THE TIMBER BELFRIES OF ESSEX

THEIR SIGNIFICANCE IN THE DEVELOPMENT OF ENGLISH CARPENTRY

By C. A. HEWETT[1]

Many Essex churches have central or western towers of stone as is common in other parts of England. In addition to these there are a large number of medieval timber towers, or 'belfries' as they are known locally; these are normally placed either spanning the westernmost bays of the nave or as a separate structure against the west end of the church and are often of great size and elaboration. In the present paper six of these belfries, a group S. and S.W. of Chelmsford, will be described in detail and differences in the methods of jointing and in the general structural concept will be discussed; it will be shown that considerable differences exist sufficient to suggest separate structural categories, and an attempt will be made to use the differences in construction as a basis for a chronological arrangement.

The absence from timber structures of the wealth of decorative elements — mouldings, tracery, and vaulting for example — used by such writers as Sharpe, Rickman and Professor Willis to provide a relatively precise sequence of development for masons' work, has led to the assumption that no such criteria are available in the less ornate timber buildings. The assumption can no longer be considered valid since other criteria, which still await a full exploration, exist in the joint forms and structural concepts referred to above. It should, however, be borne in mind by future students of these criteria that due allowance must be made for the co-existence of different schools of carpentry and for the possibility of the continued use by some carpenters of relatively primitive joint forms which might have been discarded by others. Some of the decorative elements used in stone buildings are, of course, found in the best timber structures such as the Essex belfries, and clearly derive from contemporary masonry practice with which they may reasonably be compared. Some allowance in dating may be necessary for the time-lag between the introduction of a feature in stone and its translation to timber but this could be very short indeed.

Much is to be learned from the following six examples concerning the general practice or tradition of what is known as 'carcasing-work', but they are too few in number to give more than the broadest outline of the development of timber tower construction. The earliest towers were almost certainly simple structures built around four principal posts; the multiplication of timbers allowed towers of greater area and height culminating in such structures as Margaretting and Blackmore illustrated here. The development of spire construction which shows a similar progression, from a simple structure of moderate size built around a central vertical post to spires of great complexity, will be discussed later in this paper.

[1] The author wishes to acknowledge the assistance given by the Hon. Editor in preparing this paper for publication.

Timber and masonry are so dissimilar in their structural properties that appreciation of the former has hitherto been marred by its lack of many of the decorative devices employed in the latter. The roughness, simplicity, or even crudeness in design and workmanship which is so often imputed to timber work is only true by comparison with high class masonry details; the beauty of a timber structure is in its proportions, often made possible by the great length of the oaks available to the medieval carpenters.

PARISH CHURCH OF ALL SAINTS, DODDINGHURST (Pl. XXX)

The belfry occupies the western bay of an early 13th-century nave; the bay is rectangular and the square tower is supported by tie-beams above the first stage. The outer walls are covered with vertical boarding. The N. and S. walls of the lower stage each comprise three posts with horizontal interties forming four panels each filled with curved scissor-braces. The corner posts carry cambered tie-beams supported by curved braces; these posts have thickened or 'jowled' heads which are exceptional in that the jowls clasp the arch-braces — this is not a functional requirement and doubtless represents the idiom of some structural tradition, perhaps already obsolete at the time this tower was built, which has not been found in other examples in the locality. The upper stage of the belfry is built around four corner posts separated by interties in each face to form three sub-stages; the centre of these on the N. and S. sides is strengthened with scissor bracing, and in the upper are pairs of windows, very much restored.

The outer jambs or 'stiles' of these lights have mortises for medieval tracery-heads but the heads and centre mullions have all been renewed, apparently within the the last hundred years. The stiles are mortised for the head pieces in the usual medieval manner with rebated lower ends to fit the angular or 'squint-shouldered' tenons; the tenons of the modern heads are not angled in strict conformity to the angles of the mortises, and the absence of mortises in the backs of the intermediate studs is an indication, as will be seen below, that they too are replacements although possibly of a much earlier date.

The spire is small and of simple but unique construction, being built around one central vertical post seated upon a massive cambered beam which rests upon and is tenoned into the centre of the top-plate of the tower on the N. and S. sides immediately above the studs between the windows. Chase mortises on the soffits of the N.–S. beam and of the two secondary E. and W. beams (see plan, Pl. XXX) were for braces from the studs, and the absence of corresponding mortises in the latter indicates that the studs have been replaced; this alteration may be of medieval date and was perhaps contemporary with a renewal of the top-plates of the turret. The fact that the latter are nearly square in section and have *stop-bridled* corner-joints (Fig. 3D) together with a difference in patina from most of the other timbers, indicates a late-medieval restoration.

The N. – S. and the E. and W. beams have hollow chamfers (*Scotia* chamfers in current timber-trade terminology) to their lower edges which are finished with a mason's mitre at the centre. The spiremast is supported from these beams by curved *cardinal-braces* to each face which enter the post at different

A. Navestock
National Buildings Record

B. West Hanningfield
Photograph: J. Bassham

C. Stock Harvard
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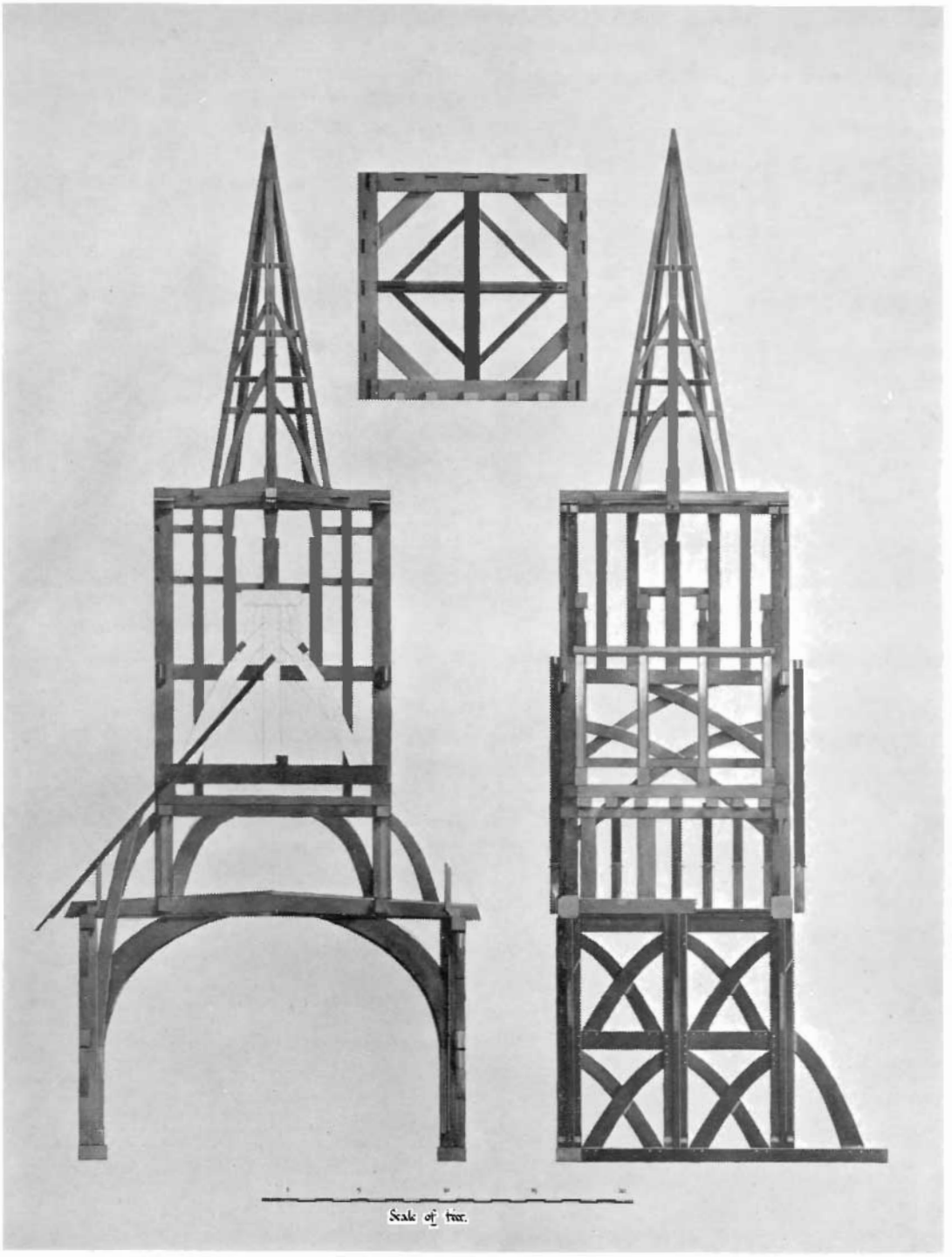
D. Blackmore
National Buildings Record



DODDINGHURST. *Left:* section facing W. *Right:* section facing N.
Top: plan from below of seating for spire

heights in spiral order to avoid weakening the timber. The spire rafters are girded round just above the heads of the cardinal braces by eight short straight timbers which form an octagon; above this the cardinal rafters are scissor-braced by intersecting cant-braces and horizontal struts (Fig. 4A).

The belfry has undergone at least two restorations, one in the 19th century and the other in medieval times. The evidence for a medieval reconstruction has already been seen in the renewal of the top-plates of the tower and the central mullions of the windows; the importance of this in indicating a possible date for the original structure is that since the top-plates were probably replaced due to the decay of the earlier members and since it is likely that these last served for several centuries before this decay became serious, a date correspondingly before the latest possible date of restoration (say the early 16th century) may be postulated.

The dating of the other parts of the church by the Royal Commission[1] confirms this conjecture and suggests the possibility of a more definite date: the N. wall of the nave, in which the tower stands, is said to be of the 13th century, and the S. doorway to be of A.D. 1220. The latter date may well apply not only to the nave walls but also to the roof which is of a type of construction normally seen only in relation to Norman or Transitional masonry; this roof-frame cannot here be described in detail but it is essentially in two bays with a central tie-beam and crown-post truss. The western truss against the belfry is similar to the central truss but the crown post is half-sectioned indicating that the roof was initially designed to meet an internal tower, possibly the present belfry. It is therefore reasonable to suppose that the nave walls and roof, and the belfry, are all of the early 13th century.

Dovetails and notched laps are completely absent from this belfry; both these joints were designed to resist withdrawal (*cf.* Pl. XXXVI; Fig. 3B) and it is, therefore, clear that none of the timbers were designed to be in tension. It is, for example, very doubtful whether the transverse beams supporting the upper stage of the belfry and the spire, resting on the principal posts, were intended to tie the posts of the lower stage together.

The most notable abutment is the *masons' mitre*; this is of importance since it is the most primitive method of jointing two moulded timbers at right angles, without the moulding being interrupted by the joint. The carpenters' mitre and scribed joint are alternative and more refined methods which will be found in the other belfries described here.

PARISH CHURCH OF ST. THOMAS THE APOSTLE, NAVESTOCK (Pls. XXIX & XXXI)

This belfry, which may be amongst the oldest of its kind and is in many ways the most fascinating of those described here, is essentially an addition to the church; it is built against the W. end of the S. aisle which has been ascribed to the mid 13th century.[2] The central structure of the tower is formed within four inclined posts, or *cant-posts*, the angle of inclination of these being the same

1 R.C.H.M. (England), *Essex*, Vol. II (Central & S.W.), 57.

2 *Ibid.*, Vol. II, 190.

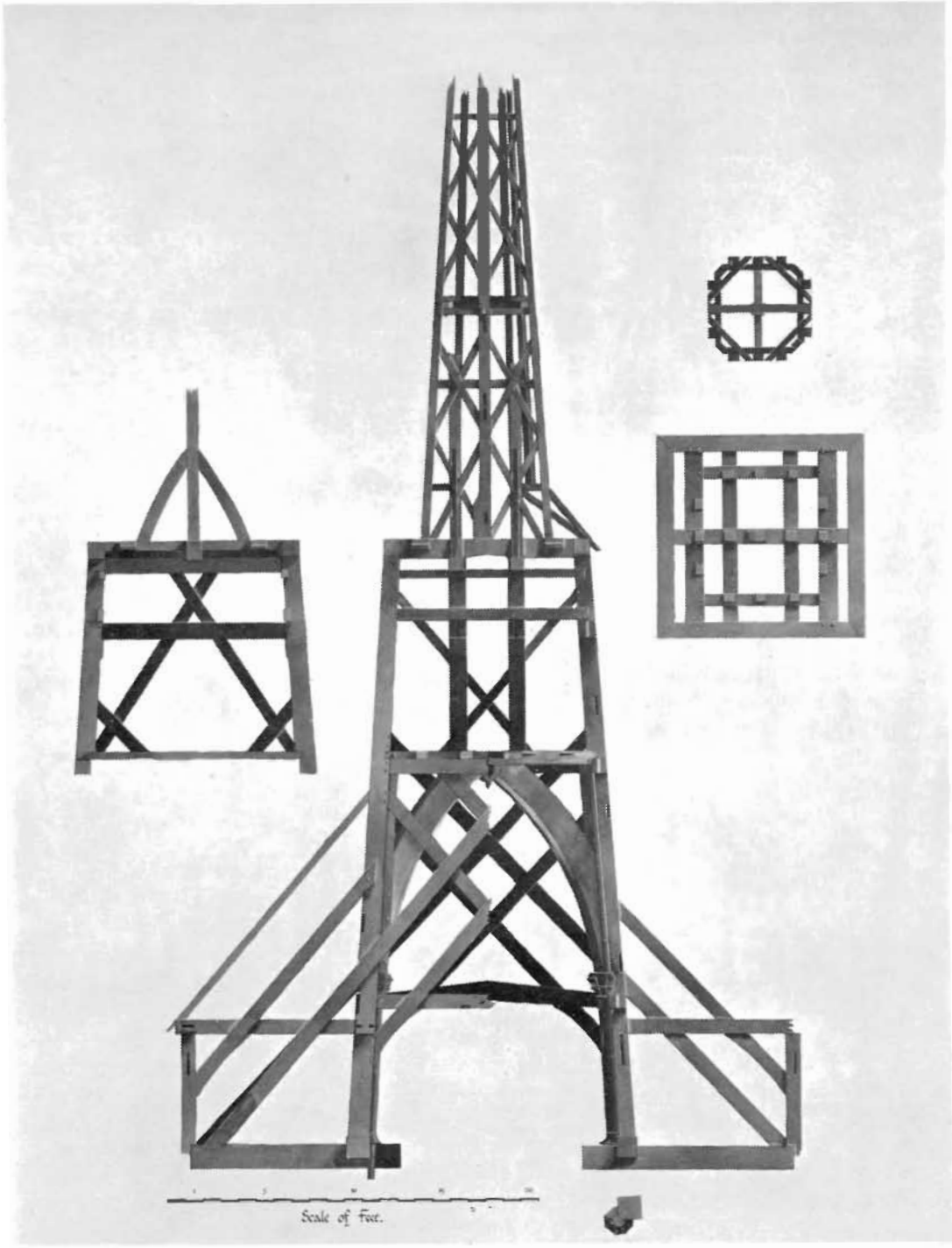
as that of the spire rafters (Pl. XXXI). The cant-posts are intertied twice between their bases and the top-plates and are prevented from spreading by an elaborate system of scissor-braces; these last are partly housed within a semi-octagonal outshot which surrounds the lower stage of the tower on all sides except the east. The principal braces rise from ground-cills, pass through *trenches* or halvings in the near-side posts and terminate against the posts on the opposite side; other parallel braces combine with these to provide scissor bracing throughout the height of the tower.

The lowest stage of the tower rises to the height of the roof of the outshot; each cant-post has an octagonal shaft the full height of this stage attached to its inner angle and incorporating a moulded capital (Pl. XXXVIc) just above the level of the first interties. Above these capitals diagonal braces spring from the shafts and form pointed arches supporting a ceiling constructed of two diagonal bridging joists into which the upper ends of the braces are tongued and which in turn support unusually large floor joists laid flat. At the intersection of the diagonal braces is a very beautiful boss, finely carved into a formal composition of oak leaves terminating in a pendant acorn in its cup. The floor has been used from late medieval times to carry the weight of the bell-frame but originally the bells, then three in number, were carried between two transoms supported by the pairs of studs in the E. and W. walls of the bell-chamber, for which the mortises remain, and the two parallel transoms in the base of the spire-frame above. The two pairs of transoms were joined by vertical struts for which only the upper mortises survive. The bell-chamber originally had only one opening, on the W. side; no tracery has survived but long mortises remain in the jambs for the head, which was not recessed as at Doddinghurst, and for the cill.

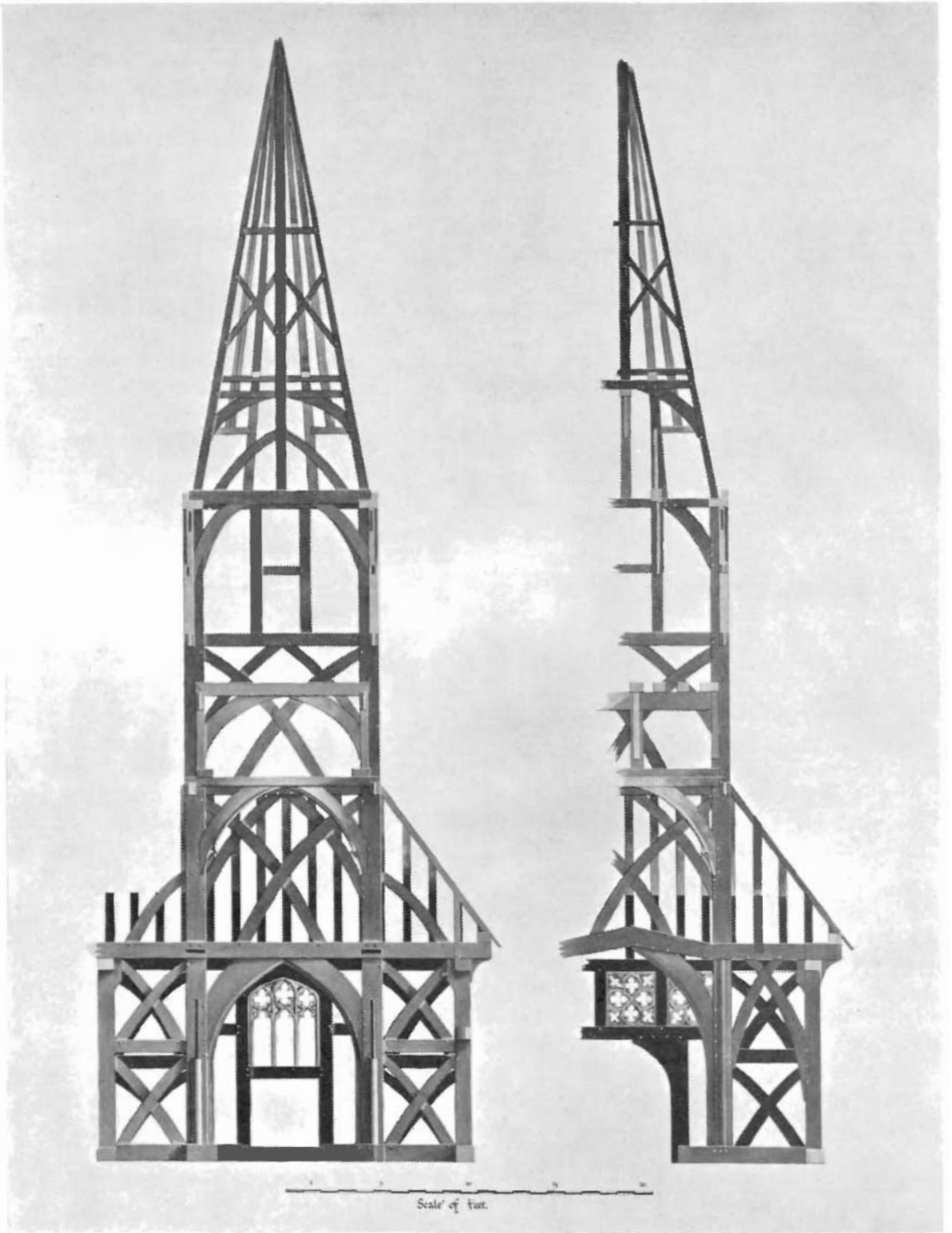
The spire, which is large in comparison with the previous example, is constructed around one central and two subsidiary spire-masts supported by a massive square-sectioned transom carried N.–S. across the turret; four subordinate transoms of the more usual flat medieval section are tenoned into this and with two further cross members (see plan Pl. XXXI) carry the spire rafters. At one-third and two-thirds height the spire is braced with a girdle of horizontal strutting designed to secure the central rafters of each facet.

A number of structural features call for special mention. The long scissor-braces supporting the tower are housed into the cant-posts with *notched-lap* joints designed according to their situation either to hold the feet of rising timbers or the tops of converging timbers (Pl. XXXVIA & B). The joints are identical with the joints noted by Deneux[1] in his study of French roof carpentry and dated by him to between the mid 11th century and the second quarter of the 13th century. The joint is very rare in Essex but comparable examples occur in the 12th-century barley barn at Cressing Temple[2] and on timbers excavated from the 12th-century castle at Rayleigh, Essex.[3]

[1] Henry Deneux, 'L'Evolution des Charpents du XI[e] au XVIII[e] Siecle', *L'Architecte*, July 1927.
[2] C. A. Hewett, *Trans. A. M. Soc.*, N.S. 9, 51.
[3] The timbers are exhibited in the Museum at Prittlewell Priory, Southend-on-Sea, Essex.



NAVESTOCK. *Centre:* section facing E.
Left: section showing framing of N. wall of bell-chamber. *Right, centre:* plan of seating for spire
Right, top: plan of horizontal bracing in spire at one-third height



STOCK HARVARD. *Left:* section facing S. *Right:* half section facing W.

The mouldings of the capitals in the lower stage of the tower have many elements in common with other wooden capitals in Essex, all of which are found in roof carpentry that covers buildings erected soon after the Norman Conquest. Comparable examples were recorded in France by Deneux who found simple capitals and bases on king-posts of octagonal cross-section, which incorporated only the torus and cavetto profiles, in the choir roof of the church of St. Serge at Angers, dating from *c.* 1210. More elaborate examples dating from 1320 were recorded in the church of St. Leu and St. Gilles, Paris, which incorporated most of the Classical profiles together with some forms peculiar to wood-carving. The Navestock mouldings considered in isolation may be ascribed to either the early 13th century or to the revival of this fashion in the 15th century, but in view of the other evidence and the details of the structure the earlier date must be accepted.

The roof of the outshot is an example of what the present writer has termed 'reversed assembly order';[1] in this the wall-plates are placed above the ends of the tie-beams instead of below. In the 'normal assembly order' which superseded it, use is made of the *lap-dovetail* joint to secure the tie-beam to the wall-plate, whereas the earlier system, the use of which may indicate ignorance of this joint, relies on the more primitive *trench* joint. This last may be regarded as a three-sided forerunner of the mortise. The 'reversed assembly order' does not occur in the other towers here described.

Examples of the *bare-faced lap-dovetail* joint occur in the bell-chamber, at the ends of two pairs of horizontal members in the E. and W. walls set immediately above or below the two pairs of transoms which carried the original bells. The use of this joint seems to have been dictated by the need to maintain a constant distance between the bell bearings — any 'end float' would be unsafe in this position.

Parish Church of St. Mary and St. Edward, West Hanningfield

The belfry at West Hanningfield (Pls. XXIXB & XXXVA) is a separate structure standing against the W. wall of the S. aisle. The four posts inside which the tower is framed stand on intersecting ground-plates which extend to take the feet of external raking shores or cant-braces which are housed since the Victorian restoration in gabled projections against each face of the tower. The main posts, 1 ft. 2 in. square, are separated by interties at the levels of the first and second floors. The lower interties are supported in each face by curved braces forming two-centred arches; the central panels of the tower are stiffened with curved braces and scissor-braces; and the upper panels have pairs of vertical studs enclosing the turret lights. The first floor is framed upon a single bridging joist, running N.–S., with seven common joists tenoned into it on either side; the second floor is framed upon two diagonal bridging joists (Fig. 2B) the crossing joint of which is a modified form of *cross-halving*, with a carved (? portrait) head in relief below (Pl. XXXVID).

[1] C. A. Hewett, *Medieval Archaeology*, VI (forthcoming); *Trans. A. M. Soc.*, N.S. 9, 34, fig. 4.

The turret, which is unusual in being clad originally in wattle-and-daub, retains on the N. side one of its original wooden traceried windows. The tracery head is cut in oak 6 in. thick, tongued into the two stiles where it is also supported by rebates, forming squint-shoulders (Fig. 1A, at *a*). The window is of two trefoiled lights with trefoiled tracery above.

The tower supports an octagonal spire which dates from the restoration and is not included in the section.

The *lap-joint* at the ends of the turret tie-beams now has no proper name since it has for centuries been forgotten. Deneux called the French examples of this joint 'assemblage en croix à double entaille' (a cross-joint with double notch) — the English examples are of greater length and more acute angularity than the French which Deneux considered peculiar to the 17th century. It may therefore be found that this curious joint was imported into France from England, where it is known to have been used during the 13th century both in the building under discussion and at Rufford Old Hall, Lancashire.[1]

The *halved bird's mouth* joint is used at the ends of the diagonal bridging joists (Fig. 2B); similar examples may be seen in this position at Navestock and Stock Harvard.

The *Arris chase-mortise and tongue* (Fig. 2B at *A*) is used to join the feet of the diagonal braces to the internal corners of the principal posts.

PARISH CHURCH OF ALL SAINTS, STOCK HARVARD (Pls. XXIXC & XXXII)

The western belfry at Stock Harvard, which with its lofty spire is approximately 75 ft. high, is extraordinarily attractive and is remarkable for the many original decorative features it retains; these include the W. door with three square tracery windows above of Geometrical design. The belfry is structurally separate from the rest of the church and comprises a square tower with an outshot around the N., S. and W. sides, and an octagonal spire.

The four corner-posts of the turret rest on horizontal transoms laid E.–W., each supported by four posts, with large curved braces in the centre bay. These two supporting frames are connected transversely by cambered and arch-braced tie-beams in line with the two pairs of principal posts, with scissor-braced projections to the N. and S. of each covered by the lean-to roof of the outshot.

The upper section of the tower stands on the framework just described; each face is divided by two interties into three stages; in the lower stage the feet of the principal posts are shored from the transoms to N. and S. and scissor-braced internally. At the top of this stage is a floor which, like those at Navestock and West Hanningfield, is framed upon two diagonal joists with two pairs of diagonal arched braces. The braces have chamfer-cusps with sunk spandrels (Pl. XXXVC, Fig. 2C) and a central boss carved with a human face surrounded by oak leaves — reminiscent of the legendary 'green man'. The floor of the bell-chamber is raised above this floor, which is strictly speaking only an ornamental ceiling, on a heavy framework designed to provide an

[1] C. A. Hewett, *Trans. A. M. Soc.*, N.S. 9, 50, fig. 14; R. A. Cordingly, *Ibid.*, 116.

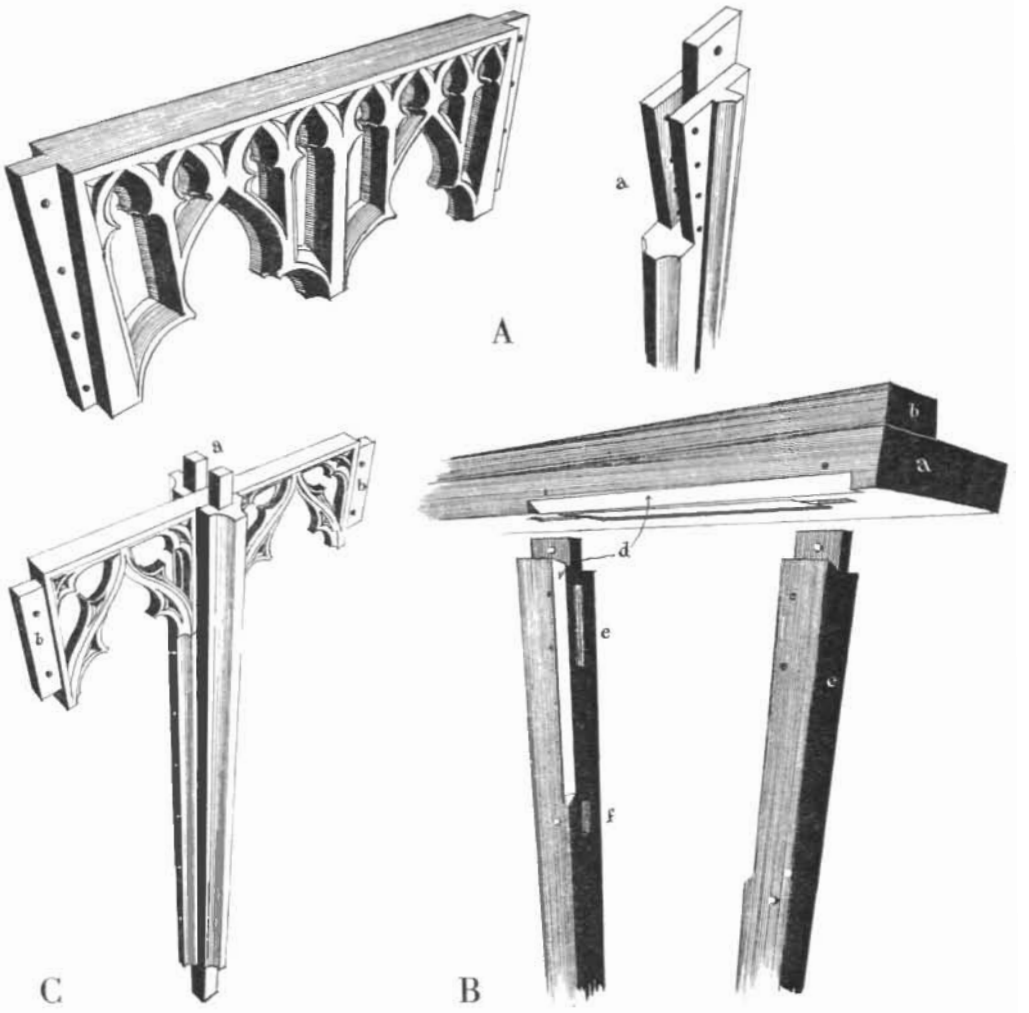


Fig. 1. Window details

A. WEST HANNINGFIELD, north window of turret
(*a*, mortise with notched butment cheeks in stile to receive window head)

B. STOCK HARVARD, east window of turret. The heads of the stiles are scribed to the chamfer of the head, on the soffit of which is a housing for the tracery panel
(*a*, top-plate; *b*, top-plate fillet; *c*, stile; *d*, chamfer; *e*, mortise for traceried head; *f*, mortise for cill)

C. MARGARETTING, west window, ground floor
(*a*, clasping mullion with twin tenons; *b*, tongues of tracery panel)

initial support for the weight of the bell-frame and to transfer that weight to the principal posts; this floor occurs some distance below the upper interties.

None of the tracery for the turret lights survives but it is clear that 'clasping mullions' were not used; instead it is probable that the apparently earlier type of mullion was used tenoned into the tracery as at West Hanningfield.

The top-plates of the tower are clearly original and have a remarkably flat and shallow cross-section for medieval work (Fig. 3E) in contrast to the square section commonly found. The two tie-beams which cross the top of the turret have lap-dovetail joints at their ends (Fig. 3B). On these tie-beams is mounted an elaborate truss which raises the foot of the spire-mast considerably above the top of the tower.

The principal joints employed include:

(i) The *stop-bridled lap* joint (Fig. 3E). This is used of necessity for the corners of the wide and shallow top-plates. Its use was probably normal in this position in medieval work and it was obviously employed at West Hanningfield prior to the restoration.

(ii) The *lap-dovetail* joint (Fig. 3B). This is certainly an early example of the use of this joint in Essex. Medieval carpenters, perhaps from prejudice, do not appear to have made much use of this technique before *c.* 1350.

(iii) *Arris chase-mortise and tongue with divergent shoulders* (Fig. 2C). This is possibly a development of the joint similarly used at West Hanningfield; no comparable examples are yet known to the writer.

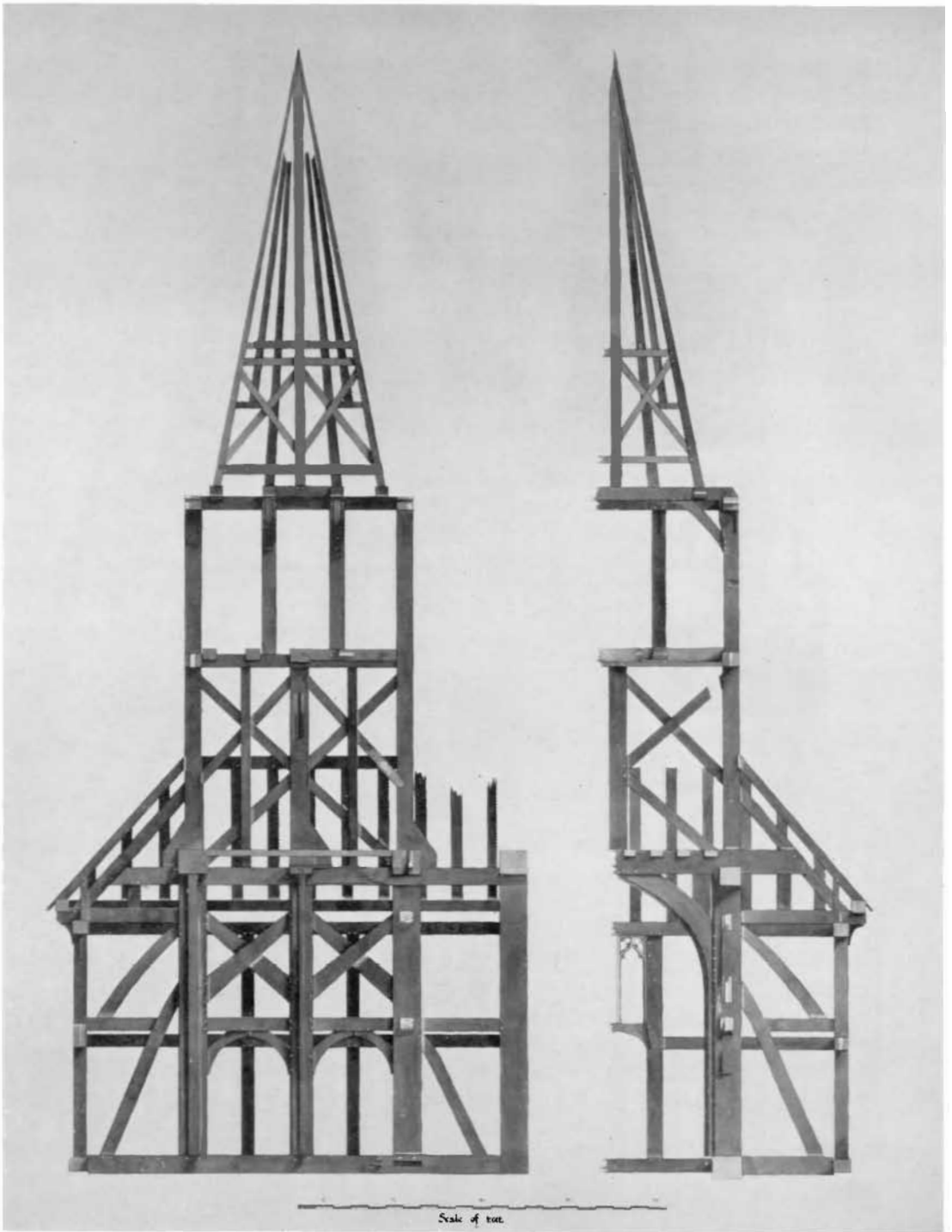
(iv) *Scribed* joint (Fig. 1B). This could possibly be an early form since it is a very simple example of the type and one not requiring the use of specialized tools such as the *scribing gouge*. It contrasts clearly with the traditional masons' mitre.

PARISH CHURCH OF ST. MARGARET, MARGARETTING (Pl. XXXIII)

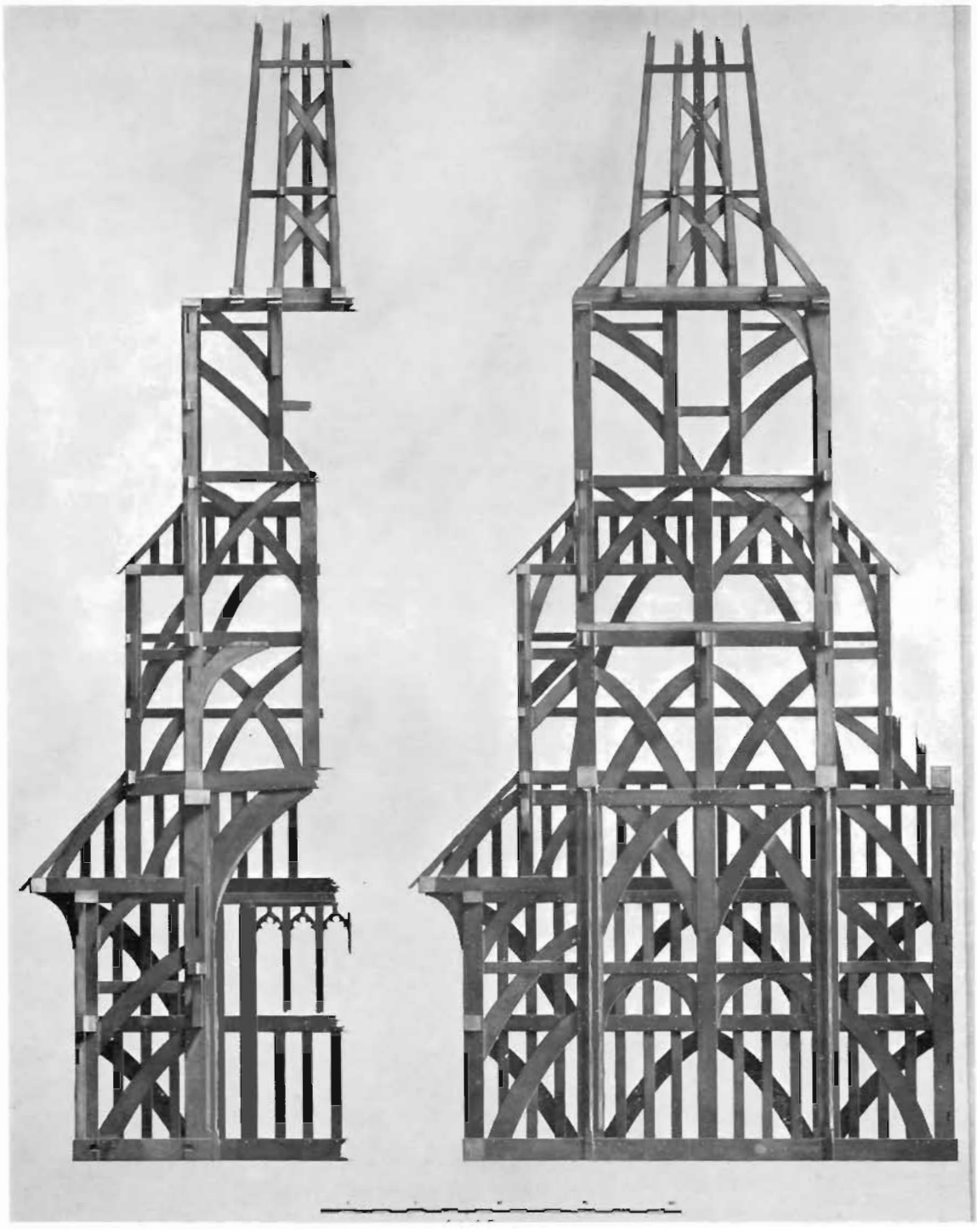
The belfry at Margaretting is of similar external form and position to that already described at Stock Harvard, but it appears to be of more recent date than any so far mentioned; it is larger on the ground and has eight principal posts. The timbers are of unusually heavy cross-section and the relative absence of mouldings and chamfers gives to it a feeling of massive dignity.

The lowest stage on which the tower rests comprises two E.–W. frames each with two principal posts (1 ft. 8 in. by 1 ft. 7 in.) beneath the turret corner posts, separated by two arch-braced interties and two scissor-braces and with a central intermediate post. Further stiffening is provided by bays to the E. and W. with canting shores to the principal posts. These frames carry top-plates above which, in 'normal assembly order', are seated three N.–S. transoms cross-halved over the top-plates; the dovetail joint is not used at this point. The three N.–S. transoms are arch-braced with vertical struts in the spandrels of the braces.

The outer walls of the outshot are heavily framed and vertically boarded as at Stock Harvard and the turret at Doddinghurst; vertical boarding is a



MARGARETTING. *Left:* section facing N. *Right:* half section facing W.



BLACKMORE. *Left:* half section facing W. *Right:* section facing N.

feature which also occurs frequently in medieval barns. The inner face of these walls has been plastered and details cannot therefore be given of the fixing of the boards. The W. doorway is surmounted by a window of two ogee trefoiled lights with cusped spandrels. The floor of the upper stage is formed of long, wide joists laid flat and extending without a break from the E. to the W. transom; the two central joists are removable and serve in place of the more usual bell-trap.

The corner posts of the turret have wide splayed bases and stand above the principal posts already described; they are intertied once, and are scissor-braced and have central intermediate posts below each intertie. The floor of the bell-chamber is heavily framed at the level of the intertie and appears to have been braced from the intermediate posts in which empty chase-mortises remain.

Considerable evidence of restoration is to be seen in the bell-chamber; the original traceried lights are missing, but they appear to have formerly extended continuously around the turret with three principal lights in each face. The joints for the cills and the mortises for the tenons of the heads remain in the studs and corner-posts, the heads coming immediately below the top-plates of the tower, much higher than the heads of the modern turret lights.

The square-sectioned top-plates are *stop-bridled* together at the corners and carry two N.–S. transoms (Fig. 4C) tenoned into and lapped over the top-plates. The transoms are arch-braced from the two intermediate studs which have jowled heads tenoned into the ends of the transoms. Two transoms of lighter section are set nearer the E. and W. edges of the turret and carry the corresponding facets of the spire.

The principal joints include:

(i) The *bare-faced lap-dovetail* joint (Fig. 2D). This is the only form of dove-tail joint used at Margaretting; it occurs frequently in medieval barns and tower framing and its use may be indicative of a particular school of carpentry. Comparable examples may be cited from the granary at Prior's Hall, Widdington, Essex (*c.* A.D. 1275), and the barn at Thurrock's, Clavering, Essex (medieval).

(ii) The *stop-bridled* joint (*cf.* Fig. 3D). This is used here for the corner joints of the turret top-plates and seems to be datable to a period between the erection of the towers of Stock Harvard and Blackmore; it will be discussed further below.

Parish Church of St. Lawrence, Blackmore (Pls. XXIXD & XXXIV)

Professor Pevsner described this tower[1] as 'one of the most impressive, if not the most impressive of all the timber towers of England'. It is a comparatively late example, evidently built at the end of the 15th century, *c.* 1480, and possibly some few years after that at Margaretting. These two towers are strikingly similar in general design and construction although in size and elaboration Blackmore greatly excels.

[1] Pevsner, N., *The Buildings of England, Essex* (1954), 76.

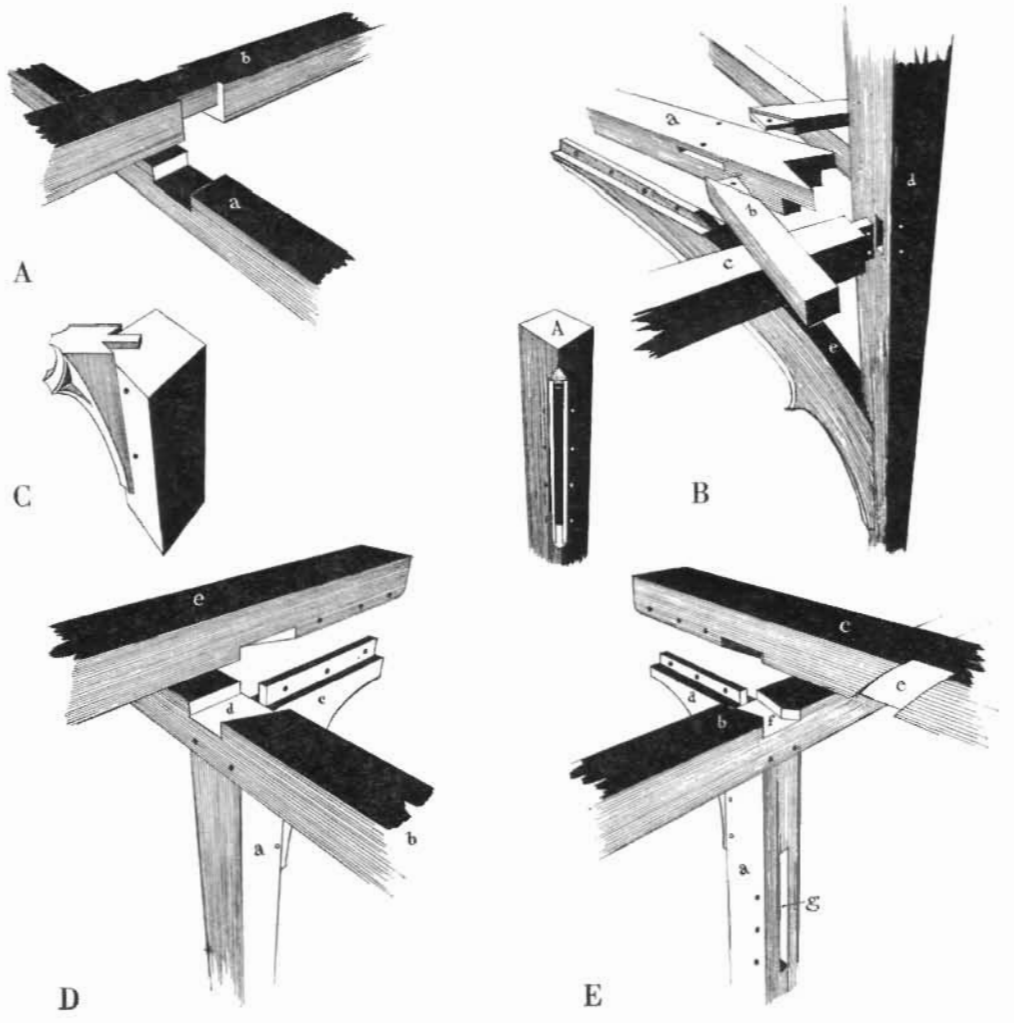


Fig. 2. Tower construction

A. WEST HANNINGFIELD. Strengthened cross-halving joint at crossing of two diagonal bridging joists

B. WEST HANNINGFIELD. Construction of ceiling to lower stage
(*a*, diagonal bridging joist; *b*, common joist; *c*, intertie; *d*, corner post of turret; *e*, arch-brace; *A*, chase mortise on inner angle of *d* for tenon of angle brace)

C. STOCK HARVARD. Joint between cusped angle brace and corner post

D. MARGARETTING. Jetty at eaves of outshot
(*a*, principal stud of outer wall; *b*, top-plate; *c*, bracket; *d*, bare-faced dovetail; *e*, tie-beam)

E. BLACKMORE. Jetty at eaves of outshot
(*a*, principal stud; *b*, top-plate; *c*, tie-beam; *d*, bracket; *e*, squint trench for passing brace; *f*, housing for re-entrant dovetail; *g*, chase mortise for foot of passing brace)

The tower is of three stages surmounted by an octagonal spire. The four principal posts, exposed as corner posts in the upper stage, are hidden in the lower parts by the projecting screen walls of two-storey outshots that hide the elaborate cant-bracing to the backs of the posts. These posts are not continuous for the full height of the tower but are each in two sections, the junction occurring at half the height of the second stage; the upper posts, the longest heavy-sectioned timbers in the structure, are seated upon and tenoned into two beams running N.–S., carried on the heads of the main posts of the lower storey. The external walls are filled with vertical studding and an infilling of wattle and 'pug'; in addition they have interties and wind-braces.

The outer wall of the lowest stage is surmounted by a boldly projecting lean-to roof the ties of which are supported by external brackets (Fig. 2E). The corners of the hipped roof are framed with dragon-beams, perhaps one of the latest examples of this in Essex, on which rest the corner posts of the second stage, which serves to protect and support the seating of the upper principal posts and is less heavily constructed.

The third stage or turret is bounded by the four principal posts; the walls have two studs on each face, between each pair of which were traceried lights now removed. The form of the tracery probably resembled that of the four-light window in the W. wall of the first stage (Pl. XXXIV); this has cinquefoil-headed lights with plain uncusped, pierced spandrels.

The spire rests upon a framework of four main beams set E.–W. between the top-plates of the upper stage (Fig. 4D); these beams are tenoned, as at Margaretting, into the inside edges of the plates. The spire is built around a central pyramidal structure of four inclined posts, each side strengthened by two pairs of scissor braces and supported externally by long curved cant-braces. The beams on which this central structure rests are reinforced by arched braces below their ends in the upper stage of the tower. The four cardinal faces of the spire are each formed of three principal rafters supported by the central structure. At the apex of the spire, so far as it may be distinguished, is a central mast supported by a horizontal frame formed of six intersecting collar beams on the heads of the four inclined posts.

The principal joints used are:

(i) *Lap-dovetail with re-entrant shoulders* (Fig. 2E). This unusual form of lap-dovetail is used between the horizontal ties and the wall plates of the lean-to roofs in the first and second stages of the tower. It is the only form of dovetail joint used in this tower. Comparable examples are found in the wheat barn at Cressing Temple, Essex.

(ii) The *Mitred bridle* joint (Fig. 3C). This is used at the junction of the wall plates of all three stages of the tower. It does not occur in four of the other towers described while examples at Navestock are not yet proved to be original and are suspect; its introduction may therefore be dated after the building of Margaretting.

THE SEQUENCES OF STRUCTURAL DEVELOPMENT

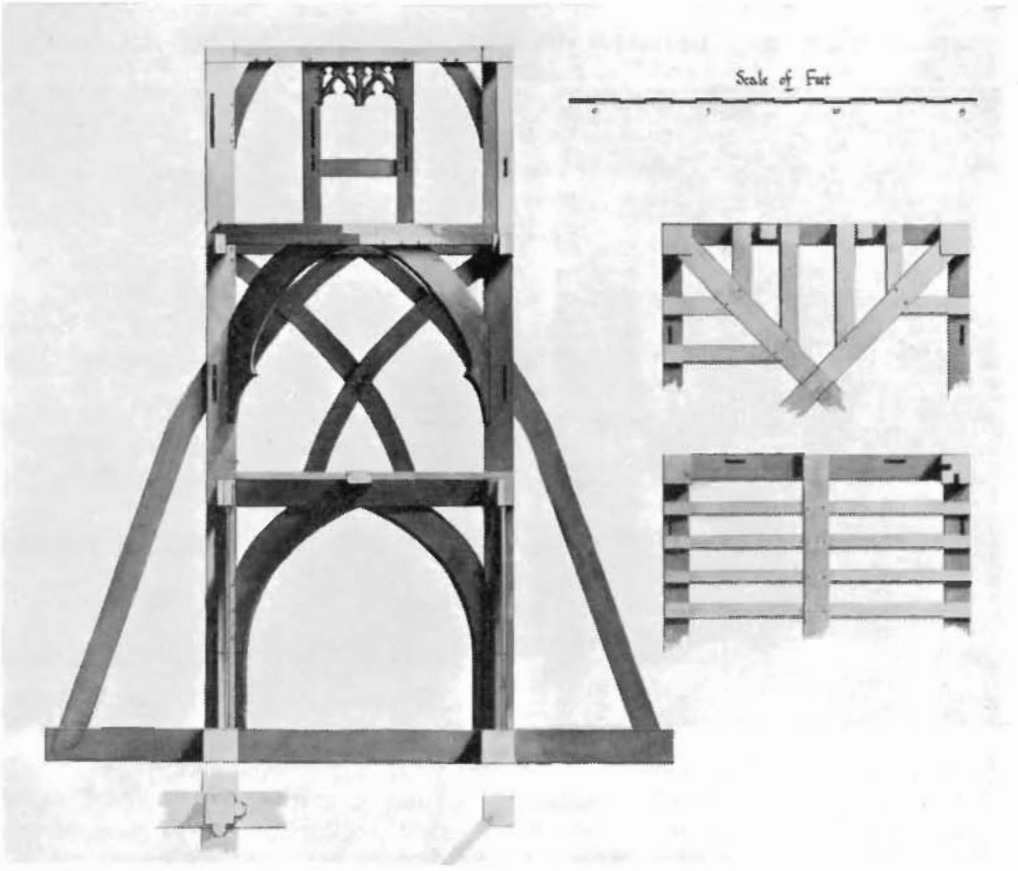
It cannot be emphasized too strongly that advances in timber construction were always dependent on corresponding advances in the design of joints — a point made by Henri Deneux in the light of the studies he made half a century ago.

The six belfries described above provide much information concerning the development of jointing technique in medieval carpentry, even though the reasons for the various changes are not yet discernible.

Not all the joints found in the six belfries may yet be placed in an historical sequence, but for those where this is possible the results accord well with the dates suggested by external evidence. For those joints or sub-types which do not appear to conform to their proper sequence the explanation seems to the present writer to lie in the co-existence of several schools of carpentry in medieval England.[1] Evidence for this is abundant: for example the towers of Stock Harvard and West Hanningfield both have tie-beams above the top-plates in the 'normal assembly' position, secured by lap joints; these lap joints are, however, very dissimilar despite the fact that the two towers were built within a century of each other and stand no more than five miles apart. It is hardly likely that an enormous stride was made in the development of joints for this purpose in such a short space of time and the difference between the joint at Stock Harvard which is a perfect lap-dovetail and that at West Hanningfield which appears to be very tenously related to the dovetail shape of such joints is remarkably great; nor can the joint at West Hanningfield be dismissed as a freak since it is known to have been used at Rufford Old Hall, Lancashire,[2] and in France three centuries later.

The joints used in the same position at Margaretting and Blackmore are, in the former *bare-faced lap-dovetails*, and in the latter *lap dovetails with re-entrant shoulders*; again these two widely different forms of joint occur on towers not more than five miles apart, and possibly with not more than thirty years difference in age. Neither of these pairs of apparently anomalous techniques can be dismissed as unique or parochial since many similar examples are to be found in secular and ecclesiastical buildings, the dates of which extend through several centuries. Examples which may be quoted in comparison are the belfry at Margaretting of *c.* 1450 and the granary at Prior's Hall, Widdington, possibly of the last quarter of the 13th century, but certainly considerably earlier than Margaretting; in both *bare-faced lap-dovetails* are used in the seating of all the tie-beams. Again, the tower at Blackmore of *c.* 1480 and the Wheat Barn at Cressing Temple of *c.* 1260–1309 may be compared; in both the *dovetail with re-entrant shoulders* is used in the seating of the tie-beams. The second pair of examples may indicate that the work at Blackmore was peculiar to a school which was earlier responsible for the Wheat Barn — the common element being the remarkable seating joint.

1 J. T. Smith, 'Medieval Roofs, a classification', *Arch. J.*, CXV (1958), 116.
2 R. A. Cordingly, *Trans. A. M. Soc.*, N.S. 9 (1961), 116.



A. Parish Church of St. Mary and St. Edward, West Hanningfield

B. Cusped brace, West Hanningfield

C. Cusped diagonal brace, Stock Harvard

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A. Head of rising brace, Navestock

B. Foot of passing brace, Navestock

C. Moulded capital above first intertie, Navestock

D. Ceiling boss, West Hanningfield

(Photographs by J. E. Kimber)

Evidence that traditions of structure and jointing may in some instances derive from abroad is found in the joints used at Navestock; these are clearly attributable to the same school and period as the barns at Cressing Temple and many of the French works studied by Deneux. The writer considers that work of the Navestock fashion was either an importation from Northern France or stemmed from some common pre-Norman origin. The characteristics of this type of work are the use of timber of slender section and the greatest available length; hence the use of passing braces which were halved over several successive members of a frame and have *notched lap* joints at their ends. The joints last mentioned are rare in English carpentry and not found in work later than *c.* 1300; they are identical to the joints noted in France by Deneux and which he dated to *c.* 1040–1260. The Navestock belfry is clearly datable within this period (possibly the second quarter of the 13th century) as are the two barns at Cressing Temple. That the precise type of jointing, together with the general structural conceptions of these three buildings, should be so distinctly similar is more than adequate evidence for the existence of a clearly defined tradition. That all this evidence should be datable to the range *c.* 1180–1260 and never to the writer's knowledge in later buildings seems to indicate a connection not only with the historical events following the Norman conquest in both date and site of the examples, but also an important similarity in date and technical detail to the French examples already alluded to.

The Development of Bell-turret top-plates

An important sequence of development may be distinguished in the top-plates of the towers which is essentially a change in the proportions of the cross-section, accompanied inevitably by a change in the type of joint used at the corners. The top-plates at Stock Harvard are very wide and shallow, almost plank-like in appearance, and those at West Hanningfield were formerly the same. These necessitated the use of *stop-bridled lap* joints (Fig. 3E). It is possible that the use of wide top-plates derived partly from the fact that the spires were in both instances designed to stand on the outermost edges of the turret, the width of the towers being comparatively small. The next examples in this sequence are Doddinghurst and Margaretting where the top-plates are approximately square in cross-section and have *stop-bridled* corner joints (Fig. 3D). The use of this section and joint at Doddinghurst suggested the possibility already mentioned of the replacement of the top-plates during a late medieval restoration. The top-plates at Margaretting are undoubtedly original and of *c.* 1450. The evidence for the existence of this sequence of development is strengthened by the top-plates at Blackmore which are truly square in section and have *mitre-bridled* corner joints (Fig. 3C). The use of the mitred abutment is not known before *c.* 1520, the probable date for the restoration of the Wheat Barn at Cressing Temple. It will be recalled that only the masons' mitre occurred at Doddinghurst and the scribed joint at Stock Harvard.

From this sequence it will be seen that carpenters' works may ultimately be datable by consideration of the joints they incorporate. In many instances the joints used may only indicate the school of thought to which the craftsmen

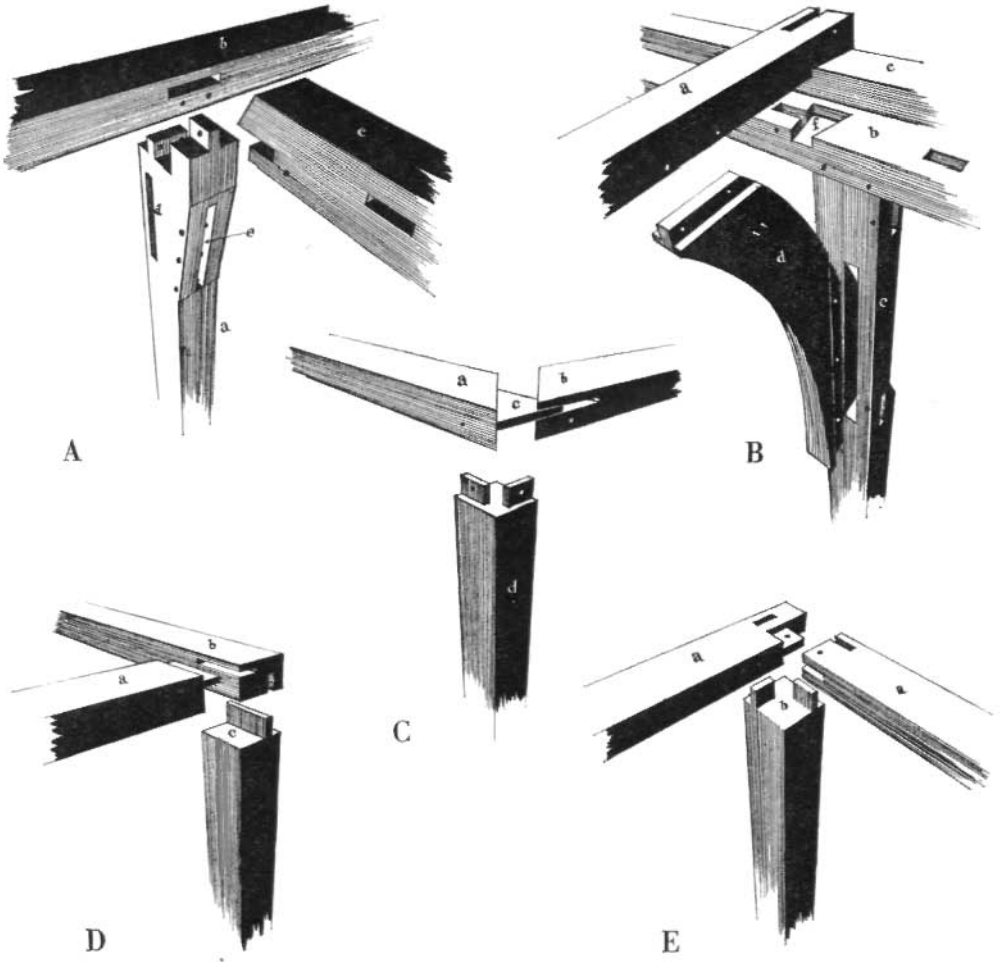

Fig. 3. Joints in top-plates of towers

A. MARGARETTING
(*a*, wall stud originally dividing turret lights; *b*, top-plate; *c*, transom; *d*, mortise for tenon of tracery panel; *e*, mortise for arch-brace to transom)

B. STOCK HARVARD.
(*a*, tie-beam; *b*, top-plate; *c*, fillet; *d*, arch-brace; *e*, stile of E. turret light with mortises for cill and head; *f*, lap dovetail joint with mortise for spire rafter on left)

C. BLACKMORE. Mitred bridle joint (*a*, *b*, top-plates; *c*, tongue; *d*, corner post)

D. DODDINGHURST. Stopped bridle joint (*a*, *b*, top-plates; *c*, corner post)

E. STOCK HARVARD. Stop bridled lap joint (*a*, top plates; *b*, corner post)

subscribed, but that in itself would provide some evidence, from the duration of the school concerned, of the period into which a structure must be placed.

The Development of Spire Frames (Fig. 4)

Three types of spire framing and several methods of mounting for such frames have been described. The towers of Doddinghurst, West Hanningfield and Navestock are all datable to the 13th century; of these the spire at Doddinghurst is a basic type framed around a single vertical post with all its rafters stepped well within the square of the top-plates of the tower. Stock Harvard and West Hanningfield have their spire rafters stepped upon the top-plates of the tower because the spires are of greater size in comparison with the towers beneath them than in the first example. In both instances the turrets have pairs of parallel tie-beams which tie the walls together in one direction only, although in so doing they also prevent spread in the other direction. One difference between these two spires is that at West Hanningfield the spire mast rises from immediately above the tie-beams, whilst at Stock Harvard, which is larger, it had to be raised much higher on a transom carried by two elaborately braced frames. The scissor-bracing between the cardinal rafters of both these spires is regular and in marked contrast to the irregular scissor-bracing at Doddinghurst.

The two latest examples of spire construction, Margaretting and Blackmore, stand on turrets of larger area and are stepped on systems of transoms that do not in any real sense tie the top-plates together; nor is such tying necessary in these cases since the feet of the rafters rest on single unscarfed lengths of timber and so are prevented from spreading. The Margaretting spire is built round a single spire-mast of great length and relatively slender cross-section, whilst the Blackmore spire is so high that it had to be framed round a central pyramidal structure of converging posts, at the heads of which is a horizontal frame carrying the spiremast.

The Development of Tracery in Towers

A further sequence that can be deduced from the given examples is the development of turret lights. The single west-facing turret light at Navestock is followed by the normal range of four lights, one in each face, which develops finally into the remarkable continuous turret window of twelve divisions that formerly existed at Margaretting. With this steady increase in the number of lights must have gone the development from tracery cut through very heavy planks, to panels cut through thin planks — this last is, of course, closely concerned with the changes in the methods of fitting mullions to the wooden tracery. Later examples of wooden tracery invariably have the 'clasping mullion', a type well-suited to the support of long lengths of tracery pierced through light planks, as in the porches of Margaretting and Benfleet for example.

The change of practice implied by the adoption of plank tracery with clasping mullions, apparently following the massive work of the western lights at Stock Harvard and the north light at West Hanningfield, is an example of the general tendency towards lighter and more sophisticated details that led

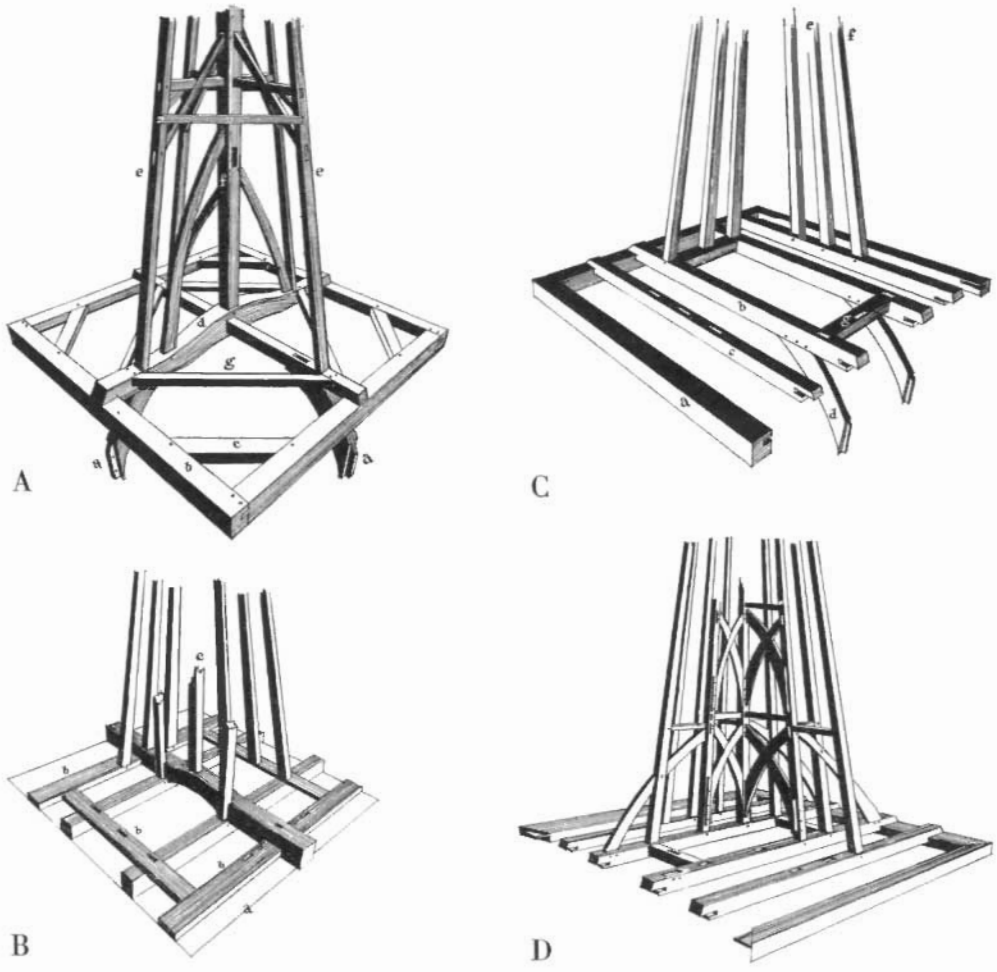

Fig. 4. Spire frame construction

A. DODDINGHURST
(*a*, arch braces (missing); *b*, top-plate; *c*, angle tie; *d*, transom; *e*, cardinal rafters (other rafters omitted); *f*, spire mast; *g*, plate or sole-piece for arris-rafters of spire)

B. NAVESTOCK
(*a*, outline of top-plate; *b*, subsidiary transoms with mortises for feet of spire rafters; *c*, spire mast)

C. MARGARETTING
(*a*, top-plate; *b*, transom with bare-faced soffit tenon and lap joint to top-plates;
c, outer transom with mortises for spire rafters; *d*, arch brace; *e*, cardinal rafter; *f*, arris rafter; *g*, trimmed joist)

D. BLACKMORE. Spire frame resting on four transoms

to the ultimate distinction between joinery and carpentry. The great thickness of the tracery timber at West Hanningfield is illustrated in Fig. 1A which emphasizes the need for massive notched joints at the ends of the lintel and a very substantial stub-tenoned central mullion. The west light at Margaretting (Fig. 1C) is by contrast very thin, with pierced panel tracery, supported by end tenons and a clasping mullion. The latter was, significantly, jointed into the head timber with twin tenons of square section. These last may also be seen on the mullions of the S. porches at Benfleet and Doddinghurst and are an indication of the cabinet maker's approach to woodworking which was to come soon after the close of the medieval period.

The copying of masonry decoration in timber

In three of the belfries decorative features occur that seem to follow comparable work in stone. These features are (1) the diagonal framing of ceilings, (2) the application to arch-braces of cusps of both soffit and chamfer types, and (3) the reproduction of tracery from stone examples; in this last it is necessary to know how great a lapse of time has to be allowed between the introduction of a form in stone and its copying in timber.

The finest specimen mentioned here of this copying from stone is the west door of Stock Harvard with its three unglazed lights above. This combines some anomalous features of which the first is the door arch. This is exactly two-centred and has a double scotia moulding with return cut round the external faces of its jambs. This moulding is typical of masonry during the Transitional and Early English period and together with the trefoiled blind arcading cut into the spandrels represents an earlier fashion than the tracery lights above. The three tracery lights are square with quatrefoil tracery apparently of the Geometrical period which is probably the date of the whole composition. The tracery of the N. and S. windows in the lower floor of the same belfry is less easily explained; the windows are clearly later than the W. door but earlier than some timbers in the E. end of the belfry dated 1683. It is possible that they are late Tudor attempts to reproduce earlier work which had to be replaced. The reason for such replacement is obvious when it is considered that the (original) west window would enjoy nearly average atmospheric conditions, but that to the N. would be weakend by perpetual dampness and shade and that to the S. by extreme weather conditions.

The tracery at West Hanningfield (Fig. 1A) appears to be a design of the Transitional period, according to the propositions of Sharpe,[1] and this would not conflict with the evidence of the joints and general design of the tower. This very heavy type of wooden tracery was not necessarily the only kind produced during that period but it is certain that the notching of the cheeks of the stile-mortises were needed for its adequate support and equally so that no well-designed clasping mullion could have been used with such thick timber. The tracery at Doddinghurst has already been shown to be a replacement and it may be added that the trefoils in the replaced heads do not conform to the apparently early date of the rest of the structure.

[1] E. Sharpe, *The rise and progress of Decorated Window Tracery in England*, 1849.

Two examples of tracery remain, both of much more recent date. These are at Margaretting and Blackmore. The former has two very fine trefoiled ogee lights above the W. door with pierced cusped spandrels. The latter has five cinquefoiled lights with uncusped pierced spandrels in a square head which probably dates from *c.* 1480 and the Margaretting window may be 30 years earlier. Both windows have clasping mullions while the Blackmore example is distinguished as the only one quoted which is grooved for glazing.

The use of cusps on arch-braces is also indicative of the influence of stone technique, the most conspicuous being the cusps on the diagonal arch-braces at West Hanningfield and Stock Harvard (Pl. XXXV B & C). These are both chamfer cusps, which form, Sharpe says, appeared as early as the Lancet period, was common in Geometrical windows and was almost exclusively used in the Curvilinear period; of this form of cusp he also says 'the plane of the fillet or edge of the cusp is generally a little below that of the adjoining fillet of the mullion or tracery bar' — which is true of the cusps at Stock Harvard. Those at West Hanningfield appear more integrated with the brace and are not in a separate plane from the face and do not have sunk spandrels; similar braces occur at Navestock but without cusps.

These ceilings with cusped braces have been noted only in connection with diagonal framing, which suggests that the carpenters were influenced very much by what they saw of contemporary masons' work. It is certain that these ceilings make absolutely no contribution to the structural efficiency of the towers and are solely used for their decorative effect; this being so their admittedly vague resemblance to cross vaults may be allowed and the influence of masonry practice admitted. The triple combination of diagonally framed ceilings, cusped arches and decorative bosses does not stem from the carpenter's imagination but was borrowed from the vocabulary of the master mason.

Dating of the Belfries

Tentative dates for the building of the six belfries can now be discussed in the light of the evidence at present available. The earliest in the series must be either Navestock or Doddinghurst which are very close in date to each other. It is possible that the latter may date from *c.* 1220 for reasons given earlier in this paper; it should be noted here that the design of this belfry is pure carpentry uninfluenced by other media.

Navestock belfry was evidently built at about the same time as its South Aisle in *c.* 1250; the W. door from the S. Aisle into the belfry is of the 13th century and one S-. facing lancet window adjacent to this door is in keeping with that date. The W. face of the W. door, now covered by the tower, shows no signs of weathering or restoration and it seems that it was not long left exposed to the weather. A sample of the oak from one of the notched-lap matrices of this tower was analyzed by Professor G. J. Fergusson of the University of California, and found to have an age of 770 years; the margin of error in such recent carbon–14 datings being ± 60 years. This gives us a central date of A.D. 1193 with the outside limits of 1133 and 1253. It is, therefore, possible that the belfry pre-dates the S. aisle in view of the absence of

weather effects on the stones of the S. door leading into the belfry, and the fact that the masonry high up in the W. facing gable of the S. aisle frequently protrudes through the plane of the E. face of the timber frame, implying that the gable masonry was laid in relation to previously erected timber-work.

West Hanningfield may also be attributed to the 13th century from the predominance of trefoiled arches, which Sharpe considered to be a characteristic ornament of the Transitional period (a period ending according to Sharpe in 1245). The remarkable lap-joint used on the tie-beams of the turret does not conflict with this date.

Stock Harvard may be dated from the profusion of masonry-influenced decoration, including the use of chamfer cusps, to between *c.* 1245 and 1315; the geometrical tracery there would also agree closely with this date range.

Margaretting and Blackmore appear to be separated by a gap of centuries from the other four examples. Blackmore is apparently the more recent of the two from the use of the mitred-bridle joint for its top-plates. The surviving wooden tracery in the two towers also confirms this order of building. At Margaretting the turret lights have clasping mullions and thin plank tracery with trefoiled ogee lights whilst at Blackmore they have cinquefoiled lights with uncusped pierced spandrels under a square head. The Blackmore tracery is also the only example of wooden tracery that was designed to receive glazing, the mullions and even the cusping being very nicely grooved to receive the glass. A date of *c.* 1450 has therefore been proposed for Margaretting, and *c.* 1480 for Blackmore.

In conclusion it must be said that although the dates suggested for the first four belfries are ealier than is usually put forward, it should be remembered that most of the evidence examined in this paper has not previously been considered. In view of the generally admitted difficulty of dating medieval timberwork the dates proposed here are at least as tenable as those hitherto accepted.

GLOSSARY

BARE-FACED Any member of a joint possessing a single shoulder: *e.g.* bare-faced tenon.

BIRD'S MOUTH Any joint incorporating a member with splayed notching resembling an open bird's beak.

BRIDLE A joint connecting the ends of two timbers at any angle, *e.g.* in tower top-plates, one member having a central tongue and the other an open-ended mortise. See *Stop-bridle.*

CANT POST Term used in millwrighting for the inclined posts at the angles of a timber tower mill.

CARDINAL RAFTERS The four principal rafters of a spire, facing the cardinal points of the compass.

CHASE MORTISE A mortise with one square end and the other sloping to allow the insertion of the tenoned member from the side instead of end-on; used where space does not allow the usual method of assembly.

CLASPED Used of a timber held either between two others, or by one cut to form two 'horns' which fit on either side of it.

COGGED A joint in which the whole of the end section of one timber is housed within another.

INTERTIE Any horizontal timber in a wall-frame which is placed between the ground-cill and top-plate; in some circumstances it is termed a *side-girth.*

LAP A timber of diminished thickness which overlaps another.

JOWL The enlarged head or foot of a timber, usually a vertical post; frequently used where two members, *e.g.* top-plate and tie-beam, were to be joined to the post.

MITRE An abutment at 45 degrees to the ends of two conjoined timbers. A method widely used in ancient Egyptian carpentry, but not used in England until the close of the medieval period.

MITRED BRIDLE A bridle joint that shows a mitre on one or both faces (Fig. 3C).

NOTCH 'A V-shaped indentation in an edge or across a surface' (*Shorter O.E.D.*). During the last fifty years the term has been wrongly applied to many joints outside this category such as rebates, housings and the like. In view of the great importance of the principle of notching during early French and English Romanesque carpentry it should be clarified and used with precision.

PASSING BRACE A term proposed by the writer as appropriate for any brace that continues in one piece past several members of a frame and into which it is halved. (Pl. XXXI.).

SCOTIA A hollow moulding or casement; the term is used in timber milling to denote hollows of quadrant section.

SCRIBED JOINT Used in place of mitreing to join irregularly shaped timbers at any angle, one timber being cut back to the profile of the other.

SHOULDERS The two abutments left either side of a tenon which meet the *butment-cheeks* at the sides of a mortise.

SQUINT Any angle not being a right angle, *e.g.* the sloping shoulders of a traceried lintel (Fig. 1A.).

STOP-BRIDLE A bridle joint in which the tenon does not fully penetrate the other timber (Fig. 3D.).

TONGUE A very wide tenon of short projection usually associated with the groove and normally cut along the grain.

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