having splayed halving, with tenoned under-abutments, held by six pegs. These scarfs date from between *c.*1325 to *c.*1400.[15] This spire and its scarf-joints is an example of the last big changes in spire construction. The evolutionary sequence appears to begin with complete spire masts, high masts, as in Laindon church spire, developing later in Wingham where the mast occupies a top section only and acts like a king-post.

There are spires with different constructions and joints that we are able to place in a typological sequence. Bradwell-juxta-Coggeshall church is in the Norman style. Its location close to London, where it might be expected to be at the fore of development, its straight braces and ancient notched lap-joints suggest a date of *c.*1100. The Upminster spire, although closer to London, still has straight braces and ancient

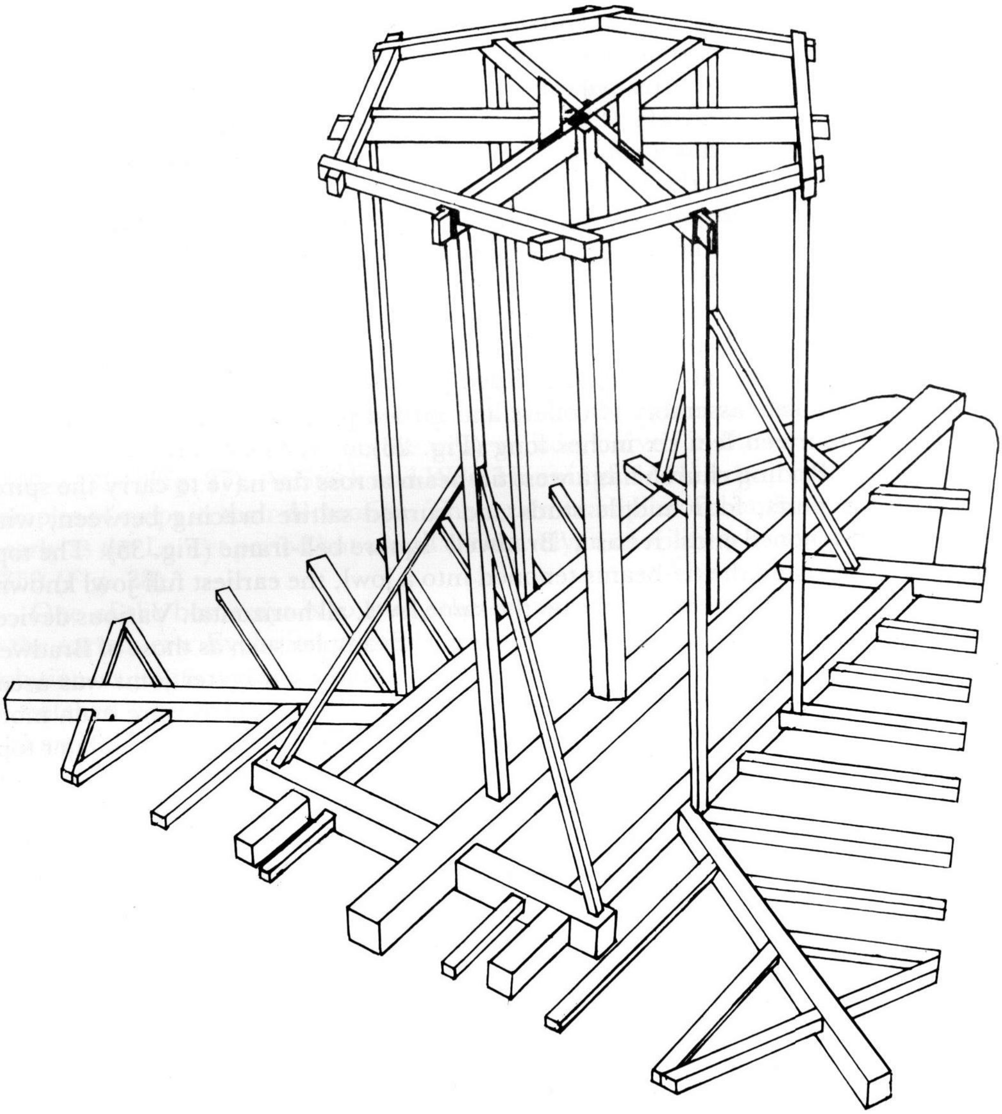

Fig. 19
Spire mast, prick-posts and collar-beams
C.A. Hewett

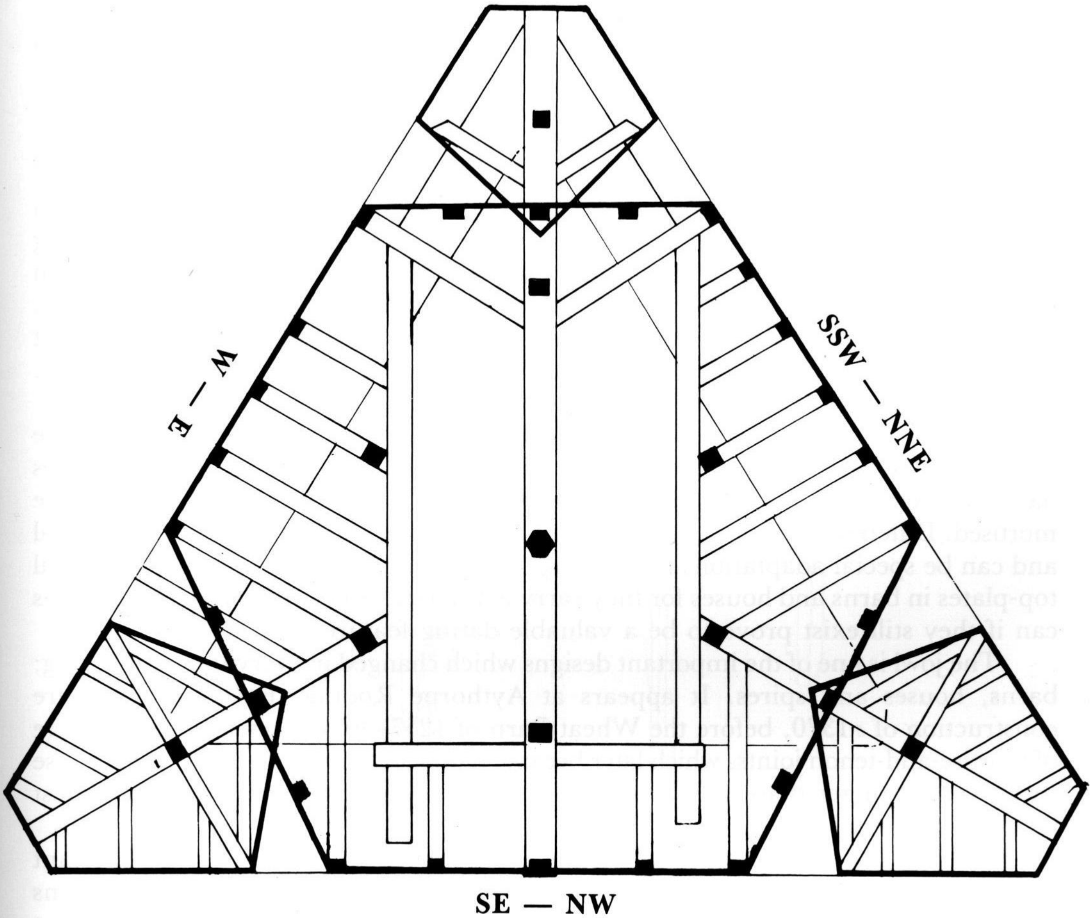

Fig. 20
A polygonal plan and the three spirelet plans
C.A. Hewett

notched lap-joints and early collar-purlins, is later than Bradwell. A date of *c*.1200 is likely. Navestock belfry is almost straight, with a few ancient notched lap-joints, but has four curved braces. It has a better design in the quasi-girded purlins, suggesting that it lies between *c*.1200 and the Interdict at Wells Cathedral (1213).

The Maldon spire which appeared with complete girded-purlins—it may be the first one—has to be after Navestock and we suggest a date of *c*.1230. Aythorpe Roding church follows with a suggested date of 1240-90; it has a box-like turret as does Bradwell. Its curved braces have tenoned ends and the first jowl, similar to that of the Wheat barn at Cressing, dated to 1257-90. Laindon spire, dated to *c*.1350 is later than Aythorpe Roding and Stock; it has double tenons to the tie-beams and criss-cross halved collars which miss the mast. The mast starts very high up, and comprises only one third of the spire. This is higher than Stock church which is dated by its wooden windows to *c*.1325. Completing this sequence is Wingham church spire, on a tower dated *c*.1380. The spire would appear to be contemporary.

Whilst these seven spires can be dated, many cannot and must be assessed by comparative methods. Hadleigh church, Suffolk, for example, has a tower 135 feet high but the timbered spire is only half that height. The tower is dated to the fourteenth century, but the spire may be either contemporary or a later addition. Whilst measuring is useful in order to determine the height, the study of the carpenter's construction is more useful. The posts under these spires, have groundsills or post-pads (cf. Bradwell, Essex), useful for dating. The mast length changes with time; the early ones start from the bottom tie-beam and go to the top. Later they start from the crown (cf. Wingham, Kent); the four prick-posts were stronger than a complete mast.

Mouldings are not usually very helpful. At Mountnessing church in Essex, the posts have applied capitals which are datable. Wind-braces are helpful: early examples have notched lap-joints with three stages of development, but later examples are mortised. Different scarfs can be useful but these scarfs in spires differ from the normal and can be special adaptations for making long rafters. These are not like the usual top-plates in barns and houses for they carry a different stress. The wooden windows can if they still exist prove to be a valuable dating feature.

The jowl is one of the important designs which changed in every timber building: barns, houses and spires. It appears at Aythorpe Roding, Essex, in the spire construction of *c*.1370, before the Wheat Barn of 1257–90 at Cressing. The change of mortise-and-tenon joints, which later became double tenons, only happened because these were stronger than the oldest single tenons. Laindon, Essex, has the earliest example of double tenons.

All these changes in carpentry help to date spires and one of the most important constructions in carpentry was the girded short-purlin, producing the 'round' purlins used to hold and position all the rafters. These are difficult to date but the earliest example appears on the Maldon spire. Two spires in England are unique in different ways: Salisbury Cathedral spire, now the highest spire in England and the only one constructed as a stone spire with a timber support inside; and All Saints', Maldon, the only one in England on a triangular tower, having a hexagonal spire. Salisbury spire has nothing in common with any other, but Maldon spire is comparable to other wooden spires in England. With its triangular tower plan, it is unique among spires in having a hexagonal plan.

It seems perfectly natural that an affluent town like Maldon, in the twelfth and thirteenth centuries, strongly linked to the abbey at Beeleigh, should seek to express its wealth and power by architectural display, and, in the case of this timber spire, a feature sufficiently prominent to be a landmark for many miles.

Essex has a remarkable surviving heritage of timber towers, belfries and bell-cotes, which show the development in the use of timber from 'square and straight' in the earliest, to generally square timber-work, but with the use of curved braces and arch members by the end of the thirteenth century (*infra*). It is therefore not

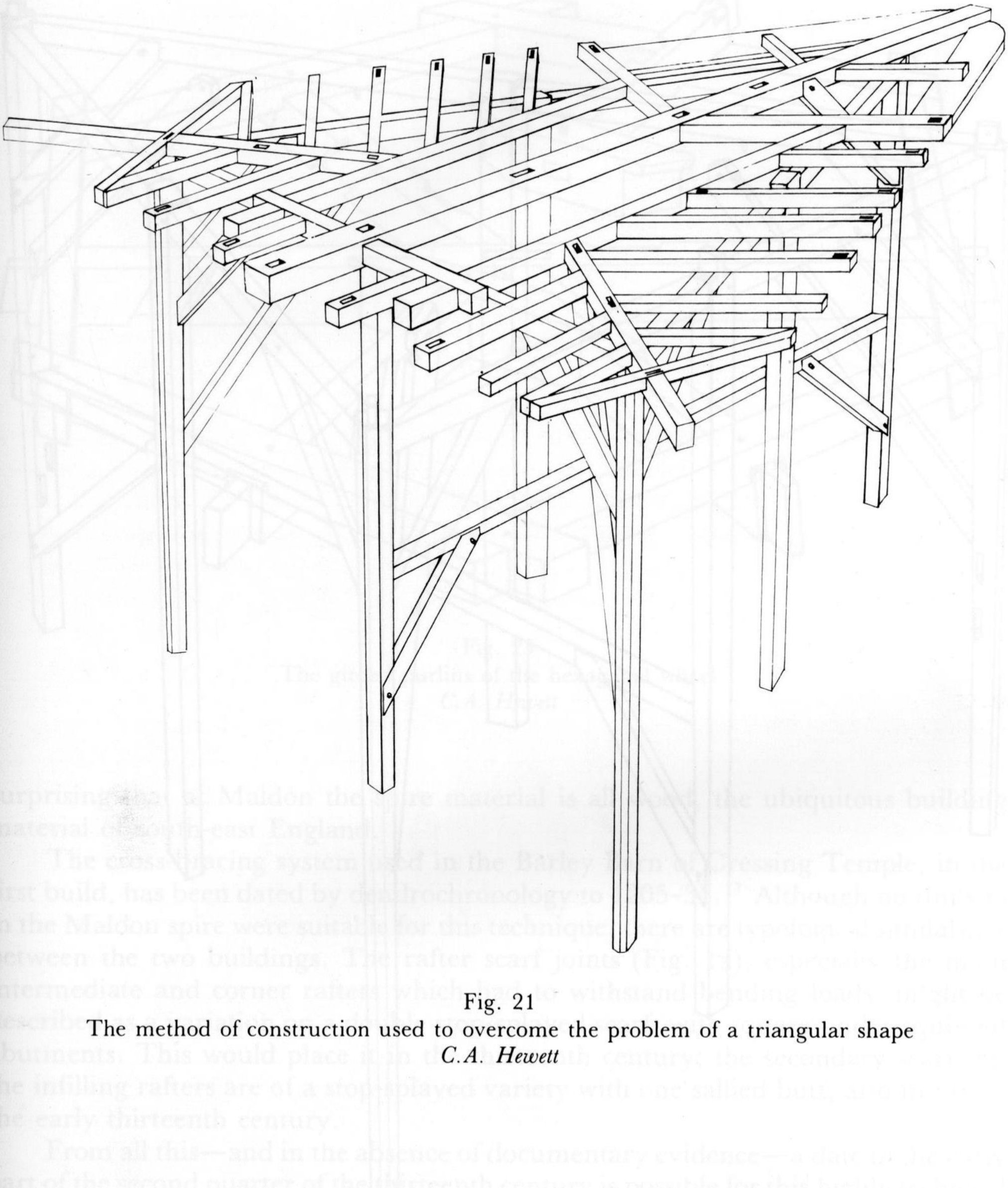

Fig. 21
The method of construction used to overcome the problem of a triangular shape
C.A. *Hewett*

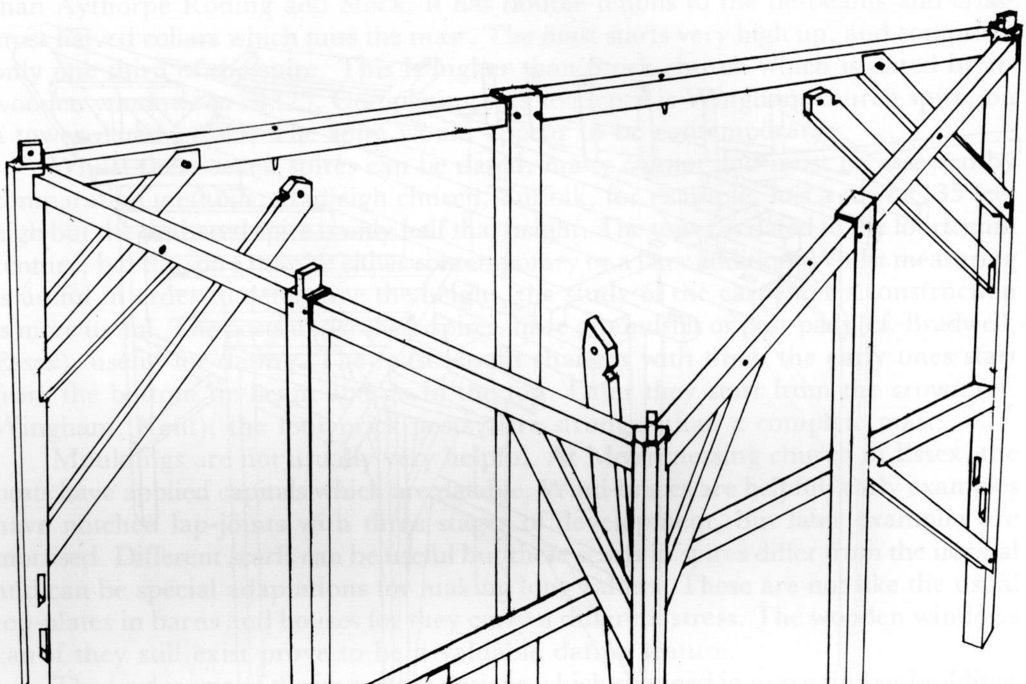

Fig. 22
Triangular timber construction for the upper tower
C.A. Hewett

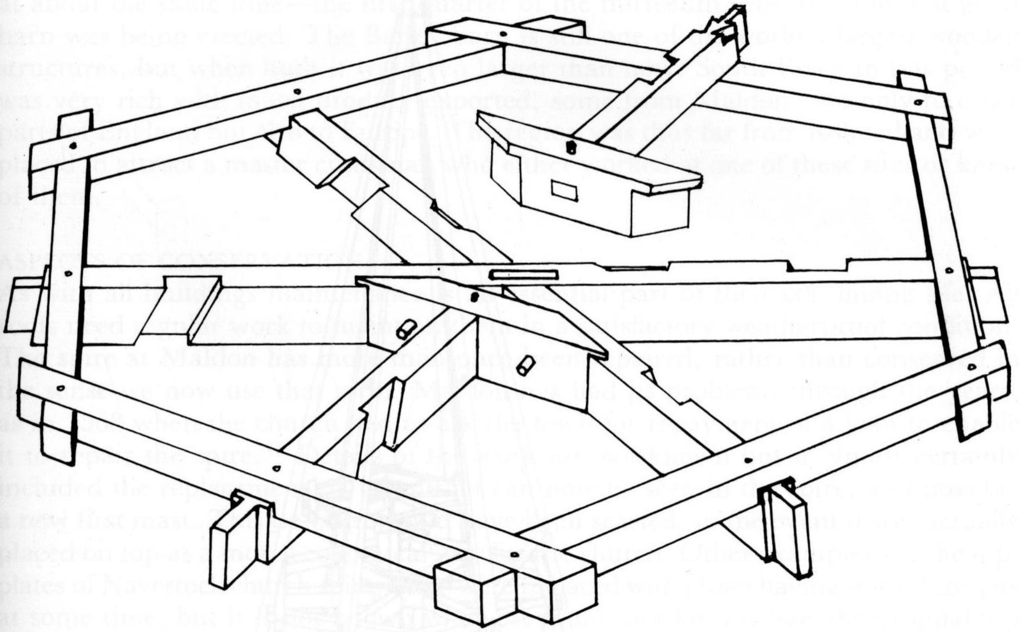

Fig. 23
The girded purlins of the hexagonal wheel
C.A. Hewett

surprising that at Maldon the spire material is all wood, the ubiquitous building material of south-east England.

The cross-bracing system used in the Barley Barn of Cressing Temple, in the first build, has been dated by dendrochronology to 1205–35.[17] Although no timbers in the Maldon spire were suitable for this technique, there are typological similarities between the two buildings. The rafter scarf joints (Fig. 1a), especially the main intermediate and corner rafters which had to withstand bending loads, might be described as a variation on a double stop-splayed scarf, with square under-squinted abutments. This would place it in the thirteenth century; the secondary scarfs on the infilling rafters are of a stop-splayed variety with one sallied butt, also in use in the early thirteenth century.

From all this—and in the absence of documentary evidence—a date in the early part of the second quarter of the thirteenth century is possible for this highly technical construction. The structure does not appear to have been equalled in later spires, many of which have deformed and twisted. It can be seen that, even in nineteenth-century spires, the frame construction has never matched that of Maldon in technological inventiveness.

As to the identity of the exceptional master craftsman we can only speculate. It is to Beeleigh Abbey that one turns for an obvious source of skilled craftsmenship in the area. The site is less than eight miles from the Templar's site at Cressing where,

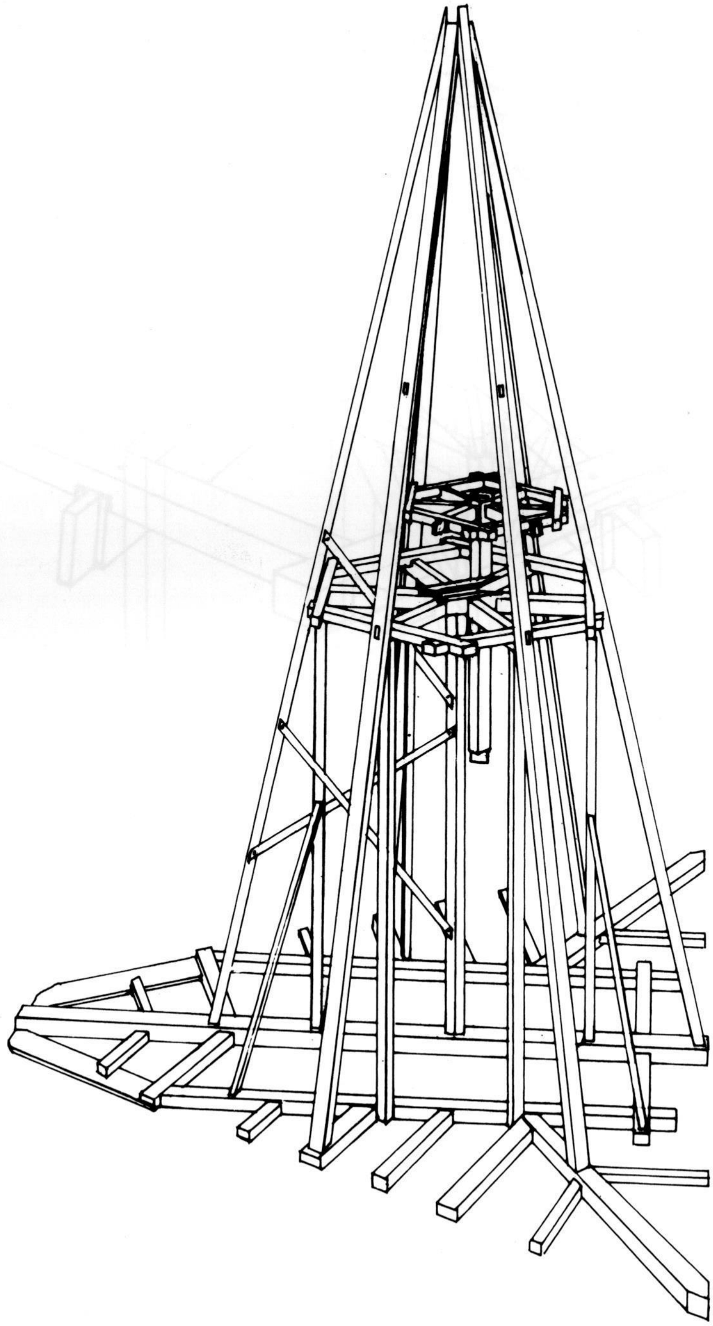

Fig. 24
The second assembly, with hexagonal girded purlins and intermediate principal rafters
C.A. Hewett

at about the same time—the first quarter of the thirteenth century—the first great barn was being erected. The Barley barn is still one of the world's largest wooden structures, but when built it was even larger than now. South Essex in this period was very rich with much produce exported, some from Maldon, not only to other parts of England but also to Europe. The region was thus far from isolated and well-placed to attract a master craftsman who either worked at one of these sites or knew of them.

ASPECTS OF CONSERVATION

As with all buildings maintenance is an essential part of their continuing life. All roofs need regular work to maintain them in a satisfactory weatherproof condition. The spire at Maldon has more than once been repaired, rather than conserved in the sense we now use that term. Maldon has had its problems through the years, as in 1568 when the church had to ask the town for repayment of a loan to enable it to repair the spire.[18] Details of the work are not known but it almost certainly included the replacement tie-beam that can now be seen in the spire, and possibly a new first mast. This tie-beam could have been scarfed, in the event it was actually placed on top as a more economical way for the church. Other examples are the top-plates of Navestock church spire; these were replaced with plates having mitred corners at some time, but it is not known when. It is also not known how the original top plates were jointed.

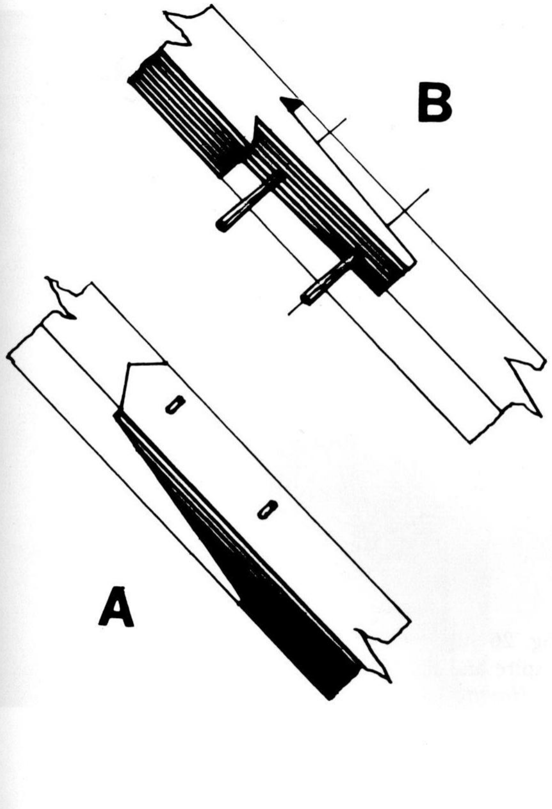

Fig. 25
Scarf joints
C.A. Hewett

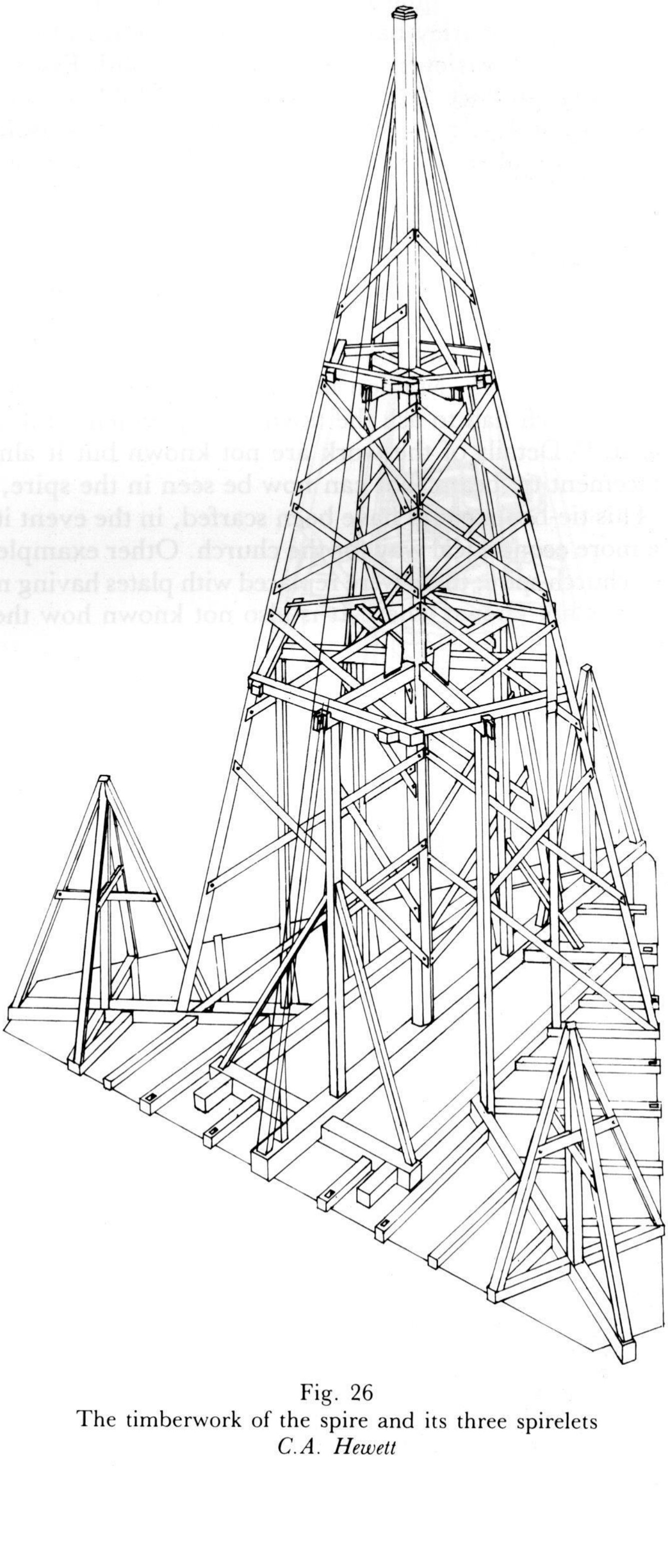

Fig. 26
The timberwork of the spire and its three spirelets
C.A. Hewett

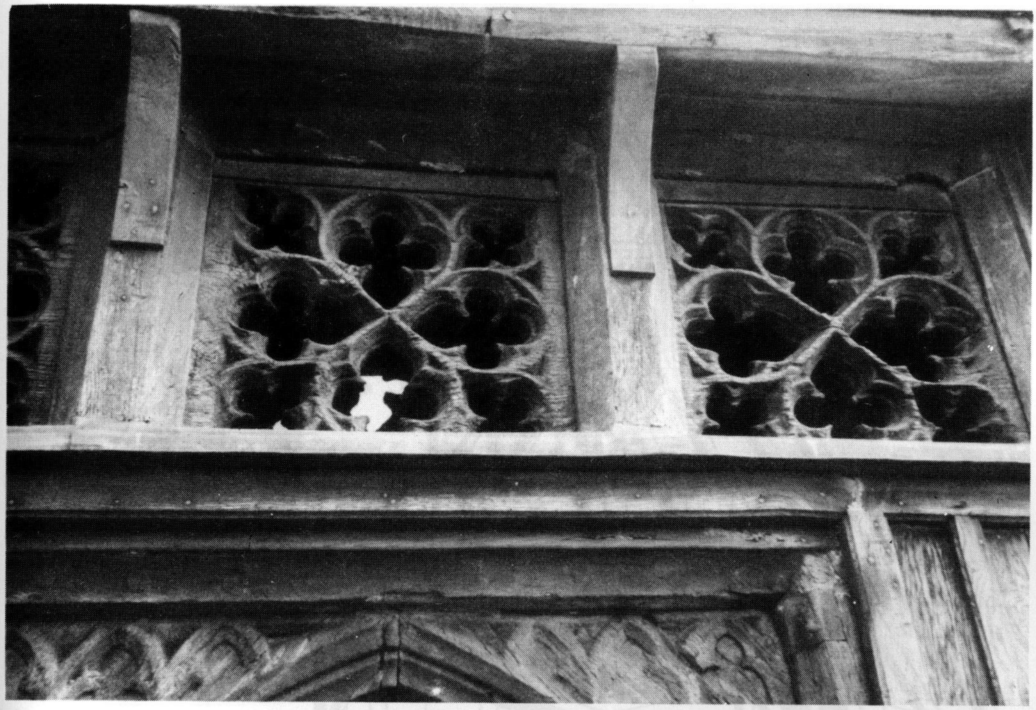

Fig. 27 *(above)*
Stock belfry, Essex, with its curvilinear windows

Fig. 28
Stock belfry, Essex: a cusped, foliated, arch-brace

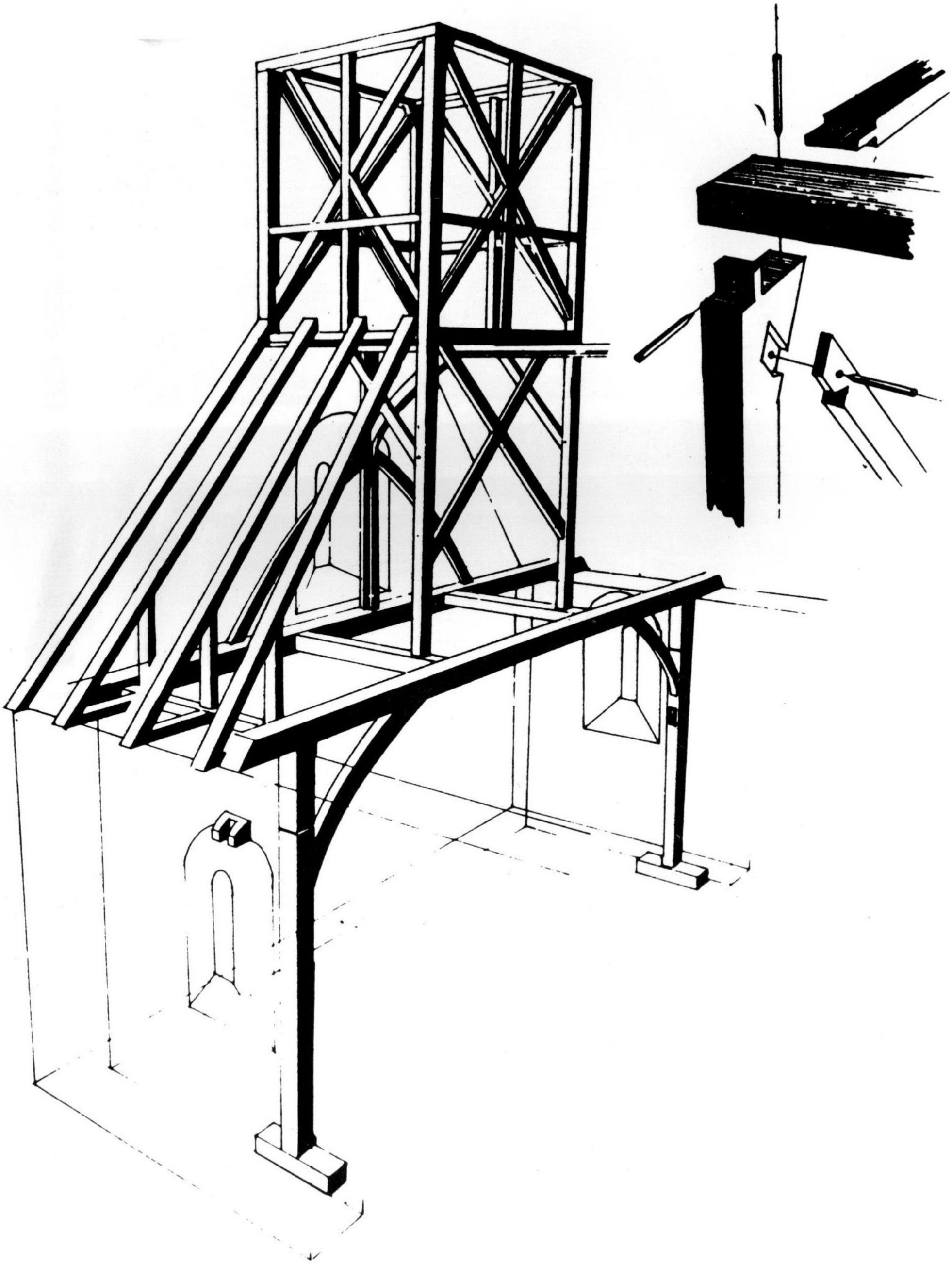

Fig. 29
Bradwell-juxta-Coggeshall, Essex: the bell turret
C.A. Hewett

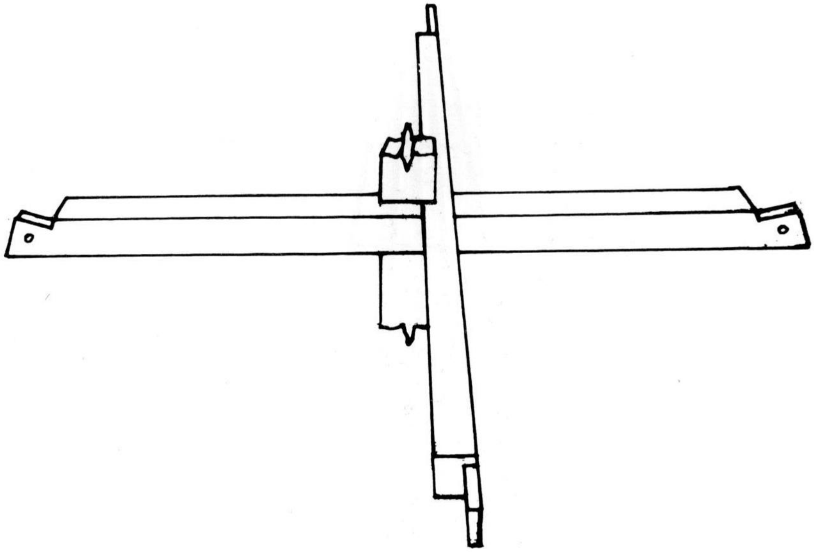

Fig. 30
The jointing of mast and rafters: the halving of members through the mast; and joined to the rafters by single-dovetail
C.A. Hewett

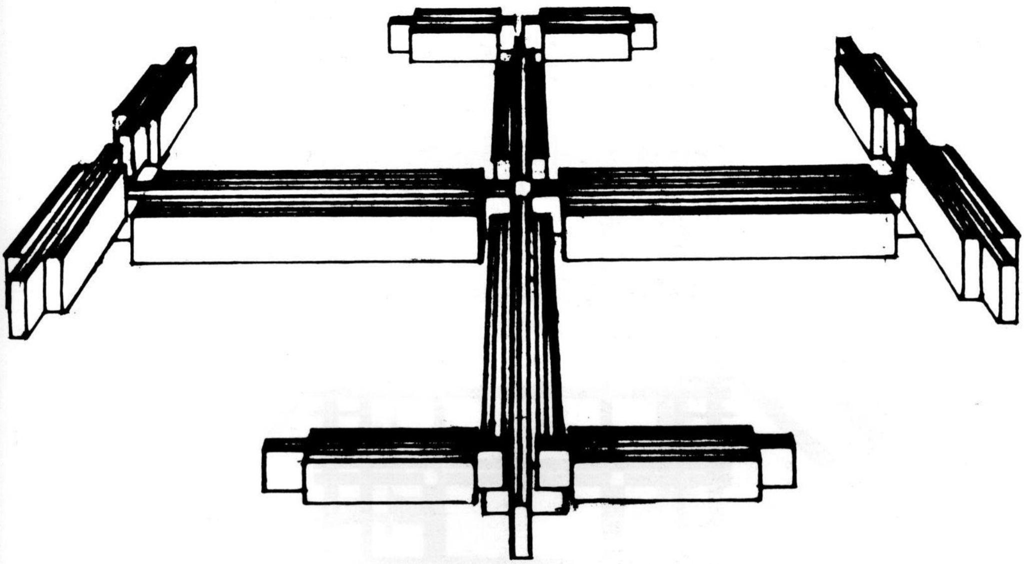

Fig. 31
The jointing of mast and rafters: collar-beams, mortised-and-tenoned to the mast, hold the four principal rafters, with eight short purlins to support a further eight rafters
C.A. Hewett

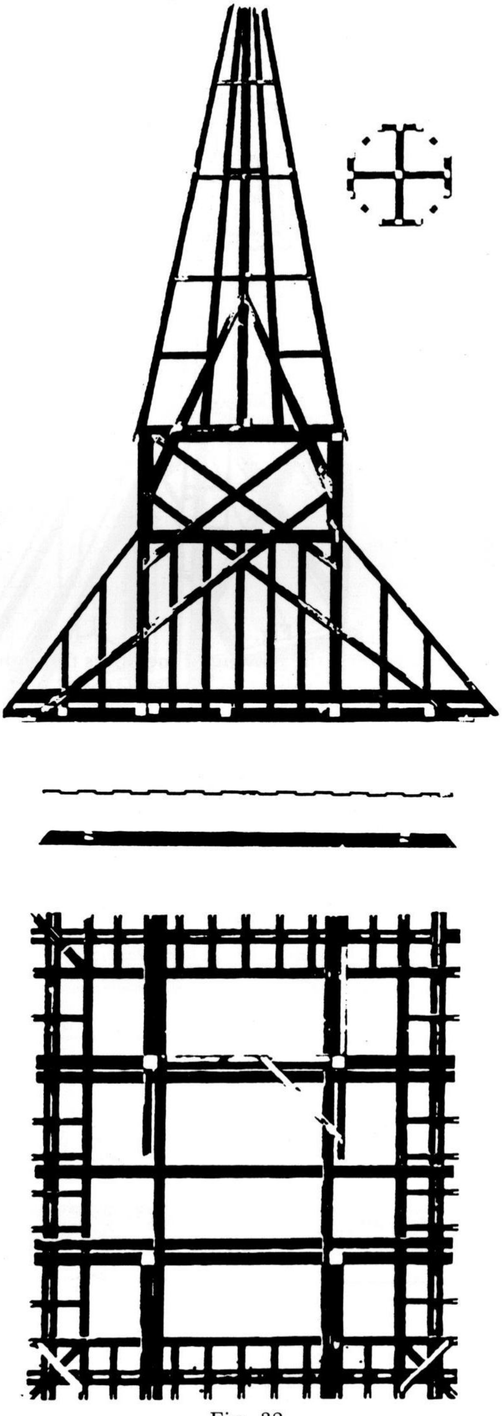

Fig. 32
The spire of Upminster church, Essex
C.A. Hewett

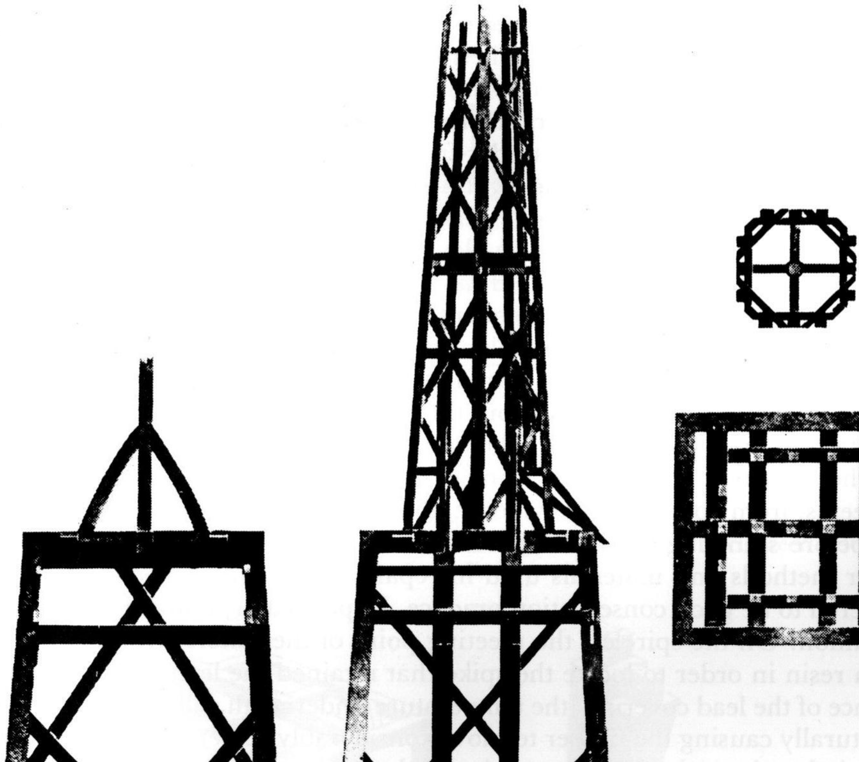

Fig. 33
The spire of Navestock church, Essex
C.A. Hewett

Be they thatch, shingles, stone, slates, lead or tile, all—other than solid stone—require stripping at regular intervals to replace the covering, fixings or subs-strata on which they are mounted. Today this is often the only time that archaeologists, architectural historians and those with similar interests have the chance to examine the fabric of the roofs at close quarters. During the work by the Victorians at Maldon, in 1867, the original design of the under-frame and bell-chamber was disposed of and ironwork installed to support the eight new bells. These bells were not integrated into the tower as were the original ones and the whole spire was subsequently held down by its own weight—and could be blown off in a high wind. These alterations were unnecessary and extra bells could have been inserted a little higher up. This kind of treatment, which happens frequently, is an example of cost-cutting.

At Maldon the opportunity to look at the spire more closely than at any time since the last reshingling in 1927, occurred in July and August 1992. Minimal work was carried out to the frame, apart from the substitution of stainless-steel bolts for pegs to refasten certain loose joints. The opportunity was also taken to increase the width of the battens supporting the shingles in order to increase the stability of the spire. It seems, from documentary evidence, that many buildings were originally fully boarded before shingling as is still the case in many other countries.

Other methods and materials used in repair work would not now necessarily be considered to be good conservation practice. In particular, four things stood out, in our opinion. On the spirelets the meeting point of the rafters with the mast was filled with resin in order to locate the spike that retained the lead finials. Owing to the presence of the lead covering, the temperature underneath will vary across a wide range, naturally causing the timber to move considerably. Over a period of time the present resin bond may break down, owing to the different rates of movement. This, in turn, may cause accelerated decay of the timber in this area. After the removal of the lead flashing at the top of the spire, it was observed that this area was covered by a cowl of shaped oak boards some thirty inches long, forming a neat progression between the mast top and the start of the shingles. These boards, although perfectly serviceable, were replaced with plywood which presents neither the same smooth progression nor, in our view, a happy bond with the start of the shingles. Above this, and fitted into the top of the mast, was a wrought-iron spike retained in place by fitting a wrought-iron ring around the top of the mast and then hammering in iron wedges around the spike. A limited amount of electrolytic corrosion had occurred where a clamp retained the weather vane. It was suggested that the spike be replaced. This was impossible without cutting off the top of the mast, or cutting flush with the mast top. In this case the proposal was made to cut back the mast and scarf in a new piece. If this had been allowed the top mast section, replaced in 1812, would have been lost as would the name of the carpenter who had carried out that work.[19] The two-hundred-year-old spike was perfectly serviceable. Consequently, a proposal to install a welded cage to anchor the new spike to the mast—which would have been liable to stress corrosion and fail, eventually causing the weather vane to fall—was rejected and the spike has been retained, now proudly carrying the regilded vane. We assume that the spike was fitted when the top section of the mast was replaced in 1812; the vane was regilded in 1901.[20] The lucarne covering the Sanctus bell was

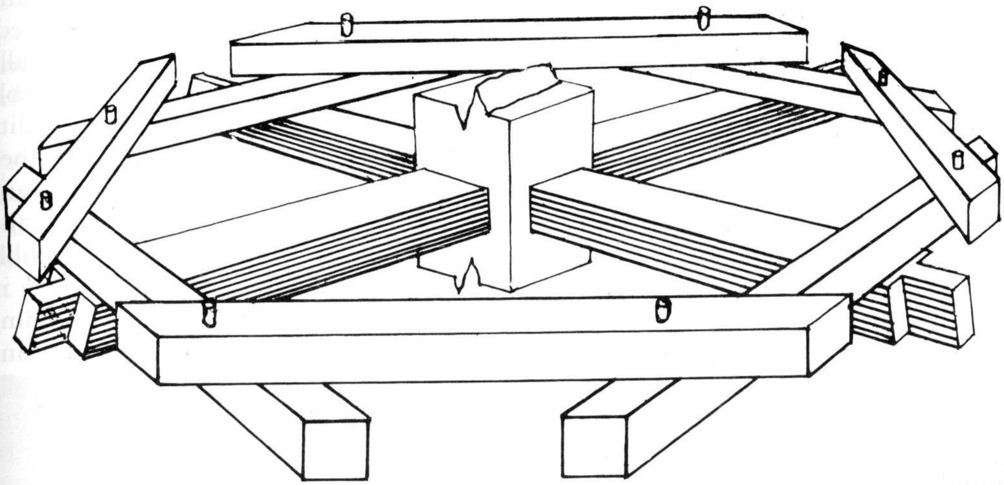

Fig. 34
Navestock church, Essex: the spire had quasi-girded purlins with eighteen rafters
C.A. Hewett

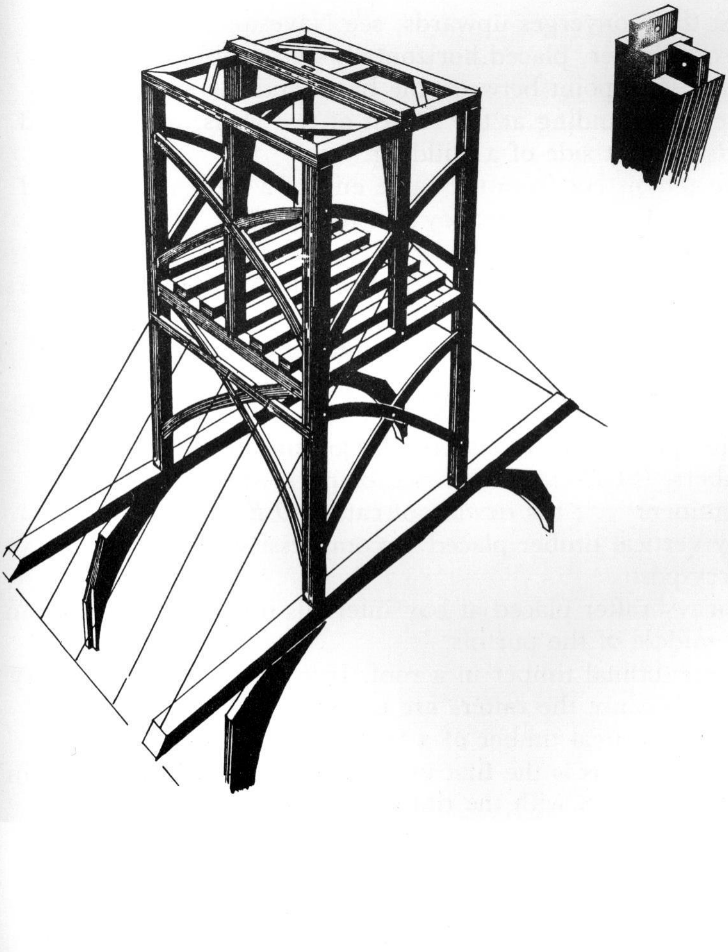

Fig. 35
Aythorpe Roding church, Essex: the spire carried on tie-beams across the nave
C.A. Hewett

remade with a combination of oak and plywood, regrettably in our view as many parts of the structure were fully serviceable and more oak might have been conserved.

This raises important points on restoration. The materials used should normally be of the highest quality to enable the restored building to last for as long as possible in good condition. Although riven oak was specified for the new shingles, the quality of the timber was not what it might have been (it is important with shingles that they be manufactured from high-quality timber to obtain a good weatherproof cover). Shingles made from twisted timber, however carefully fitted, will always move and lead to problems sooner than one might expect from such a normally durable material.[21] On completion of any work the original form should be discernible in material and design. Nothing should be needlessly destroyed. When building specifications for ancient buildings are written they should allow for continuing discussion and variation throughout the contract time to enable the best and historically least damaging path to be taken. One lesson to emerge from the restoration of this spire is that insufficient consideration was perhaps initially given to what might be found as various members were unpicked. Had this been otherwise it might have been possible to retain more of the historic structure.

GLOSSARY

Cant post	Post that converges upwards; see Navestock belfry.
Collar beam	A roof timber, placed horizontally and uniting a rafter couple at a point between the bases and the apex.
Corner post	The post standing at the return of two walls, as at the end and adjacent side of a building.
Double tenon	Two tenons cut from the same end of a timber and placed in line; if side by side they constitute a pair of single tenons.
Halving	In jointing, the removal of half the thickness of two timbers, as in cross-halving.
Hip rafter	A rafter pitched on the line of intersection of two inclined planes of roof.
Jowl (Jole)	Term applied to the thickened ends of such timber as storey-posts, which facilitate the jointing of several other timbers. ('The external throat or neck when fat or prominent . . . the dewlap of cattle' *O.E.D.*)
Prick-post	Any vertical timber placed in compression, but not a storey-post.
Principal rafter	A heavy rafter placed at bay intervals in a spire—usually in the middle of the purlins.
Purlin	A longitudinal timber in a roof. If it is in a spire, it is very short; because the rafters are tapering right to a point.
Spire-mast	Central vertical timber of a frame spire.

(Note: the authors believe that this is the first published use of the terms 'purlin' and 'principal rafter' in connection with the timber-work of spires.)

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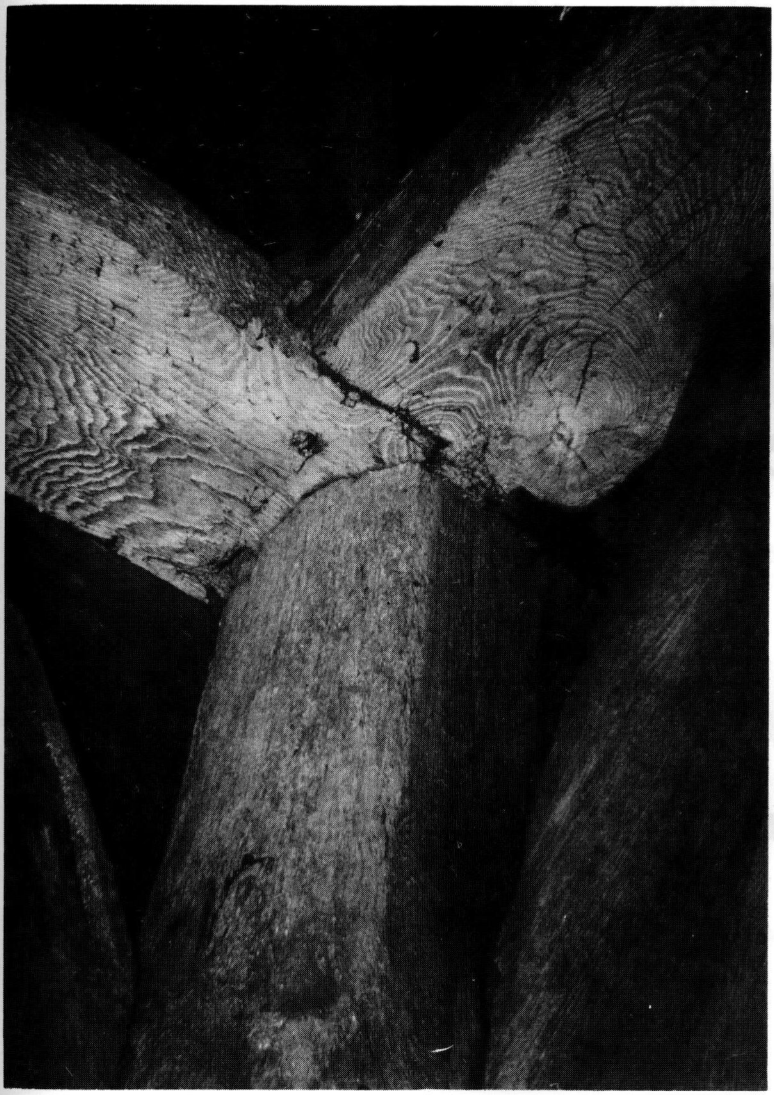

Fig. 36
Stock belfry, Essex, showing a late top-plate before the mitred joint

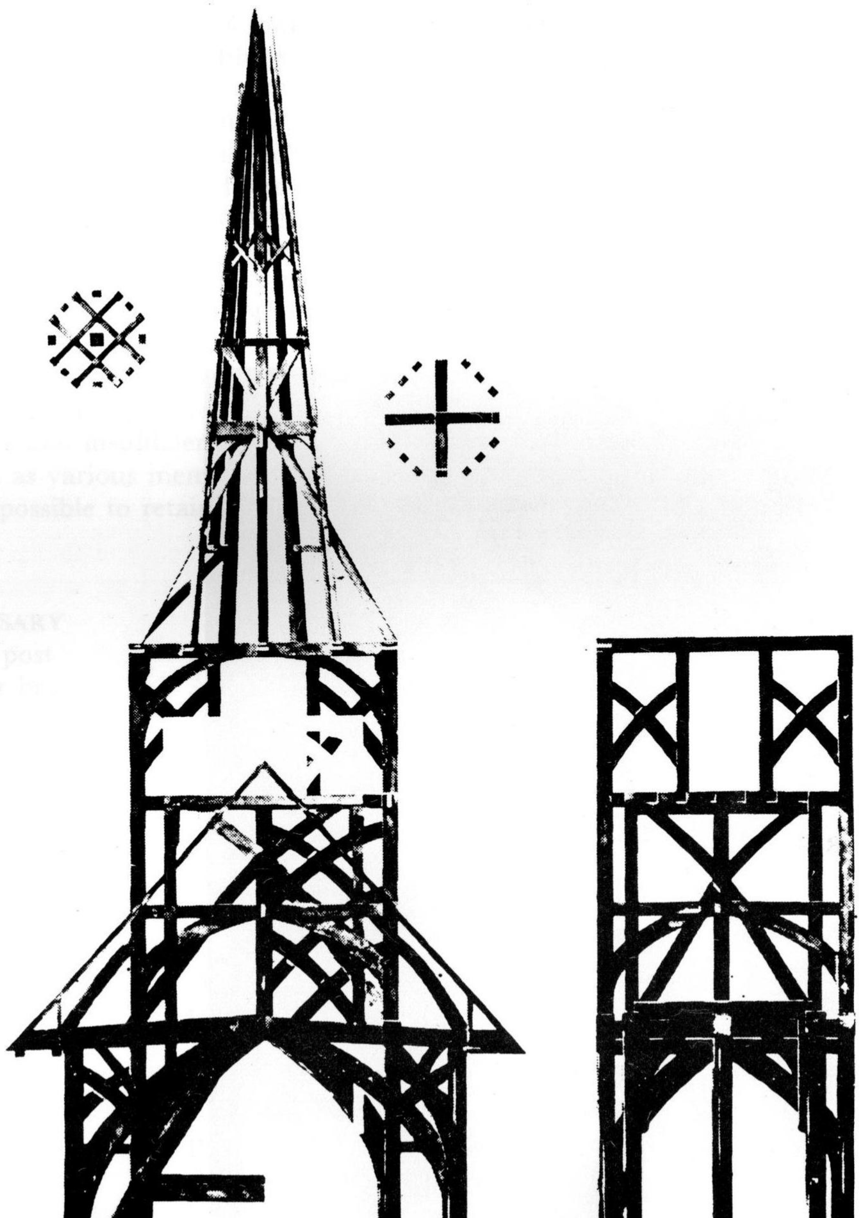

Fig. 37
Laindon church, Essex. A timber construction, usually called a belfry, stands inside the west bay of the nave
C.A. Hewett

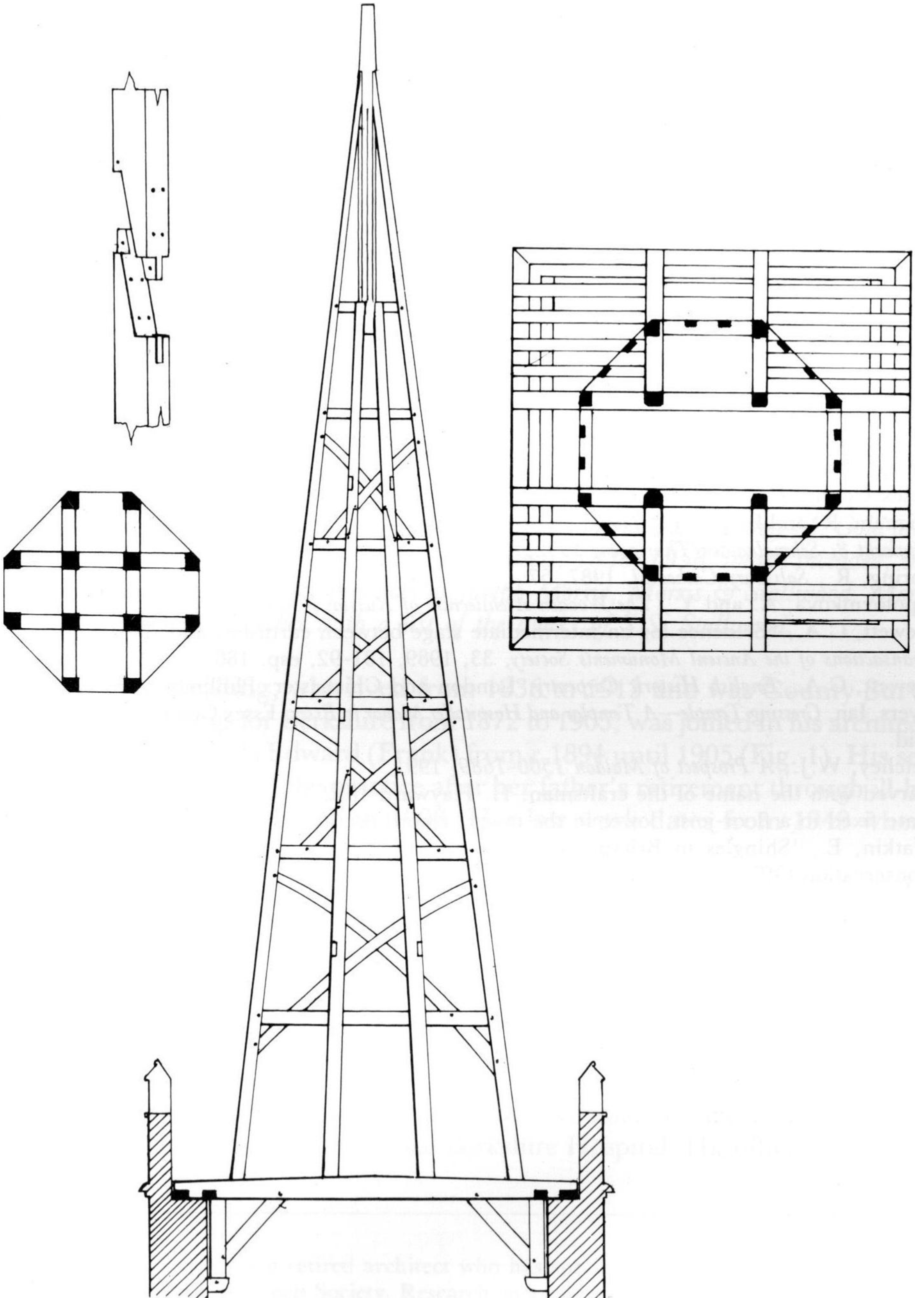

Fig. 38
Wingham church, Kent, has an octagonal spire. Instead of the usual long mast it has four prick-posts supporting a short mast
C.A. Hewett

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