

The Construction of Medieval and Tudor Houses in London

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In the medieval and Tudor periods, London houses were built out of four basic materials: stone, timber, bricks and earth. In each case we may examine the types, sources and supply of the material; and study the way it was used, how well the buildings stood up, and how far the character of each material was conducive to architectural or decorative expression.

Though this paper is mainly concerned with domestic structures, materials and methods of construction in royal, public and religious buildings in London will be used as parallels and as better-recorded examples of certain techniques.

Stone

The main stones used on domestic building-sites were ragstone, chalk and flint. The earliest source of these stones must have been the considerable amount of Roman building rubble littering the early medieval city, or available for the comparatively small labour of digging out old Roman foundations, some of them very substantial. Apart from the city wall and gates, no Roman structure of stone is known to have survived into the late Saxon period, though there are some probable cases;¹ by the eleventh century, in general, there can have been few if any Roman masonry buildings to be seen within the city walls, and large-scale digging-out ('robbing') of both standing and buried walls and foundations was common practice. The third-century Roman riverside wall gradually disappeared until by 1100 stone buildings reused it as foundations for their front walls, facing north to help form the line of Thames Street. Saxon and early medieval (pre-1200) stone churches and secular stone buildings all contain some element of reused Roman stone or tile in their fabric, suggesting that robbing of Roman structures continued until perhaps the thirteenth century.

Ragstone came in two varieties: from Kent (Maidstone) and from Surrey (Reigate or Merstham). Kentish rag had been quarried in Roman times and in the medieval period it was favoured for rough locations, such as river-walls, and occasionally for exteriors of prominent buildings and as paving for kitchen floors.² Reigate or Merstham stone is a calcareous sandstone, which is softer than the Kentish but hardens on drying. It was used for London Bridge from 1176, and in great quantity by the masons at Westminster, both on the abbey and palace, in the middle of the thirteenth century.³ Although the variety is not specified, it seems likely that Reigate was intended when a mason's contract for the Peter and Paul tavern in Paternoster Row in 1342 expressly required *bon pere de Rag* to be used for the walls of the cellar and ground floor (at least on their external and internal faces), the steps leading to the cellar and to the hall and the jambs of the cellar door.⁴ Merstham stone was specified in the building of Grocers' Hall in 1435-6.⁵ Being initially soft, Reigate was much used for carving, and window- and door-frames.⁶

Flint, a silica nodule occurring in the chalk, was often used with chalk for rubble

walling, roughly plastered on one or both sides.⁷ The widespread use of flint dates from the second half of the thirteenth century.⁸ Knapped flints were laid in regular courses after 1250, and in the fourteenth and fifteenth centuries several church and secular interiors in London had chequerwork walls, in which flints were composed into black squares to alternate with a paler stone (usually chalk; Fig 1).⁹ A house in the parish of St Olave Silver Street was called *le Flynt Hall* in 1399, presumably from the character of its walls.¹⁰

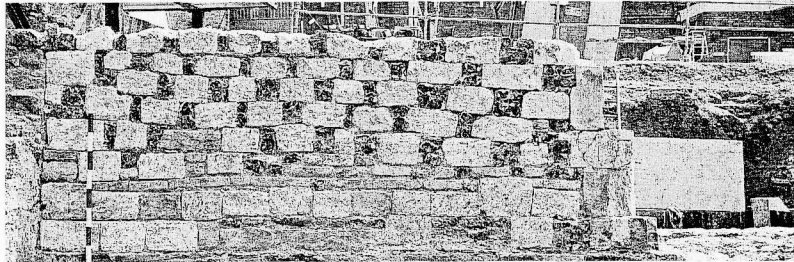


Fig.1 Internal use of chequerwork in the fifteenth century: the east end of the south aisle of St Botolph Billingsgate, excavated in 1982 (Museum of London)

Examples of some other English stones have been noticed in churches or public buildings, but rarely on the sites of private houses. Wheatley stone, from around Oxford, is found in some London parish churches.¹¹ Stapleton (Yorks) stone was used, unwrought and ready hewn, for windows jambs and sills at Grocers' Hall in 1428.¹² Beer stone (a fine chalk from Seaton, Devon) was bought for an unspecified municipal purpose in 1350.¹³ Huddleston stone (Yorks) passed through London, since the clerk of works at Sion in Middlesex sold some at London to the builders of Eton College in 1444-5.¹⁴ Corfe stone from Dorset was used at the Tower in 1278; Portland stone, also from Dorset, was used at the Tower in 1349 and on the Bridge in 1350.¹⁵ The hard grey-green limestone from Purbeck (Dorset), composed of small freshwater mussel and snail shells and which takes a high polish, was fashionable in southern England towards the end of the twelfth century and remained so for two centuries; but apart from the comparatively late occurrence in columns in the western crypt of Guildhall (1411-30), its use for buildings is not documented in the secular city.¹⁶

The most important foreign stone used in London was Caen stone, from Calvados in Normandy. This had a fine grain but weathered badly, and so was often soon replaced if exposed to the elements.¹⁷ It was generally used in prestigious residences for the jambs of doors and windows or loop-holes.¹⁸ Presumably the use of Caen in royal works made it more easily available for domestic use; in at least one case in Caen stone was resold in London from royal works at Eton.¹⁹

The effect of royal and ecclesiastical building on the grand scale in the city and its environs must have stimulated certain fashions in stone usage. A useful analogy may be supplied by medieval Florence, where marble was used in private houses after the cathedral authorities organised the large supply they needed for the cathedral itself²⁰: similar things may have happened in London.

Foundations and Walling

The secular stone buildings erected in the city from the late eleventh century were

often greater in area than the largest timber cellars which preceded them on central properties, and in every case much heavier. New foundation techniques were therefore developed: the use of piles, and later, arches in stone. In a study of sites around Cheapside, three main techniques of construction of foundations beneath stone buildings have been identified: (i) chalk and gravel foundations without mortar, sometimes with piles; (ii) arched and mortared foundations; and (iii) mortared foundations without arches. Each of these techniques had a definable period of currency or widespread usage.²¹

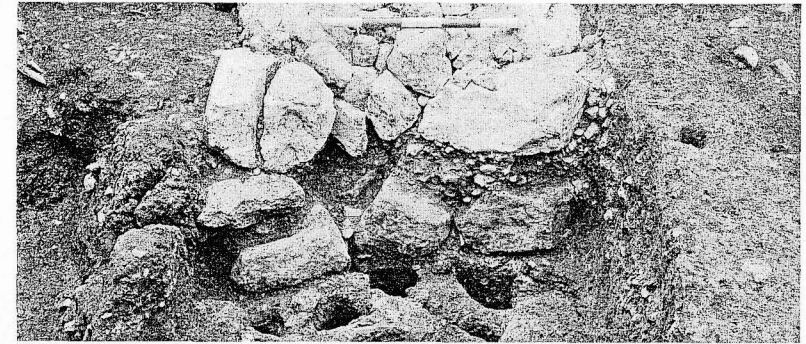


Fig.2 Section through the foundations of an early twelfth century building at Milk Street, excavated in 1976. The foundation trench would originally have been deeper, but the surrounding soil has been removed in modern times. At the base of the trench are the voids left by beech piles; the base layer is of ragstone, then upper layers of chalk, interleaved with rammed gravel (Museum of London)

The technique of foundations formed of unmortared layers of large stones interleaved with gravel, sometimes supplemented by piles, is found throughout the city and its environs in religious structures in the Saxon and early medieval period, and on secular sites from the twelfth century.²² Secular examples include buildings in the streets off Cheapside (Fig 2) and on the waterfront, at Seal House, Upper Thames Street (Building A, early-mid twelfth century) and New Fresh Wharf, Lower Thames Street (Buildings A-D, mid twelfth-early thirteenth century). In the City of London there are at present no examples independently dated to later than the mid thirteenth century, and it seems likely that the technique, which was expensive in stone, was thereafter modified.

Several excavated stone buildings of the thirteenth century have arched foundations: pits had been dug in the bottom of the foundation trench at regular intervals and the foundation constructed as piers of stone linked by arches, brought to a level surface at or slightly below the level of a cellar floor, or a comparable distance below ground level where no cellar was intended (Fig 3). An early example is Building 11 at Well Court, Bow Lane (excavated 1979), possibly the vault mentioned on the site in 1269. It is suggested that a suitable date for construction would be the 1220s. A second example from a secular context, Building F at New Fresh Wharf in Thames Street (excavated 1975), had walls on arches, supported by timber piles through reclaimed land, and may have comprised part of a rebuilding of the tenement known on documentary grounds to have taken place in 1293. Arched foundations were used at the same period in religious building: the crypt of the chapel of the Bishop of Ely at his mansion in Holborn, built in 1286-90; and shortly afterwards beneath the south wall of the choir of the Greyfriars' church,

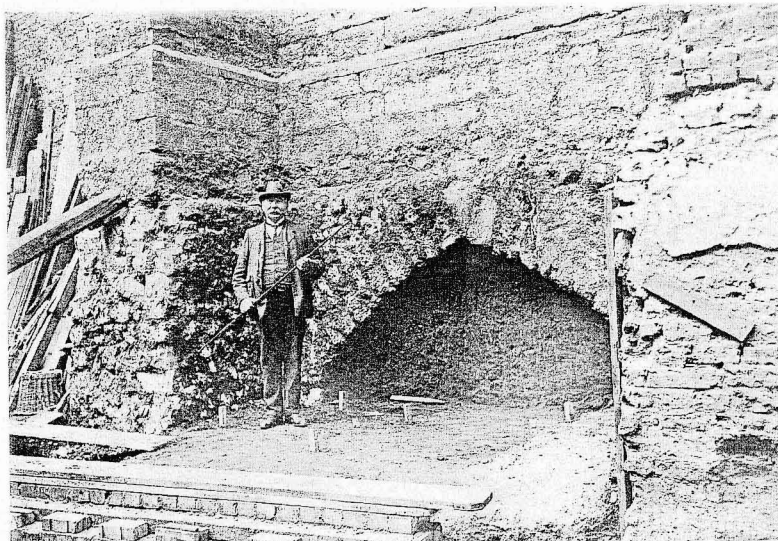


Fig.3 Merchant Taylors' Hall, Threadneedle Street: foundation arches below the north wall of the hall, photographed in 1910-12 (Museum of London)



Fig.4 Ashlar in Kentish ragstone employed in a river-wall of the mid fifteenth century at Trig Lane, excavated 1974; here two corbels (one later destroyed) supported a timber river-stair to a wide entrance through the wass from the river (Museum of London)

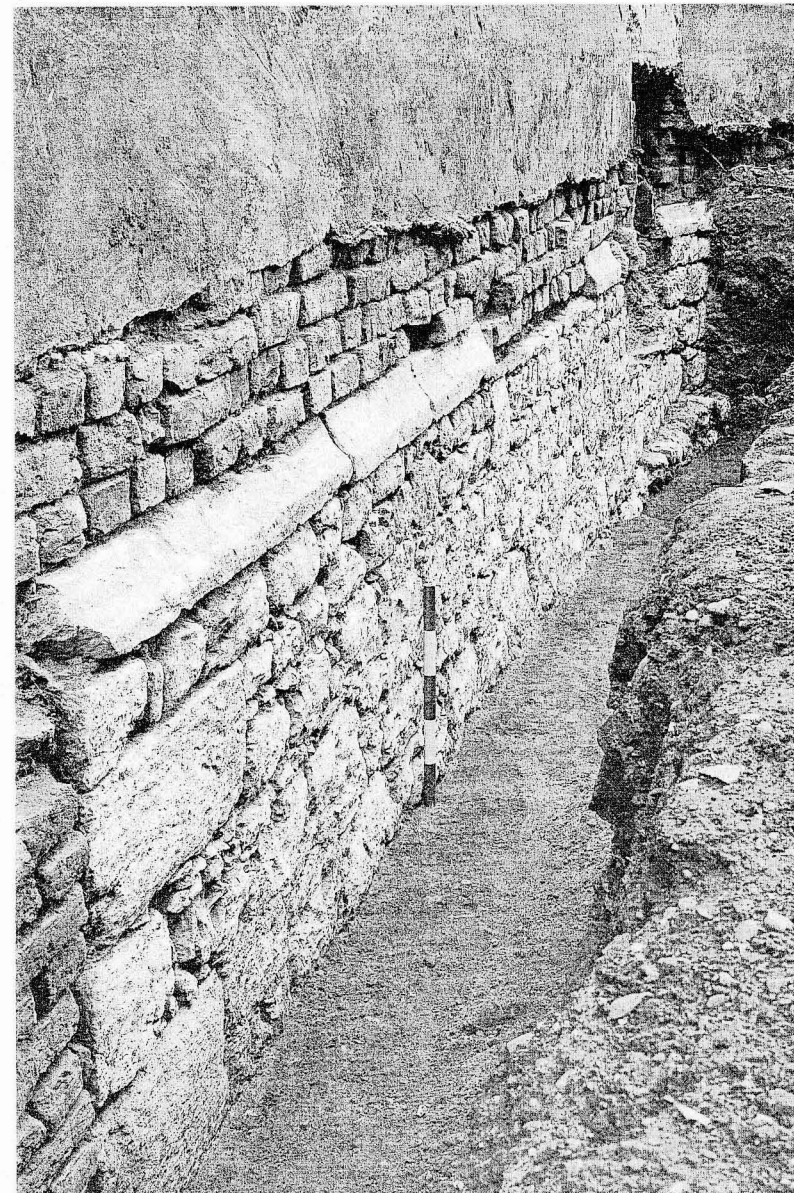


Fig.5 Part of a foundation exposed on the edge of St Botolph Aldgate churchyard in 1987; probably the main building of the adjacent Crowne Inn, Aldgate (Museum of London)

begun in 1306 and finished in 1337.²³ Thereafter the technique was widely employed for stone buildings in the fourteenth and fifteenth centuries, for church extensions, company halls and the better-built private houses.²⁴ The technique therefore broadly dates from the middle of the thirteenth century (and possibly from c1220) to the mid-fifteenth century, when brick began to be widely used for foundation arches. In London the arched form was well adapted to the stabilising of large stone buildings erected upon the soft soil of previous occupation, and may have been developed for this purpose.

Foundations of chalk bonded with mortar, as opposed to pounded gravel, but without occasional arches, were the less ambitious complement to arched and mortared foundations. They were often not carefully layered, but the chalk was evidently poured with the mortar. They are first recorded below medieval secular buildings in London in the twelfth and thirteenth centuries²⁵ though in larger buildings arched foundations were often preferred. From the thirteenth century thinner mortared foundations or walls with no foundations at all are recorded in situations where very heavy loads did not have to be supported, e.g. cesspit walls or inner walls of cellars within the area covered by buildings.

Above the foundations in twelfth-century stone buildings, an almost standard technique of wall-building may be noted. Large rag blocks were laid to form the outer faces the spaces between them being then filled with smaller chalk blocks, occasional flint and fragments of Roman tile, all mortared together. The sides presented a random uncoursed appearance with wide joints occasionally filled with small stones. A twelfth-century townhouse recorded in Southwark in 1839 had a first-floor doorway edged in Caen stone, but nineteenth-century engravings suggest that the walls of this building were otherwise of coursed stone rather than ashlar. Thus although prominent twelfth-century secular stone buildings in London probably had tooled ashlar quoins and details such as door and window surrounds, there is no evidence at present to suppose that they had ashlar exteriors, as at, for example, the Jew's House in The Strait, Lincoln (c 1170-80).²⁶ The full dignity of squared ashlar was largely reserved, presumably on grounds of cost, for public buildings such as later at Guildhall or Leadenhall, though it was also employed on prestigious buildings such as Merchant Taylors' Hall and Fishmongers' Hall (as shown by Wyngaerde and the other panoramas), in certain undercrofts and, because of its durability, for river-walls (Fig 4).²⁷ Many other buildings, both religious and secular, had stone walls with roughly-coursed and rough-hewn stone, embellished with larger but still rough-hewn quoins; both ashlar and roughly-coursed walls sometimes had a hollow-chamfered offset of tooled stone between two and four feet above ground level (Fig 5). This was presumably the 'water-table' of medieval and post-medieval building contracts.

A very few superior residences in the fourteenth century had crenellated walls. Among the first may have been the Savoy Palace, licensed in 1293 to be crenellated by Edmund of Lancaster.²⁸ The house of Richer de Refham in the parish of St Michael Paternoster had a stone *alure* (walkway behind a parapet) in 1306,²⁹ which may refer to crenellation, though the licence to crenellate is not in the usual source, the *Patent Rolls*. The *Rolls* give details of eleven licences between 1305 and 1385; two bishops, of Coventry (Chester) in the Strand in 1305, and of Salisbury, in Fleet Street in 1337, and nine citizens, all but one in 1305-41.³⁰ A study of crenellation between 1200 and 1536 suggests that this aristocratic gesture was confined to nobles and religious lords, though the licence to crenellate did not necessarily result in

building: since the licence sanctioned seignorial rights, 'very often bluster sufficed and no building was done'.³¹ The only crenellated domestic building (i.e. apart from buildings such as Leadenhall, the Stocks, Mercers' and Fishmongers' Halls) visible in the sixteenth- and seventeenth-century panoramas is the main range of Poultny's residence in Lawrence Pountney Lane, licensed in 1341 (Fig 6).

The walls of later medieval buildings contained an increasing proportion of chalk on their interior faces. Further economies are found in fourteenth-century undercrofts, where the greater part of the wall below medieval ground level was often of chalk, though the interior face was often carefully composed of coursed, squared blocks or could incorporate a colourful chequerwork of chalk and knapped

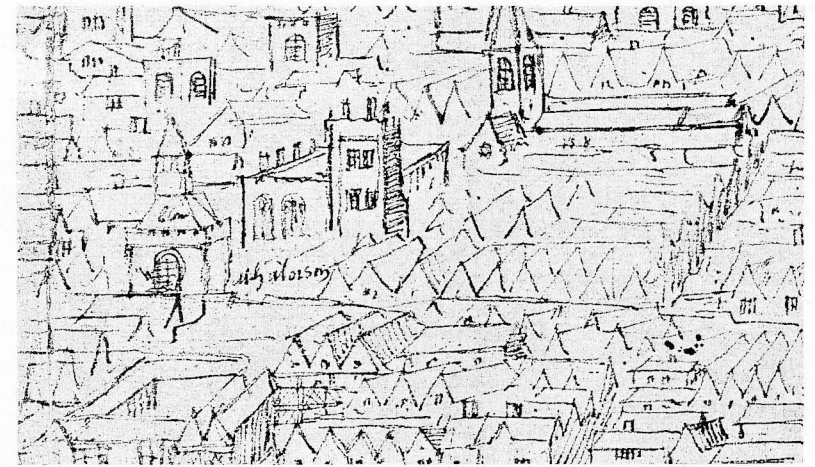


Fig. 6 A detail from Wyngaerde's panorama of London (c1540), showing Poultny's crenellated hall (Ashmolean Museum)

flint. A rough layering of ragstone and chalk, as well as a crude attempt at chequerwork in those types of stone, is seen in the walling of the east undercroft of Guildhall (c 1430). By the late fifteenth century undercrofts were built in a mixture of chalk, rag and brick (as at 7-8 Philpot Lane). During the fourteenth and fifteenth centuries the most frequent use of stone in the ordinary house must have been for new cesspits (almost always chalk), as demanded by the *Assize of Nuisance*, civic regulations in force from about 1200.

A wall of stone was not always the permanent asset it may have seemed. There was a thin but constant stream of accidents when walls collapsed, and concern about walls which were alleged to be leaning dangerously.³² As the period progressed, party-walls of stone also tended to be built thinner than the 3ft demanded in the early thirteenth-century building regulations.³³ It is likely, moreover, that stone was largely confined to party walls except in a minority of prestigious cases where complete stone buildings were to be found; stone undercrofts often supported timber-framed buildings. By the time of the surveys of London houses by Ralph Treswell in 1610-12 there were very few houses with stone walls, and none with all four walls of stone: houses in stone must have been a rarity since the time of the great residences of the fourteenth century.³⁴

Wood: Species and Sources

Oak was the most widespread timber used in buildings and other wooden constructions: it was used for structural timbers, laths and boards.³⁵ Oak for royal contracts, as in the case of the roof of Westminster Hall, came from royal woods in Hampshire, Berkshire, Surrey and Hertfordshire. The leaders of the church could also rely on royal or noble assistance for large structural timbers, as when the abbot of Westminster asked the king for six large oaks for his hall.³⁶ The established religious establishments such as St Paul's could use wood sent as part of the *firmæ* of their manors. The sources of oak for domestic building were also at least partly local: the Bridge bought oaks in Lewisham, Croydon and Coddington.³⁷

Elm was supplied usually in the form of boards³⁸ to be used for doors, window shutters and floors, and for benches, dressers and shelving;³⁹ also in privies, probably for the lining of their chutes (*pipes*).⁴⁰ The sources of elm were local: the Bridge Account Rolls for the brief period 1381-97 mention eighteen places in Essex, Kent, Middlesex and Surrey as sources.⁴¹ As with oak, the Bridge occasionally bought elms direct from magnates, such as from the earl of Kent who held an estate at Stepney, or from the abbot of Chertsey who had 60 elms at Petersham.⁴²

Ash was used for handles of tools, the uprights in wattling and as planks in certain situations, especially pastry boards⁴³: a table of ash was supplied to the Coldharbour in 1485.⁴⁴ Beech was used for laths, occasionally for shelving,⁴⁵ and by 1607 beech puncheons (studs) were an allowed thinner alternative to oak.⁴⁶ Beech was sometimes used for scaffolding or other forms of poles, as was alder, fir and willow.⁴⁷ Wicker (horizontal and vertical rods woven together) was used chiefly for fences, weirs and in other external situations. Two hurdles from an early fourteenth-century fence found in the medieval city ditch at Old Bailey (Fig 7) were made of pliant rods of hazel, alder and a little oak.⁴⁸ During the tenth to twelfth centuries wicker was also used to line rubbish pits (Fig 8).

The greater volume of wood must have come downriver from such places as Kingston, since a distinct quarter of the waterfront at the west end of the city

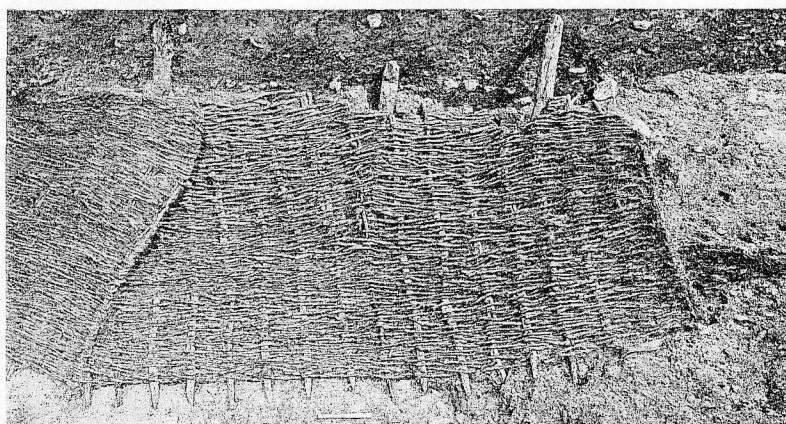


Fig.7 A wicker fence found in the backfilling of city ditch north of Ludgate in 1982; probably of fourteenth-century date (Museum of London)

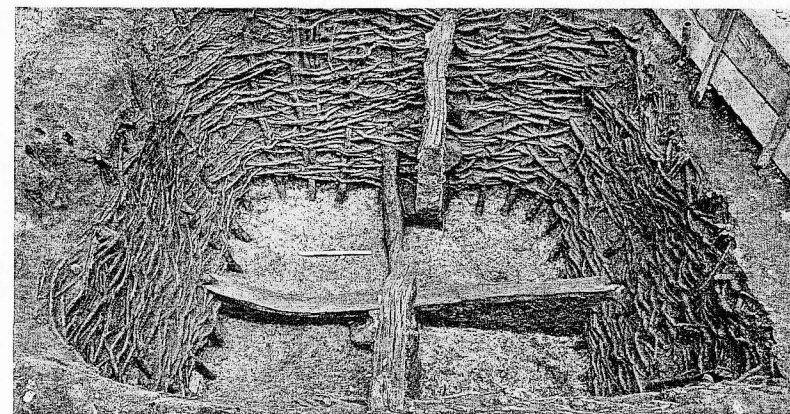


Fig.8 A wicker-lined rubbish pit of the twelfth century at Milk Street (Museum of London)

became associated with the timbermonger trade by the mid fourteenth century; the parish of St Benet Woodwharf is so called in 1374. Nearby in St Peter's Hill lay Woodmongers' Hall, though it is documented only when it had passed into other uses.⁴⁹ Woodmongers were among the will-making class in the 1370s, one with a fleet of small boats and a wharf; another was in partnership with a colleague in Kingston.⁵⁰ In the late fifteenth century it was usual to have timber brought from the waterside, and sometimes the client paid for carriage, wharfage and crange of the timber.⁵¹

By the thirteenth century it was as cheap to import oak and fir (deal) from the Baltic as it was to bring it from anywhere in Britain outside the home counties; presumably a symptom of the extraordinary demand in London as well as of difficulties with overland transport. Eastland or Estrich boards (almost always of oak, but sometimes of deal in later accounts)⁵² were employed in royal buildings in the mid thirteenth century and are mentioned in the Bridge stores in 1350.⁵³ The doors and shutters of the St Paul's shops of 1369 and the Friday Street shops of 1410 were to be of Eastland boards, presumably because they were better seasoned. In 1405 the chapter of St Paul's undertook to supply Eastland boards for the building of a courtyard house in Bucklersbury, whereas the framing was done by the carpenter. Estrich boards were also used to make lintels over the windows on the south side of Brewers' Hall in 1423, indicating perhaps that they were carved with tracery.⁵⁴

The word *spruce* derives from *Prussia*, and must have referred to fir; spruce tables, coffers and chests are known from the late fourteenth century.⁵⁵ Furniture of other rare or possibly foreign woods are mentioned infrequently from the sixteenth century, for instance of cypress⁵⁶ and walnut.⁵⁷

Study of the way timber was used needs to take account of several considerations: the character of timber-framing (sizes of timbers, bracing methods); the construction of floors and therefore upper storeys; the height of the various storeys; the first appearance, nature and decline of jetties; the decorative element in timberwork, including architectural embellishment; and finally what this evidence in total suggests about the styles of framing in London houses.

Building with Timber

In certain London building contracts the cross-sections of many of the principal timbers are specified, and these have been tabulated in Table 1. The methods of

Table 1: Sizes of principal timbers in three building contracts (inches)

	1369	1383	1532
Cellar joists	10 x 10		
Sillbeam/groundsill	7 x 12	6 x 10	6 x 10
Principal posts	14 x 12 (bot) 12 x 10 (top)	12 x 9	12 x 10
Groundfloor puncheon	12 x 9		
Groundfloor summer	13 x 9	10 x 9	12 x 10 8 x 9, 9 x 9
Mullions	6 x 9		
Tie-beam/enterkeys	10 x 9		12 x 14, 10 x 12
1st floor joists	10 x 8	7 x 6	12 x 10, 5 x 3 6 x 9
1st floor sillbeam	6 x 8		
1st floor puncheons	10 x 8		
1st floor summer	12 x 8		
2nd floor joists	9 x 7	6 x 5	
2nd floor sillbeam	5½ x 7½		
2nd floor puncheons	9 x 7		
Wallplates	10 x 8		
Principal rafters		7 x 8	
Rafters	6 x 5 (bot) 5 x 4 (top)	6 x 5	
Lyernes (?tiebeams)	6 x 8		

Table 2: Regulations for timber sizes, 1607

	Number in load	Cross-section	Length
Solid timber	50'		
Joists	30+	4" thick throughout	8'6"
Puncheons	40 50	6" x 4" (oak) 5" x 5" (beech)	6'6" 6'6"
Rafters	30+	4½" x 4" (bottom)	12' +
Double quarters	50	4½" x 3"	8'6"
Single quarters	100	3½" x 2"	8'6"
<u>Boards</u>			
Stable planks	40	12' x 2'	6'6"
Bedsides	60	10' x 2'	6'6"
Quarter boards		1" thick at thicker edge, ⅓" at thinner edge	
Seelinge boards		½" thick at thicker edge, ⅓" at thinner edge	
Planch boards		1" thick (?throughout)	
Laths	30 bundles	1½" x ⅓"	larger 5' (5 score to a bundler smaller 4' (6 score to a bundle)

measuring timber by volume were codified by Richard More, a past master of the Carpenters' Company, in 1602: the regulations for timber sizes as laid down in 1607 are given in Table 2.⁵⁸ There were also accepted methods of calculating the amount of wood in waney timbers, but by 1602 these were a comparative rarity in London: most timber seems to have been hewn into rectangular cross-section before arrival.⁵⁹

Two things may be observed immediately: firstly, that these examples suggest a general diminution in timber sizes between the middle of the fourteenth century

and 1602; and secondly, that the variety of sizes of timbers available and used in 1369 was severely curtailed by 1602. Thirteen different cross-sections of timber were specified in the contract of 1369, but only five general thicknesses in 1602.

Standardisation of dimensions would aid prefabrication of buildings outside the city. Buildings were sometimes framed elsewhere, presumably near the source of the timber, and brought to London in a prefabricated state. For the large Bucklersbury house in 1405 St Paul's had the timber, including the arch-couple roof, framed at Hadleigh (Essex); in 1425 the new frame for Drapers' Hall came from Croydon, though other timber was bought at Hunton in Kent. A house 40ft x 22ft and 24ft to the eaves built in 1510 was to be framed at Kingston on Thames, and in 1515 the new Bridge storehouse was framed at Charlwood (Surrey), carried to Kingston and brought by boat in 225 loads.⁶⁰

Timber was not only used above ground. Beech piles were used to spread the load of stone foundations from the opening of the twelfth century.⁶¹ From at least the thirteenth century larger timbers, sometimes from previous buildings, were also used within foundations, particularly when laid through reclaimed land.

Several separate traditions of building with timber were evident in the city by 1100. The main techniques of wall construction in the timber buildings of the late ninth to twelfth centuries were stave-building, walls of mud, planks or wattles supported by posts, and plank revetting of sunken areas, sometimes using a double cladding of planks, or earth walls.⁶² Most of the buildings would have had daubed or horizontally-planked exteriors.⁶³ Some of these techniques may have continued well into the medieval period on smaller structures.

By the thirteenth century, on the basis of examples recorded in the environs of London, timber-framing using long thin vertical panels might be envisaged in the city.⁶⁴ In the fourteenth century, regular but still rectangular panels are more likely; the framing of buildings began to reflect a structure based on trusses at intervals, with principal timbers emphasising the bays as major divisions in walls.⁶⁵ By the time of the first engravings of London houses in the late eighteenth century the majority of timber-framed houses were plastered over; occasionally solid framing in square panels, which might be of fifteenth- or sixteenth-century date, is seen (e.g. Fig 9).



Fig.9 A building in Hosier Lane, drawn in 1795 by J T Smith, showing construction in square panels (Guildhall Library)

The walls of medieval timber buildings were often braced across the corners of panels with diagonal or curving timbers, set either outside or inside the studs and connecting a principal timber, often a corner-post, with a horizontal beam either at ceiling or at floor level. Where two houses shared a timber wall and its principal pots, braces of each house might share a post.⁶⁶

Surviving buildings in the region suggest that braces were of different forms at various times: before the influence of Gothic forms in stone, c 1230, braces were straight, but after that date they were sometimes curved. In the fourteenth century the 'Kentish' form of matching curved braces beneath a first-floor window was common, and an example can be seen in the room in the service accommodation at the Bishop of Bath's mansion, as drawn by Hollar in 1646 when it was Arundel House (Fig 10). Ogee curved braces were introduced in the early sixteenth century⁶⁷ and are shown on a house by Wyngaerde c1540; Saltire or X-form braces are shown in the same panorama. In the later sixteenth century there was a return to straight braces, often confined to the first-floor corners;⁶⁸ a feature of the otherwise undated building, perhaps a lodging for retainers, shown on the north side of the court at Arundel House in another engraving by Hollar.

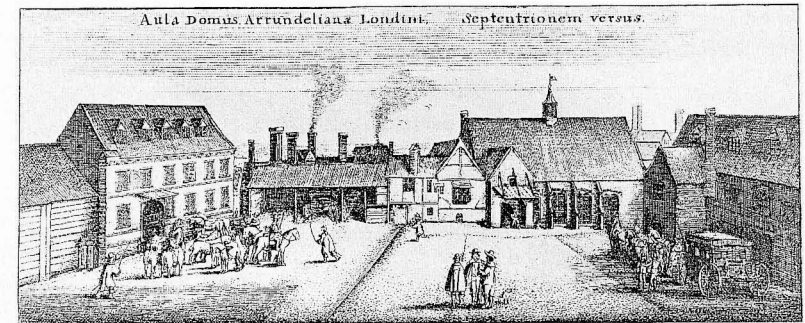


Fig.10 The south side of the main court of Arundel House, formerly the Bishop of Bath's Inn, Fleet Street, drawn in 1646 by Hollar (Guildhall Library)

There were several periods when framing and bracing included timbers which were structurally superfluous, and when therefore it is highly likely that the external faces of timbers were exposed as a form of decoration and ostentation. By the early fourteenth century, in rural buildings of standing, selected gables such as parlour cross-wings had double curved braces which were more for show than for stability.⁶⁹ The widespread fashion of close-studding – in which buildings often had close-spaced timbers at the front, but more economical large framing on side and rear walls – began in Kent c 1445, and was remarked upon by a Venetian visitor to London in 1497.⁷⁰ This may have led to some faulty practice, in that in the late sixteenth century there are examples of some studs (puncheons) not being jointed into the horizontal beams; they were there purely for effect.⁷¹ The

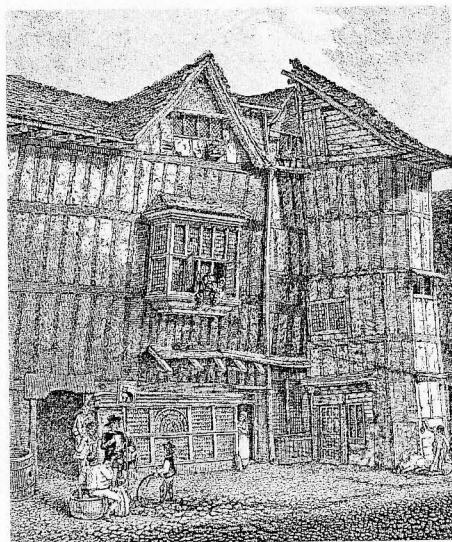


Fig. 11 (above) House in Sweedon's Passage, Grub Street (later Moor Lane), drawn by J T Smith c1800 (Museum of London)

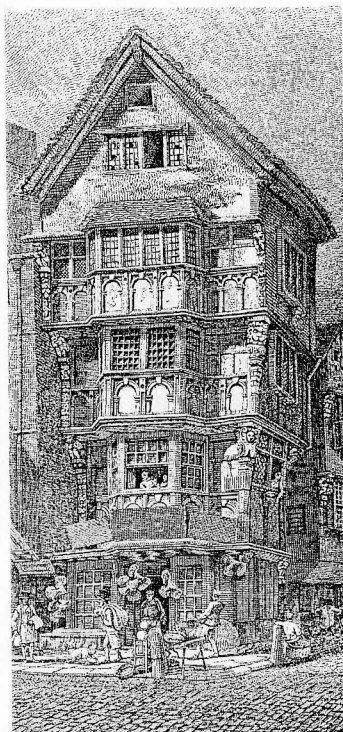


Fig. 12 (right) House at the corner of Fleet Street and Chancery Lane, drawn by J T Smith in 1789 (Guildhall Library)

only authentic example of close-studding noted in London engravings (though representations of the building differ in their renditions of its magnificence) is a house in Moor Lane (Grub Street) (Fig 11). Although the frontage of Staple Inn to Holborn is today a fine example of this style, its previous appearance shows that it may originally have had panels without close-studding.

There is no evidence for the painting of these exposed timbers, whether studs or braces: they must have kept their natural colours, except when the whole house or storey was painted over.⁷²

During the second half of the sixteenth century, in London, close-studding seems to have been replaced, in high-quality constructions, by a new fashion of square or rectangular panels with applied Renaissance mouldings (including classical blind arcading) and, at intervals along the front of the building, grotesque corbels growing out of elaborately carved vertical strips. This exuberant carving could be found in courtyards or on house-fronts (Fig 12) and was clearly *en suite* with contemporary styling of fireplaces and internal woodwork. It is usually attributed both to the influence of Renaissance-Mannerist pattern-books and the influx of foreign joiners and carvers, particularly from the Netherlands.⁷³ The grotesque corbels were widespread on London buildings, including some of modest proportions; though it must be remembered that we only know of these examples because they were durable enough to survive two hundred years to be recorded.

Upper Storeys and Jetties

Three-storey buildings are mentioned in London in 1314 and became increasingly common during the fourteenth century.⁷⁴ The height of individual storeys in a timber-framed house does not seem to be an indicator of date. The ground floor, at least where adjacent to the street, was to be 9ft high in regulations of 1276; thereafter examples can be given in which contracts stipulated ground floors between 8ft 9in and 12ft high (Table 3). In 1602, a standard length for timbers called *quarters* was 8ft 6in (Table 2), suggesting a standard storey height.

Table 3: Documented storey heights in London, 1276-1466⁷⁵

Floor	Date	Type of document	Height
ground	1276	civic regulation	9ft
	1310	contract	10ft
	1384	building lease	12ft
	1410	contract	10ft 6in
	1466	civic regulation	8ft 9in
first	1384	building lease	10ft
	1405	contract	11ft
	1410	contract	9ft
second	1384	building lease	7ft
	1405	contract	9ft

Jetties first appear in London records in 1246, when a *getticium* bordering Ironmonger Lane was classed as a nuisance;⁷⁶ presumably the large number of solars also indicted were criticised because they stuck out into the street.⁷⁷ In 1276 it was ordered that jetties, along with pentices and gutters, should be at least 9ft above the ground so as not to impede horsemen. In a narrow lane or alley, where houses might face each other, there was a danger that a jetty of even normal dimensions might extend beyond the middle of the lane.⁷⁸

Side jetties often of considerable length were prosecuted where they overhung neighbours' property or churchyards: in 1378 one was allegedly 14 yards 16in (43ft 4in) long.⁷⁹ Overhangs of small dimensions might be a result of leaning, but the size of some indicates that jetties were occasionally contributory factors, as in one overhang of over 5ft in 1323.⁸⁰ Jetties continue to be prosecuted under the Assize in the fifteenth century,⁸¹ and in 1519 the Vintners were the unfortunate recipients of a judgment which ordered the cutting back of their new building in Fleet Street by one inch, the excess of the first-floor jetty into the street.⁸² By the second quarter of the sixteenth century jetties were commonly of very slight projection (e.g. 18, Old Buildings, Lincoln's Inn of 1524)⁸³ and from the middle of the century jettying was falling out of fashion in the London area: many jettied buildings, for instance the once fashionable Wealden houses, were having their first floor jetties underbuilt.⁸² Cases in London from the 1560s indicate that jetties were being regarded as a nuisance to be removed, rather than tolerated.⁸³ By 1600 new buildings of 4½ storeys were being constructed without any jetties.

Dormer windows are probably a development of the first half of the fifteenth century in London. As shown in Wyngaerde's and Hollar's panoramas, dormers could light garrets formed out of the triangle formed by a sloping roof. The subsequent development of half-height walls to give the garret extra headroom is more difficult to date. A fixed point is provided by the street-range of Staple Inn to Holborn of 1586, with its half-walls in the garret. In this range the roof is supported on bent timbers which have the appearance of base-crucks, a feature present also in a similar building of the first half of the sixteenth century in Bruges⁸⁶: a date of c 1550 for the introduction of half-height garret walls into London is likely.

Infilling of the Frame

The filling of the timber frame was commonly lath and loam, finished with a skim of plaster. This was still the technique in the early seventeenth century, and references to brick infilling of the frame are few. Internal walls were generally insubstantial: in 1390 a burglary at an inn was undertaken by breaking through the wall of a guest's room.⁸⁷

Exterior plaster panels with cartouches, strapwork designs or emblems (the Prince of Wales' feathers, the thistle) have been recorded on houses from the 1580s; they occur together with grotesque pilasters around the beginning of the seventeenth century. A group of four panels, presumably of plaster, recorded on the front of the lavish timber-framed banqueting house in the garden of Paul Pindar's house in Bishopsgate, is undated but perhaps contemporary with the rebuilding of the house in c1600.

Joists and Boards

Larger timber buildings in Saxon London, such as those recently excavated on the Watling Court site at the junction of Bow Lane and Basing Lane (now Cannon Street), must have had timber floors above their deep and roomy cellars, but the carpentry of these buildings is almost totally unknown.⁸⁸ Surviving floors of the thirteenth century are usually lodged on stone walls, as in the case of the floor of the chapel of the bishop of Ely in Holborn, now St Etheldreda's, Ely Place.⁸⁹ The distance between joists was thought to be of importance on the ground floor, over cellars; the joists of the floor at St Etheldreda's are 10in square but only 5in apart. Joists were usually laid on their wider faces, though square-sectioned joists could be specified (e.g. in 1369, over the cellars of shops).⁹⁰ When substantial timbers were rarely straight, this was probably because only in this plane would they lie flat. The earliest recorded deep-sectioned (i.e. laid on a narrower face) joists recorded are at the Queen's House, Tower of London, completed in 1528 and in the floor of Middle Temple Hall in 1561.⁹¹

Several kinds of boards are mentioned in London accounts: Estrich or Eastland boards, pipe boards, planchbord, elm board, quarter board and evis board. With the exception of pipe boards, which were definitely larger and used for lining latrines, the types of boards were all about the same price⁹² but had different functions in and around the house.

Planch board, mentioned at the Tower in 1324, averaged 10ft x 1ft 6in and probably 1½in thick: in 1568 a standard board 11ft long is implied and in 1602 a planchboard had to be 1in thick, probably throughout (Table 2). It was used for gutters, garden fences and garden doors.⁹³ This type of board would seem to be the likeliest

for flooring, but references are lacking. *Quarterboards* were boards made from trunks which had been quartered, i.e. split into four by cuts at right-angles.⁹⁴ As Table 2 shows, these boards would tend to be triangular in section: the smaller boards could be called seeling boards – presumably these were the overlapping boards used in early wainscotting or seeling. Quarterboards were used for making a pentice over a window or in gutters.⁹⁵ *Evis boards* were eavesboards, which were also triangular in section since their main purpose was to lie under tiles at the eaves to throw water away from the wall below.⁹⁶ They could also be used for making garden walls or fences.⁹⁷ *Clovenboards* or weatherboarding, in which boards overlapped, had been used for external constructions and in waterfront revetments since at least the twelfth century: the term *weatherboarding* occurs in 1554-5 and 1568,⁹⁸ and weatherboarded buildings are shown on the waterfront in both the Wyngaerde and especially Hollar panoramas (c 1540 and 1647).

External Details in Timber

Apart from details of some grotesque corbels of the late sixteenth century, we are largely ignorant of any figured carving on domestic buildings. Similarly with signs: places of public resort, such as major tenements, taverns and inns, were known by their signs in the thirteenth century, but great houses were often named rather from their appearance (Copped – i.e. with a pointed roof – Hall, *La Rouge Sale*, *Flynt Halle*) than from heraldic signs.⁹⁹ Taverns and alehouses had stakes protruding outside their doors. In 1387 the length of alestakes was restricted to 7ft, both because they extended too far over the highway, and because their weight seriously affected the structure of the building to which they were attached.¹⁰⁰ Several tavern signs, on the ends of long beams, are shown in Cheapside in the 1638 engraving (Fig 13).

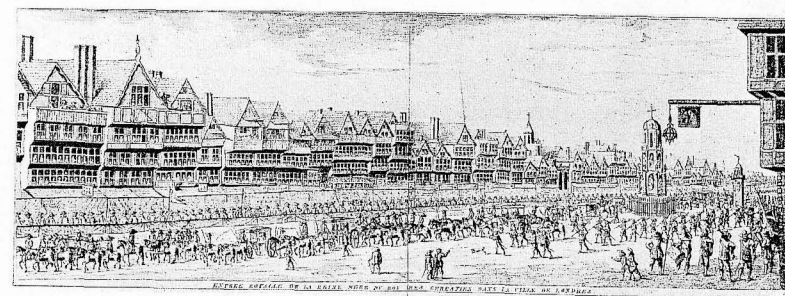


Fig.13 The processional entry into London of Marie de Medicis, 1638 (anonymous; Guildhall Library)

The word *pentice* denoted two different structures: a long corridor or verandah-like structure connecting two buildings or a sloping rainwater roof over a

window or door. In this sense it was also called a penthouse.¹⁰¹ Pentices were the most common source of complaint in the 1244 Eyre and 1246 inquest. A pentice was usually built over a ground-floor door or over cellar-steps, and clearly impeded the highway. In 1276 it was ordered that pentices should be 9ft high as mentioned above; thus the pentice might be fixed to the solar.¹⁰² Even so pentices may well have afforded good protection in bad weather, since in 1345 the butchers were told to sell their meat beneath the penthouses of the houses adjoining the Stocks Market on fishdays, to allow the fishmongers to practise within the Stocks.¹⁰³ The copperplate and other panoramas of the late sixteenth century show houses with pentices on most of the major streets. Bargeboards, which were usually nailed on the outside of the frame beneath the two slopes of a roof in a gable, are shown on houses in Cheapside in the 1547 painting of Edward VI's coronation procession, and the 1638 engraving (Figs 14 and 13 respectively).

Since the evidence for medieval and Tudor buildings is largely documentary (including lease-plans and panoramas), examples of carpentry joints in London are few, and they have been well studied. Recent archaeological excavations on medieval waterfront sites in the City are however adding to this corpus of joints, with new examples dated by dendrochronology, and this topic will be the subject of a forthcoming study.¹⁰⁴

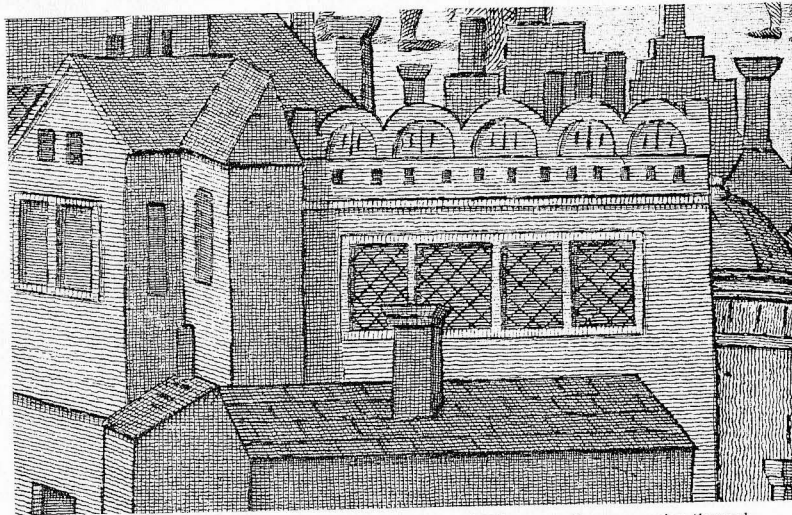


Fig. 14 Detail of the engraving after the painting of Edward VI's coronation procession through Cheapside in 1547, showing a house with decoration - perhaps in brick (Museum of London)

Brick

Imported Flemish bricks were used in great quantity for the curtain wall of the Tower in 1283, but although bricks were regularly imported in small numbers, it is now thought that south-east England produced its own bricks from the beginning of the fifteenth century, after experience at Calais and works such as the city wall at Hull.¹⁰⁵ Yellow bricks of local manufacture have been noted in the curtain wall

at Eltham Palace in the first quarter of the fourteenth century, at Northolt manor house (Middlesex) before 1350, at Kennington Palace in the middle of the century and at Charterhouse in 1372: they are found in excavated buildings in the City by about 1370.¹⁰⁶ The wardens of London Bridge engaged Dutch craftsmen to make bricks at Deptford from at least 1404: a small dock was constructed, and other buildings added soon after.¹⁰⁷ The rebuilding of the royal house at Sheen by Henry V in 1414, which included much brick from Calais, may have been the first royal venture in the new medium.¹⁰⁸ Two million bricks were made locally for Eton college by 1451.¹⁰⁹ Richard Buckland, treasurer of the king's works at Calais between 1421 and 1436, was accused of stealing 20,000 of the king's bricks to repair his place in London: at the same time the new Drapers' Hall, in 1425, was using the relatively small number of 12,000 bricks in its construction.¹¹⁰ Brick was increasingly used for chimneys and as a component of stone walls throughout the fifteenth century. At Crosby Place, Bishopsgate (1466), for instance, brick was used to vault the undercroft and fill in behind the impressive stone ashlar of the hall. Buildings largely or wholly of brick survive from the first half of the fifteenth century in the area around London, but near the city only from the 1480s.¹¹¹ Within the city and Westminster, notable constructions in brick of the first four decades of the sixteenth century included Charterhouse Wash House Court (early sixteenth century), Lincoln's Inn courts and gatehouse, the latter with an intended (but not completed) vault (1506-8, 1518 and 1534-5), Bridewell Place (1515-22) and the Augmentations Office next to Westminster Hall (1536-7).¹¹²

Purchases of brick figure regularly in company accounts of the fifteenth and sixteenth centuries. Much was used for comparatively mundane purposes such as underpinning timber-framed buildings or internal features such as a reredos in a kitchen¹¹³ and occasionally, though rarely for partitions, i.e. as infilling of frames.¹¹⁴ Use of brick for extensions or even whole buildings, after the palaces and Lincoln's Inn of 1515-38, dates from the mid-sixteenth century, as for the hall (1549) and parlour (1594) of Clothworkers' Hall and for unknown but substantial works at Weavers' Hall in Basinghall Street in 1542. In Treswell's surveys of 1610-12 there are a few brick buildings and a larger number of buildings with parts of their structure, besides the chimneys, built of brick: brick was also used rather than stone for garden walls and at last the upper parts of wells.¹¹⁵

On facades, brick could be used in a variety of decorative embellishments. The earliest known brickmakers in London, those engaged by the Bridge from 1404 and those working at the Charterhouse around 1415, were aliens from Flanders. Predictably similarities can be seen between many fifteenth-century brick buildings in England and on the continent, including a repertoire of decoration on brick surfaces such as diaper patterns in darker bricks, banded arches, saw-tooth bands or strings.¹¹⁶ There is a little evidence for these decorations on London buildings: in the foreground of the 1547 procession painting and the engraving from it (Fig 14) is a house apparently with semi-circular roundels of brick along the eaves. Crow-stepped gables are shown in the same engraving, and still survive at Gray's Inn Hall of 1556-60.¹¹⁷

Earth

Walls of unbaked earths, including mud mixed with lime and straw (known as cob in south-west England), were 'the stuff of rather humble buildings, mostly cot-

tages, small farm-houses and their appendages' in pre-modern England.¹¹⁸ Timber walls banked up with earth are known in tenth-century London buildings¹¹⁹ and walls of earth forming tenement boundaries are mentioned from c1250.¹²⁰ They were frequently in need of rebuilding, as shown by cases in the *Assize of Nuisance* throughout the fourteenth and early fifteenth centuries: most were located in suburban parishes or those within the walls but away from the city centres. Earth walls could be as long as 200ft, and were not necessarily only to be found on humbler properties: one ordered to be rebuilt in 1425 lay between the *Domus Conversorum* (House of the Converted Jews) in Chancery Lane and Clifford's Inn.¹²¹ 'Mudwalls' were still to be seen near St James Heritage, Cripplegate, in 1516 and in Finsbury, immediately north of the City, in 1589.¹²²

Tiles, Glass and Ironwork

This survey has not dealt with roof coverings (tiles, slates, stone slabs, thatch), floor tiles, window glass or structural ironwork. These categories of building material are currently being scrutinised by my colleagues in the Department of Urban Archaeology of the Museum of London, in the light of many archaeological discoveries in the last twenty years in the City. It is intended that corpora of these items and fittings will be published, and therefore future studies will furnish better discussion than could be offered here.¹²³

Conclusions

This paper has not discussed the plans of secular buildings in London, or stylistic development of individual features such as roofs, windows or doors.¹²⁴ It has reviewed evidence for the use of building materials and some of the main construction techniques in secular buildings in the period c1200 – c1600. From this survey, certain conclusions can be drawn.

The secular buildings of the city, in 1600, were largely timber-framed. Stone buildings were a great rarity, though stone party or boundary walls could occasionally be seen. Brick was present but not prominently so. Records are particularly deficient as regards styles of timber-framing in the city, but it seems possible that the city shared in every conceivable style as it provided homes for a constant flux of immigrants both from the provinces and from abroad. The cosmopolitan air of buildings in late sixteenth-century London may have been a characteristic also of earlier centuries, when merchants from every European country stayed in the city for extended intervals.

Over the period, there was evidently a gradual standardisation of timber sizes; and stone, always expensive, was replaced by brick in every building context (foundations, walls, window-frames and probably door-frames) by 1500. The chronology of these changes is still crude, so we cannot yet tell if London was a place where innovations were first implemented as far as building materials are concerned. It seems probable that jetties first occurred in towns, as an expression of a wish for more space on restricted sites; and jetties were clearly present in London by 1246, earlier than all known surviving examples in the countryside roundabout and, as far as I am aware, examples in other British towns. In some decorative fashions, such as close-studding in the 1440s and the change to classical (ovolo) mouldings in timber-work in the 1570s, the capital probably led other towns: unfortunately, the lack of physical evidence means that the timing of these

and other innovations cannot at present be satisfactorily specified. It is possible that archaeological excavation, which is constantly unearthing timber-work on waterfront sites, may uncover parts of houses reused in the waterfront constructions. Such fragments, if datable by dendrochronology, may enable the development of building in London in timber, at least, to be charted more exactly.

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5. B. Heath, *Some Account of the Worshipful Company of Grocers* (3rd ed, 1869), pp. 418.
6. E.g. at Winchester Palace, Southwark; for the vaulting and battlements on the Bridge chapel, 1396 (Corporation of London Record Office, Bridge Acct Rolls 14/11/1xii); and in several medieval city churches (Museum of London, Archaeological Archive).
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8. It may be significant that the building accounts of royal works at Westminster Abbey and Palace of 1249-70 (Colvin, *Buildings Accts Henry III*) never mention flint; the earliest occurrence of the English form of the word noted by Salzman was in 1283, when a wall at the Tower used chalk and flint in quantity (Salzman *Building*, 139).
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13. H.T. Riley, ed. *Memorials of London and London Life in the XIIIth, XIVth and XVth Centuries* (1869), p. 262.
14. D. Knoop and G.P. Jones, *The Medieval Mason* (1933), p. 55.
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16. Henry III's new buildings at the Tower in 1239-40 may have been decorated with Purbeck (R. Allen Brown, H.M. Colvin and A.J. Taylor, *History of the King's Works: i, The Middle Ages* (1963), p. 714); and a Purbeck capital has been

- recovered from excavations at Kennington Palace (G. Dawon, *The Black Prince's Palace at Kennington, Surrey* (British Archaeological Reports 26, 1976), p.77.
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 18. J. Gage, 'Letter... accompanying drawings of remains of the Prior of Lewes' Hostelry, in the parish of St Olave, Southwark', *Archaeologia* 23, pp.299-308; Salzman, *Building*, 135-7; Caen was used for windows at Grocers' Hall in 1495-6, for five windows on the south side of St Stephen Walbrook in 1536-7, and by the Clothworkers' Company for repairs of property in 1560-1.
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77. E.g. *Eyre 1244*, 405-63, *passim*; it might therefore be suggested that solars (a general term for an upper chamber) were commonly jettied by the second quarter of the thirteenth century in London.
78. *Assize of Nuisance*, 545 (1368).
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91. Hewett, *Historic Carpentry*, pp.217, 282, Fig. 305.
92. I.e. 3-4ft for 1d, or 2s 2d-2s 4d the hundred foot (references from churchwardens' accounts and Marsh, *Carpenters' Company, ii*, give a detailed picture for the years 1477-c 1514).
93. Salzman, *Building*, p.242; B. Marsh, ed. *Records of the Carpenters' Company, iii: Court Book 1533-1573* (1915), p.106 (1568) where the phrase used is 'eight foot (i.e. 8 cu.ft.) of season plaunche borde of the length of xj fote of assysse'.
94. Salzman, *Building*, p.242; H.Cescinsky and E.R. Gribble, *Early English Furniture and Woodwork* (2 vols, 1922), i, p.19, Fig 7.
95. Marsh, *Carpenters' Company, ii*, pp.99, 101.
96. Salzman, *Building* p.244; Marsh, *Carpenters' Company, ii*, pp.104, 139.
97. Marsh, *Carpenters' Company, ii*, p.104.
98. G. Parsloe, *Wardens' Accounts of the Worshipful Company of Founders of the City of London* (1964), p.131; Marsh, *Carpenters' Company, ii*, p.107; overlapping boards were recorded in the revetment of c 1170 at Seal House, Upper Thames Street (Museum of London, Archaeological Archive).
99. In 1438-9 the Falcon on the Hope brewhouse in Aldersgate Street received a new sign requiring a bolt of iron weighing 12lbs, a 'shaftre' and the sign itself which was carved and painted; it took a carpenter three days to put it up: P. Basing, ed. *Parish Fraternity Register: Fraternity of the Holy Trinity and SS Fabian and Sebastian in the Parish of St Botolph without Aldersgate*, London Record Society 18 (1982), 128.
100. H.T. Riley, ed. *Munimenta Gildhallae Londoniensis, i: Liber Albus* (1859), p.389.
101. E.g. Marsh, *Carpenters' Company ii*, p.131 (1500).
102. *Assize of Nuisance*, 234.
103. Riley, *Memorials*, p.203.
104. Hewett, *Historic Carpentry*, analyses most of the standing structures, though unfortunately he studies the restored frontage of Staple Inn as though it were original. For the medieval waterfront, see Milne and Milne, *Trig Lane*, and G. Milne, *Medieval Waterfront Structures*, Museum of London study in preparation.
105. Salzman, *Building*, p.140; *King's Works i*, p.427, n.4.
106. J.G. Hurst, 'The kitchen area of Northolt Manor, Middlesex', *Medieval Archaeology* 5, (1961), p.244; Dawson, *Kennington Palace*, pp.23, 78; Billingsgate Lorry Park Site 1982 (Museum of London archive).
107. J. Harvey, 'Four fifteenth-century London plans relating to Bridge House properties in Deptford, without the Bar of Southwark, without St George's Bar towards Newington, and in Carter Lane in the City', *London Topographical Record* 23 (1972), pp.36-7.
108. *King's Works i*, p.999.
109. There was also a watergate with a brick arch on stone jambs, of either Henry VI or Richard III's building, at Westminster Palace: H.M. Colvin, 'Views of

- the Old Palace of Westminster', *Architectural History* 9 (1966), Pls.9 and 10.
110. *King's Works i*, p. 431; Johnson, *Drapers' Company, i*, p.313.
 111. Bishop of Ely's palace at Hatfield, 1485; the same builder, John Morton's, gateway at Lambeth Palace, c1490; bishop of London's palace at Fulham, 1506-22.
 112. D. Gadd and T. Dyson, 'Bridewell Palace: excavations at 9-11 Bridewell Place and 1-3 Tudor Street, City of London, 1978', *Post-Medieval Archaeology* 15, pp. 1-79; Colvin, 'Views of the Old Palace of Westminster', pp.33, 35; p1 31, 49-50.
 113. Marsh, *Carpenters' Company, ii*, pp. 92, 95; perhaps significantly, on two occasions in the Carpenters' Company records, in 1484 and 1491, the brick-laying was carried out by masons: pp.65-7, 92.
 114. *Ibid.*, 92.
 115. For brick in the Treswell surveys, Schofield *Treswell*, pp28-9; for the Cloth-workers' Hall rebuilding, pp.94-6.
 116. *Cal Patent Rolls 1416-22*, p.22; T. Smith, *The medieval brickmaking industry in England 1400-1450*, British Archaeological Reports 138 (1985), pp.7-8, 12-18.
 117. R.C.H.M. *West London*, P1 84.
 118. Clifton-Taylor, *Pattern*, pp.287-93.
 119. Horsman et al, *Saxo-Norman London, i* pp. 81-2.
 120. N.J.M. Kerling, ed. *The Cartulary of St Bartholomew's Hospital* (1973), p.143.
 121. *Assize of Nuisance*, 209, 215, 218, 276, 281, 293, 307, 337, 380, 418, 450, 475, 496, 519, 520, 570, 593, 605, 609, 620, 634, 653.
 122. C.L.R.O., C.C.P.R. St James in the Wall 1516; Finsbury 1589; other fourteenth- and fifteenth-century property boundaries were made of palings of wattle and daub and of daubed or plastered wood, which was probably the same thing (*Assize of Nuisance*, 278-9, 595).
 123. See G. Egan et al, *The medieval household* (Medieval finds from excavations in London, 5), in preparation.
 124. For plans, see Schofield *Treswell*.

Eighteenth Century Britain's Missing Sawmills: A Blessing in Disguise?

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At the onset of industrialisation in Britain in the eighteenth century wood was one of the principal raw materials of the economy — as indeed it still is — although subject even then to a gradually increasing scarcity of domestic supplies which was relieved by imports from continental Europe and later from North America.¹ It was worked for a wide variety of uses by a range of hand tools, most of them with origins in antiquity or earlier, which had been gradually increasing in specificity of design for particular purposes. The basic elements of those tools were part of the common stock of technology of Europe and much of the rest of the world. Power driven tools were lacking except in two instances; the turner's lathe, usually worked by a treadle, and the frame saw, commonly driven by wind or water power to convert felled timber into convenient sections. In Europe woodworking continued for long with predominantly manual practices. Neither on the Continent nor in Britain was mechanisation of the industry in the forefront of industrial progress. Only in the United States was development of successful woodworking machinery a notable feature of industrial advance.

This outline of circumstances does not necessarily point to a British or a European 'failure', to a casual or even wilful neglect to achieve what was technically feasible and economically worthwhile (although those possibilities should not be excluded). There are often good reasons for sectoral unevenness in rates of industrial change; good reasons, too, why particular industries have been more prominent in some countries than in others in the course of development (as will be seen later in comparison of woodworking machinery in Britain and the United States).

In the case of Britain, while comparisons in the history of mechanisation of woodworking do not in general point to a British failure, sawmilling at first sight makes a different impression. Sawmills were virtually absent from the British industrial scene throughout most of the eighteenth century. Musson believes they began to become common towards the end of that century and in the early nineteenth century and mentions the 'strong popular opposition' to them.² Certainty, however, is reduced in the absence of such sources as taxation data or census or survey information. In the case of county maps, for instance, we are told by Laxton that the 'mapmakers gave no systematic indication of the use to which the power (of watermills and windmills) was put'³ Extensive development of sawmilling probably came as late as the middle of the nineteenth century in the form of steam-powered works (a point considered more fully later). Mills powered by water or wind had, however, long been established on the Continent, apparently in considerable numbers, where their first appearance can be dated to the later medieval period. If this was so on the Continent, why not in Britain also?

Origin and Development

As early as the thirteenth century Villard de Honnecourt, master mason and artist, showed in his sketchbook a design for a 'semi-automatic sawmill' driven by water.