

The Mary Rose - Deck Construction

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The Orlop Deck

Compared to the other decks, the orlop deck is lightly constructed, with comparatively thin planking and relatively few nails being used to fasten the planks to the half beams in some sectors of the deck. The planks are perfectly cut to fit around the braces and between the knees, and the outboard ones are neatly chamfered against the side of the hull. There was no need to have a heavily timbered orlop deck as, unlike the gun decks, it would not have suffered from the point loading and dynamic stresses caused by the carriage and use of artillery. This deck was primarily a storage area for everything from rigging to officers' chests.

Orlop Deck Clamp

This serves both to house the outboard ends of the deck beams and as a stringer, treenailed through the frames and hull planking to provide longitudinal strengthening to the hull. The orlop deck clamp consists of five sections of timber, scarfed together vertically, running from O1 to O12.

Unlike the main deck clamp, the orlop deck one is not deliberately cut thicker beneath the deck beams. While there are slight variations in thickness, this appears to be an accidental rather than a deliberate variation.



Orlop deck clamp

The deck beams are housed in rebates cut into the upper/forward faces of the deck clamps and sit slightly proud of their rebates. The inboard faces of the deck clamps have been finished with an adze and are chamfered on their lower edges.

Orlop Deck Beams

The orlop deck beams are single timbers stretching right across the hull. They are 300mm wide and 285mm thick on average, and chamfered on their lower edges. Their outboard ends are housed in the deck clamp and they are fastened to the rising knees with between one and three iron bolts. There is a considerable amount of sapwood on some of the beams, the worst example being O80.



All the deck beams have single-stepped rebates to both hold the carlings in place, and, with certain exceptions, to pass over them. They also contain both sliding and square mortices on their undersides for the hold stanchions to tenon into, and several have mortices on their upper faces for the orlop stanchions. A number of these beams also appear to have been modified, and hence it is probably worth examining them individually. Unfortunately, none of the orlop deck beams has returned a viable dendrochronology date, so any attempts to understand the sequence of modification is rather subjective.

Sapwood on O80 below the scale

Starting from the bow, beam O10 has a forward carling rebate offset inboard, obviously the ship is narrowing at this point. There is a possible treenail hole in this rebate. There is a single mortice on the underside near the starboard side, and the possible remains of an eroded sliding mortice below the carling rebate.



The forward carling rebate on O20 is longer than the width of the carling and there are unused rebates on both forward and aft faces. There is an empty mortice close to the starboard side on the lower face, with an in-situ stanchion flanked by a disused sliding mortice to port. The eroded remains of a sliding mortice can be seen on the centre-line, vertically above a matching mortice on the rider.

Carling rebate on O10 below scale

O30 has fore and aft carling rebates that are considerably longer than the width of the carlings, possibly new rebates were cut that incorporated original ones. The lower face of the deck beam shows no signs of modification, containing three sliding mortices for the stanchions beneath. There is a sliding mortice on the upper face of the beam on the centreline, for an orlop deck stanchion.

There are unoccupied carling rebates on both bow and stern faces of the O40 deck beam, inboard of the carling. The O5 carling is offset to starboard to provide room for the galley below. As on O30 there is a sliding mortice on the upper face on the centreline. There are three unused mortices on the lower face of the beam, without matching mortices on the rider below. Unfortunately, the rider did not provide a usable dendrochronology sample, but may well be a later addition.

O50 has no unused rebates, and as on O40, the forward rebate is offset to outboard for the galley carling. At the port end of the beam, the eroded aft rebate is still visible. There is a sliding mortice on the upper face, similar to those on O30 and O40. As well as mortices for three stanchions, the lower face of O50 has an extra mortice for the starboard galley partition support. There are also three groups of double nail holes on the aft face of the beam for the partition supports for the rear galley partitioning.



Eroded port carling rebate on O50

O70 has the eroded remains of both the fore and aft carling rebates on its port end. There are four square mortices on the lower face for the hold stanchions. Similarly, the remains of the port carling rebates are evident on O80. There are two square tenons on the lower face for the hold stanchions, one below the inboard end of the rising knee and one on the centreline. There is a square mortice on the upper face, also on the centreline.

The O90 deck beam has a 10mm deep rebate on its upper face between the carling rebates, as well as a small rebate on both fore and aft faces on the outboard ends of the carling rebates. These may be the remnants of recut carling rebates. A treenail just forward of the centre of the aft carling rebate, fastened the bow end of the O10 carling in position.

The displacement of the rider below slightly complicates the interpretation of the mortices in the lower face of the beam. However, while most of the mortices can be matched with opposing ones below, there are two sliding mortices that appear to be unused. One is so close to the starboard side that it is difficult to see how it could have ever held a stanchion, and there is no mortice below the sliding mortice under the carling rebates.



Mortice on O100

O100 has a treenail in the centre of the aft carling rebate, matching a treenail hole in the O11 carling, while the forward rebate appears to have been recut. There is a mortice on the upper face of the beam, and a large square mortice on the underside below it on the centreline. The hold stanchion would have fitted straight into this mortice without a tenon.

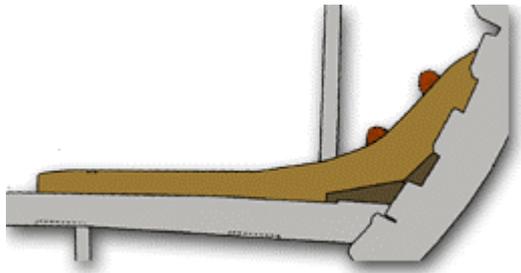
There is only a carling rebate on the forward face of O110, with no mortices for supporting stanchions below. This beam appears to have passed directly across the hull, without support.



O60 carling rebate

Orlop Rising Knees

The orlop deck beams are supported by rising knees bolted to their upper faces. In turn the knees are bolted and treenailed to the hull. There are two to four bolts fastening the knees to their beams, and two to three bolts attaching the knees to the hull. Four of the knees, ORKs 30, 50, 70 and 80 have a shallow, transverse lap joint on the underside, matching one on the deck beam below.



030 rising knee, the inserts are the dark brown areas, while two concreted bolt heads protrude from the upper face.

All the knees are cut from a single piece of grown timber and are rebated to fit around the starboard side stringers. ORK 30 has two inserts adjacent to the starboard side, compensating for the shape of the timber. The inboard faces of the knees are cut in a smooth curve and are not stepped like the main deck rising knees. This means that the whole length of the knee protrudes above the deck planking, dividing the orlop deck into discreet sections.

The upper faces of the knees have square and sliding mortices to house the tenons of the orlop stanchions.



Stanchion and sliding mortice. The mortice is filled with a small wedge, nailed in place.

ORK70 has a rebate on the its stern face, the purpose of which is unknown. ORK100 has two rebates on its bow face. These were apparently not used by partition supports at the time the ship sank, the partitioning on O100 is recorded as against the aft face of the knee.

ORK70 has a rebate on the its stern face, the purpose of which is unknown. ORK100 has two rebates on its bow face. These were apparently not used by partition supports at the time the ship sank, the partitioning on O100 is recorded as against the aft face of the knee.



Rebate in O100 rising knee

A unique feature of the orlop knees is the incision of large roman numerals in the aft faces of ORK20, ORK40, ORK50, ORK70, ORK80 and possibly on ORK100, although this looks more like accidental damage as opposed to deliberate marking.

Seven of the knees have provided valid dendrochronology samples, with earliest felling dates for ORK40 of 1474, ORK50 of 1494, ORK60 of 1497 indicating that these knees were probably part of the original construction. Dates for ORK10 of 1523, ORK20 of 1511, ORK100 of 1514 and ORK110 of 1524 would indicate that these timbers were installed during a refit.

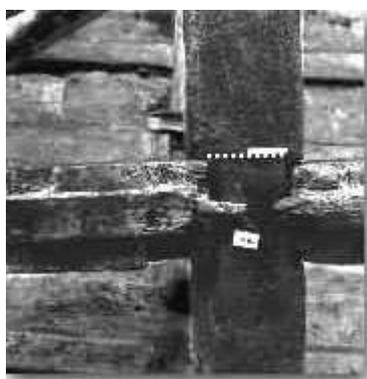


Mark on O50

Orlop Carlings

There are three distinct sections of orlop carling; a single timber stretching from O10 to O40, a separate carling between O40 and O50; set back towards the starboard side to make room for the galley, and a line of carlings between O50 and O110.

The O10 to O40 carling was made from a single piece of oak, 9,000mm long, 280mm wide and 180mm thick. While the other carlings have similar widths and thickness' it is difficult to establish how many individual timbers comprise the carlings between O50 and O110, owing to the damage they have sustained where they pass over the deck beams.



Damaged carling at O80

The carlings are lap jointed into rebates on the bow and stern faces of the deck beams, and, except where they terminate, pass completely over the deck beam. This single step rebate, with the upper part of the carling protruding above the beam is also found on the main deck. In general, the carlings are not fastened to the deck beams, although there are exceptions. Both the O6 and O8 carlings are nailed to deck beam O70, and the O6 carling is also fastened to O50 with a single nail. The O10 carling is held on O90 with a single treenail, as is the O11 one to deck beam O100. At the other end of the deck, the O1 carling would have been fastened to the O10 deck beam with a single treenail.

Angled rebates have been cut into both the inboard and outboard faces of all the carlings except O5. The rebates on the outboard face house the orlop deck half beams, and those to inboard the hatch cover half beams. It is doubtful that the inboard rebates on the O6 carling were actually used, the presence of the pump and main mast rising through that section of deck would seem to prevent the use of hatches in this sector, and indeed none were found in H6/O6.



Hatch cover half beam rebates

As stated, the O5 carling is unique on the orlop deck in having no inboard rebates for hatch cover half beams. There is a shallow rebate on the inboard face near the aft end, possibly connected with the longitudinal partitioning masking the galley area. This carling also has a sliding mortice on the underside for the forward, starboard, galley partition support and nail holes on its outboard face for further partition supports

Orlop Half Beams

The starboard ends of the half beams rest in rebates in half beam shelves and are angled in both the horizontal and vertical planes to fit against the side of the ship or into rebates in the braces, while the port ends angle gently to fit into the rebates on the carlings. As with all the half beams in the ship the angle extends beyond the carling rebate, creating a weak spot. The surviving tool marks show that they were sawn timbers, with some being partially dressed with an adze.



View along the orlop half beams

Four of the orlop deck half beams are inscribed with carpenters marks; MR83 T1315, MR82 T176, MR 82 T177 and MR82 T212. The actual meaning of these marks has not yet been deciphered.

The half beams were nailed to the deck planks using 100mm (4") nails, but they were not fastened to either the carlings or the half beam shelves. The half beams acted almost purely as support for the deck planks, not as transverse bracing for the hull. The lower edges of the half beams are chamfered, with the chamfers terminating in V-shaped chamfer stops.

Orlop Half Beam Shelves

In the orlop deck, small half beam shelves are used to house the outboard ends of the half beams. These were nailed to the top of the deck clamps, usually with two nails.

Each sector of the orlop deck contains two of these shelves between the deck beams and either the horizontal or vertical braces, depending on the sector in question. The half beam shelves butt up against the deck beams at one end and are either angled against the diagonal braces, or simply squared off.



Half beam in shelf

The half beams sit in rebates which average 30mm in depth, cut in the upper faces of the shelves. One exception to this rule occurs in O8/O9, where both the stern and bow shelves respectively terminate short of the deck beam, leaving the half beam on each side of the deck beam sitting directly on the deck clamp.

Orlop Deck Planks

The orlop deck planks are rather different from those of the main and upper decks; they are lightly constructed, being 25mm thick on average, and made of elm, rather than oak, with the exception of two planks in O9.



Adze marks on deck plank

The planks are flat sawn and subjectively appear to have been relatively new when the ship sank, displaying very fresh saw marks on both their upper and lower surfaces. A number of the planks have been dressed with an adze around the long edges of their upper faces, presumably to ensure an even surface with adjacent planks.

The starboard planks in each sector have a chamfered edge to allow for the upward and outward curve of the hull at this level. These planks are also shaped and chamfered to fit around the vertical and diagonal bracing that plunges through the orlop deck at its junction with the hull.



Planks shaped to fit round brace



The method of fitting the planks around the braces varies. Either two planks are shaped to fit around the brace in each sector, as in O2 for example; or two planks butt against the fore and aft faces of the brace, as in O10. An exception is the outboard plank in O8, (MR82 T206) which is rebated to fit around the three exposed faces of the brace.

Orlop deck planks in-situ

The actual layout of the planks could be considered to be slightly eclectic. Essentially the basic design comprises of short planks between the knees, with longer planks between the inboard ends of the knees and the carlings.

However, instead of relying on a uniform pattern of stealer planks to compensate for the longitudinal curve of the hull, the majority of the planks are either parallelograms or insufficiently angled to compensate for the curve. This necessitates the use of sharply angled stealer planks, as can be observed in O2, O6 and O10. To further exacerbate the situation, a number of the planks are wider at the opposite end to that required to reduce the angle, examples being found in O4, O5 and O8.

The two inboard planks in O4 and O6 respectively overlap the O40 and O50 deck beams, the O6 plank adjacent to the carling having a mortice for the base of a stanchion cut in it. The O5 inboard plank has a lap around the ends of both the O40 and O50 knees. The short forward inboard plank in O10 does the same with the O90 knee.

With the exception of the planks in O4 and O5 the orlop deck planks are fastened to their half beams with fewer nails than is the norm on the other decks. There are on average only seven nails per plank in O2, compared with 14 in O5, two nails per plank per half beam being the usual pattern on both the main deck and the forward part of the upper deck, (although this distribution may vary with plank width).

With the possible exception of one plank in O6 there are there are no countersunk nails on the orlop deck.

The nails have not survived, but examination of the holes left in the planks and half beams, and the marks created in the planks by the nail heads, indicate that they were similar, if not identical to the surviving nail (MR81 A4599) found in a cauldron of pitch. This has a flattened, rounded head, approximately 15mm in diameter, a maximum shank width of 5mm and a length of 100mm, in imperial measurement a four inch nail.

The comparative lightness of the fastenings in most of the orlop deck, combined with the movement of the ballast when the ship sank, was probably responsible for the displacement of sections of the orlop deck observed during the excavation.

Further examples of the disruption of the orlop deck are shown in the site books; 81/O7-O8/p133 and 82/O7/p26,28 and 32. O8 is particularly badly damaged, with the

majority of the deck planking broken or missing. This may have been caused by the same agency that damaged the M80 deck beam and rider R9.

The Main Deck

The timbers used to construct this deck are the most substantial, not only to take the weight of the guns, but also to provide both lateral and longitudinal strengthening for the hull. Several design features on this deck are utilised to provide the extra strength, the lodging knees, double carlings and the thickened beam shelves.

The main deck is the lowest waterproofed deck, the planking is caulked, there are waterways cut through the midships rising knees and there are scuppers cut through the hull at this level.

Main Deck Clamps

The main deck beams are rebated into a very substantial deck clamp. This deck clamp is composed of seven sections, vertically scarfed together. Unlike the other deck clamps, that of the main deck has a thicker section beneath the majority of the deck beams.



The deck beams are housed in rebates cut through the thickness of the clamps and, as on the other decks, sit proud of the rebates.

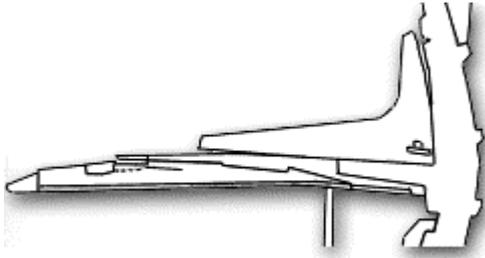
The clamps are secured to the hull almost exclusively with treenails, with at least one of the scarf joints, that between 83T1252 and 1253 secured with nails.

Main deck clamp

The section of clamp between O3-O6, 83T1252, contains 63 disused treenail holes, suggesting either modification or repairs to the framing and/or hull planking in this area. The inboard faces of the clamps have been finished with an adze and their lower edges are chamfered.

Main Deck Beams

The main deck beams are substantial timbers between 300mm and 400mm square. From the surviving evidence it appears that, with the exception of the M60 deck beam, the beams are single pieces of timber spanning the width of the hull. M60 would have been the longest beam in the ship, measuring approximately 10.5m, and was probably originally composed of three sections of timber, jointed with locking scarfs.

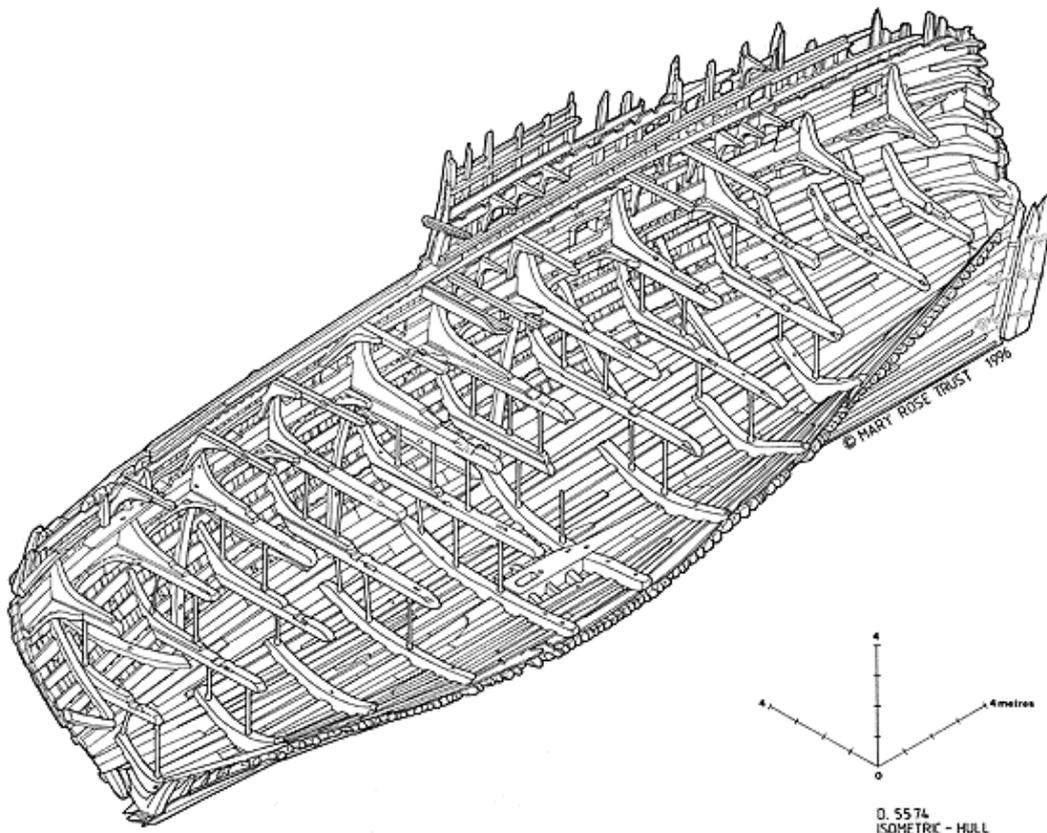


The surviving scarf starts approximately 1m from the starboard end of the beam and extends some 3m inboard. The ends of the scarf both above and below the deckbeam are secured with a pair of nails each.

M60 scarf

As on the orlop deck, the majority of the beams have a small transverse lap joint on their upper face, helping to lock them against the lower faces of the rising knees.

The deck beams are very firmly secured to the hull. Not only do most of them rest in thickened sections of the deck clamp, they are secured by both rising and lodging knees. Both types of knee are fastened to the deck beams with clench bolts of considerable length, usually two bolts for the rising knee and two for the lodging knees.



Isometric showing the deck beams

As on the orlop deck, the main deck beams have mortices in their lower faces to house the tenons of the stanchions below. These are of both the square and sliding varieties. There are however no mortices on the upper faces of the beams. Whether there was a row of stanchions on the centreline supporting the upper deck, or a system of sole plates was employed to house the stanchion mortices will be discussed in the stanchion section.

With the exception of M10 and M110 which are eroded, and M100 which is missing, all the deck beams have single stepped carling rebates on their port and starboard faces. The uneroded beams all have double carling rebates with the exceptions of M80 and the aft face of M70. M80 has a filler piece secured to the deckbeam with a single treenail between the carling and the inboard end of the rising knee.

One of the most striking features of the main deck beams is the way M40 is offset to stern of the O40 deck beam below. This causes the orlop deck stanchions to lean aft at a rather alarming angle. Careful inspection of the area seems to indicate that the effect has not been caused by accidental damage, rather that the beam was installed in this manner.

This beam was a replacement, returning a date of 1535 from a dendrochronology sample. This was a true felling date, as the sample included bark. The other beams that have returned dates appear to be from the original construction phase, M70 has produced a date of 1443, M60 of 1452 and M90 of 1465. The first two samples contained no sapwood rings, explaining their very early dates.

Main Deck Rising Knees

The main deck rising knees share most of the features of those on the orlop deck. They are made from a single piece of grown oak, are bolted to the deck beams below and are bolted and treenailed to the hull. Generally, two bolts are used for each purpose, but MRK60 is held to the deck beam with three bolts. The tops of MRK30 and MRK40 are additionally fastened to the stringer with a single nail.

One of the major differences between the main and orlop deck rising knees is the stepping of the inboard ends of the knees to allow for a greater area of uninterrupted planking. MRK40 has a particularly pronounced step, 900mm long.



As on the orlop deck the majority (MRK10,30,40,60,70,80 and 110) have transverse lap joints on their lower faces matching those on the deck beams below.

Main deck rising knees

The knees in the centre of the ship (MRK30,40,50,60 and 70) have holes cut through their widths at deck plank level close to the starboard side. These holes are between 70mm and 100mm square.



The lack of these waterways towards the bow and stern of the ship is probably due to less water entering the area covered by the castles and the increased height of the stern main deck gun-ports above the waterline.

Waterway through Knee

Several of the knees have untypical features. MRK 30 has a rectangular slot cut through the width of its upper arm. The purpose of this slot is unknown. MRK20 is rebated to help support the horizontal structure in M2/3. MRK60, 80 and 90 contain rebates for partition supports. M60 has two cut into its forward, upper face to hold the bow end of the Barber Surgeon's cabin. MRK 80 and 90 house rebates connected to the partitioning for the Carpenter's cabin. The two rebates in MRK80 are in its forward face and those of MRK90 in the stern face. The latter were unused, the cabin having been extended to stern.

Three of the knees, MRK50, 80 and 90 have chocks inserted between their outboard faces and the starboard side. These would have made up the deficiency in the original shape of the knees. MRK80 has given an earliest felling date of 1528 from a dendrochronology sample, so is certainly a replacement. MRK50 and 90 have provided no datable samples, though MRK90 does contain six disused treenail holes and a possibly redundant bolt hole, suggesting some type of modification in this area.

The only other main deck rising knees to provide datable dendrochronology samples are MRK 10, from 1525 and MRK30 from 1526. While these may have been replaced in the 1527 refit, the lack of sapwood rings from MRK30 and the post 1527 date of MRK 80 suggests that they were part of the 1536 refit. The lack of dating evidence from the rest of the knees prevents us from establishing whether all the knees were replaced in this refit.

Main Deck Lodging Knees

Lodging knees are only used to support the main deck beams. These are horizontal knees with one arm situated on top of the main deck clamp and the other extending along the bow or stern face of their respective deck beams. These knees not only helped distribute the forces acting on the deck beams, they also provided a considerable degree of lateral stiffening for the beams and longitudinal strengthening for the hull. Except in M1, where the knee is incomplete, M11 where one is missing, and M12 at the stern, there are two lodging knees in each sector.

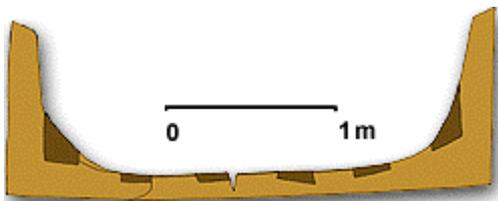
These knees are fastened to the hull with both treenails and bolts, and to the deck beams with bolts passing through each beam and the knee on either side. Two bolts are usually used for each purpose, although MR83 T1270 in M8 may have had up to four bolts holding it to the starboard side. The inboard ends of the knees are chamfered towards the fore or aft faces of the deck beams and secured with a single nail. The two lodging knees in each sector are vertically scarfed together, the lengths of the arms not necessarily being equal.



The lodging knees forward of the M60 deck beam all have shallow rebates cut in their upper surfaces to house the outboard lap joints of the main deck half beams.

Lodging knee against M10

Aft of M60 the situation is rather more complex. The knees in M7 have no rebates, rather the half beams rest in a shelf on top of the knees. In M8 there is also a half beam shelf, but the inboard arm of stern knee has two half beam rebates as well. M9 has a half beam shelf resting on the forward knee which butts against the aft knee. M10 has no half beam shelves. M11 has a set of rebates in both the knee and in the half beam shelf. (There is only one lodging knee in H11, the other having been torn out of the ship along with the M100 deck beam).



Half beam rebates on M5 lodging Knees

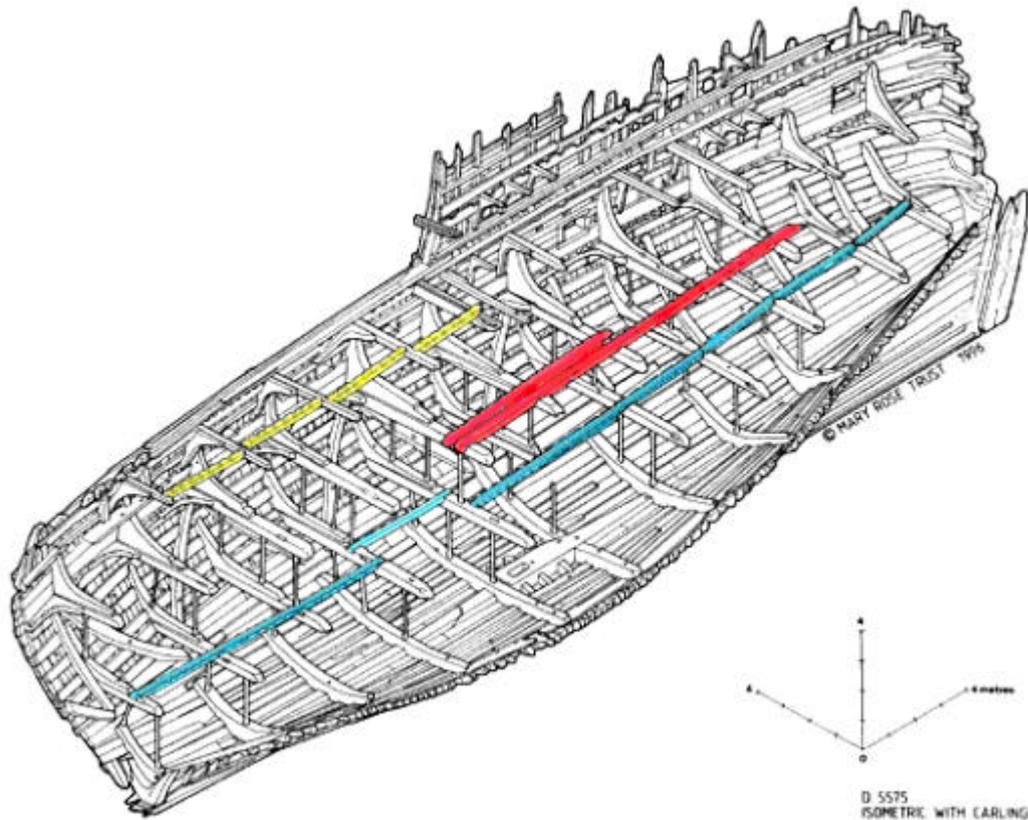
M12 has a hybrid arrangement with a small lodging knee fixed to the stern face of M110 plus half beam rebates cut into the timbers to stern of it.

The angled rebates in the knees and half beam shelves between M8 and M11 reflect the use of locking lap joints in the main deck half beams in this area.

These will be discussed in more detail in the section covering the main deck half beams. Unfortunately there are no valid dendrochronology samples from the lodging knees.

Main Deck Carlings

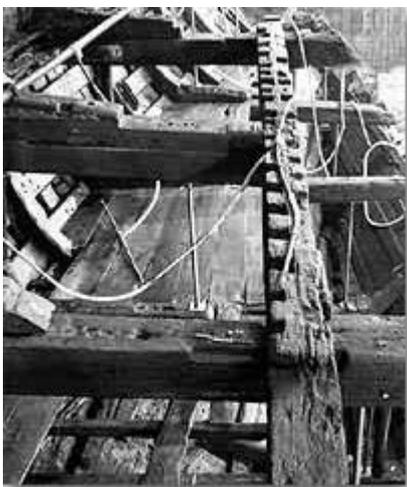
The carling arrangement on the main deck differs from that of the orlop deck inasmuch as there was a double carling system on each side of the centreline for part of its length. There are rebates for such a system on the deck beams M30-M70, although owing to the proximity of the carlings to the erosion line, only a limited number of these timbers survive.



Carlings

These are the outboard carlings between M30 and M70 and the inboard carling between M50 and M70, which then continues as the sole carling to just aft of the M90 deck beam. The carlings sit in single-stepped rebates in the deck beams, similar to those on the orlop deck, passing over the deck beams.

These are the outboard carlings between M30 and M70 and the inboard carling between M50 and M70, which then continues as the sole carling to just aft of the M90 deck beam. The carlings sit in single-stepped rebates in the deck beams, similar to those on the orlop deck, passing over the deck beams.



Carling between M70 and M90

The double line of carlings occupied the central section of the ship, extending forward from the M70 deck beam at least as far as M30. The outboard line of carlings terminates just aft of M70.

Both the M30-M40 carling and the outboard M50-M70 carling have no half beam rebates on their inboard faces, while the inner M60-M70 carling has no rebates on either face. This opens the possibility that much of the centreline of the main deck was an open well-deck. Spanning this void would have been the mast partners for the main mast in M6, and the inboard carling in this area has three bolt holes passing through it which may mark the position of one of those mast partners.

Further aft, in M8 and M9, there are long shallow rebates in the inboard face of the carling. The aft one may have housed the mast step for the mizzen mast, while it is possible that the forward one may have been for a capstan (pers. comm. David Meagher 1996). Most of the outboard half beam rebates in the M8-M9 carling are angled to lock the half beams firmly in place, providing extra stiffening in an area where the forces imposed by a mast would affect the structure.

In the stern the surviving sections of carling were scarfed together horizontally, the best preserved example being the inboard carling in M7. This joint was a hooked scarf and is held together with both nails and treenails. There is evidence for another scarf at the stern end of the M9 carling.

Main Deck Half beams

While generally similar, the main deck half beams have a number of differences from those of the orlop deck. The weight of the thicker deck planking plus that of the guns means that the half beams are more massively constructed. The distribution of the half beams is more consistent than on the orlop deck, between five and eight per sector, excepting M9, which contains eleven. In appearance, the half beams are flatter in section than the orlop deck ones.

The outboard ends of the half beams between M1 and M7 usually terminate in a lap joint that rest in the rebates in the lodging knees or half beam shelves. These lap joints are angled where the half beams rest on the inboard arms of the lodging knees. The outboard ends are angled in the horizontal plane to compensate for the longitudinal curve of the hull. In the same area, the inboard ends of the half beams are identical to those of the orlop deck.



Between M8 and M11 a change occurs in the design of many of the half beams. These feature a locking lap joint on their outboard ends, and/or a hooked joint on their inboard ends to fit angled rebates in the carlings. A. Fielding has suggested that this system would provide additional transverse stiffening in an area where the mizzen mast was probably stepped.

Main deck half beams



The half beams were fastened to the planks with nails at least 6" (150mm) in length, usually two per half beam per plank, although this varies with the width of the planks. Around half of the beams have what appear to be disused treenail holes cut through their thickness. There is no trace of the use of treenails in the deck planking above and these holes rather suggest some sort of reuse or modification.

Locking lap joints in M9

Where there is no half beam located close to the deckbeam a smaller beam is nailed to the side of the beam to support the ends of the deck planks, an example being MR81 T1238 in M9.

Main Deck Planks

The main deck planks are made solely from oak and are approximately 70mm thick on average. There are considerable variations in both the widths and lengths of the planking, with the maximum width being around 500mm and the longest plank measuring 7335mm. The planks are flat sawn, and their upper faces are generally finished with an adze. As on the orlop deck, the plank layout comprises a series of short planks between the rising knees, with longer planks between the inboard ends of the knees and the carlings. Because the knees have a step in their upper faces, the area of uninterrupted planking is greater on the main deck than on the orlop deck.

The method of compensating for the curve of the hull is similar to that employed on the orlop deck. The outboard edges of the planks adjacent to the hull have little in the way of a chamfer, the hull rising almost vertically at this point.



One of the features noted during the underwater excavation was a ridge on the inner edge of the inboard deck planks. This feature is recorded in the 1980 Trench 7 and 8 Report (p.15). Apparently between 60 and 160mm wide and 40mm high, and extending from at least M3 to M8. This feature would have acted as a coaming, preventing water from penetrating down to the deck and hold below.

The main deck planks are secured to the half beams with iron nails (see the section on half beams). These nails are set in chisel-cut countersinks of varying size and depth and these countersinks may be plugged with pitch, although this seems to be an accidental by-product of caulking the seams.

Main deck planking

The seams are filled with a mixture of hair and pitch, with additional pitch being poured along the top of the seams, often covering a considerable portion of the deck planks. The seams between the outboard plank and the starboard side are generally very heavily caulked.

The majority of the planks have no real distinguishing features, exceptions being MR81 T906, which has an insert in its aft end, this looks like a damaged area was removed and the insert is a repair. There is also a rebate in the deck planking in M9, the purpose of which has not yet been ascertained.

Main deck half beam shelves

As mentioned in the section on the lodging knees, there are half beam shelves in sectors M7 - M9 and M11 - M12. The half beam shelves in M7 and M8 curve slightly to follow the line of the lodging knees, whereas those in M9 and M11 are straight pieces of timber.



M7 half beam shelf

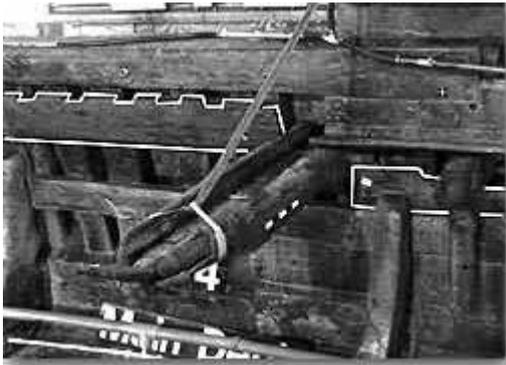
The M12 half beam shelf is atypical, being a deep piece of timber resting on the transom knee and nailed to the frames behind. The lodging knee is rebated into its forward end. The half beam rebates in the shelves are up to 50mm deep and some of those between M8 and M11 are angled to fit the locking lap joints in the half beams.

The Upper Deck

This was both a gun deck and a fighting platform for the archers and other troops. It is lighter in construction than the main deck, and is constructed on two levels, separated at the midships daille. The area forward of the aftercastle is 270mm higher than that to stern. There is a considerable structural difference between the two sections of deck but no firm evidence as yet for any chronological difference. There was good clearance between the upper and castle decks, 5' 8" to the deck beams and 6' 4" to the underside of the castle deck planks.

Upper Deck Clamps

The upper deck clamps are lighter in construction than those of the orlop and main decks. On average they are 320mm high but only c.95mm thick at their widest points and c.75mm where the beams are rebated into them. The rebates are shallower than the height of the beams, which stand proud of them. The surviving forward section between U2 and U6 consists of two pieces vertically scarfed together.



Upper deck clamp (outlined in white) – showing the discontinuity between the forward and aft sections

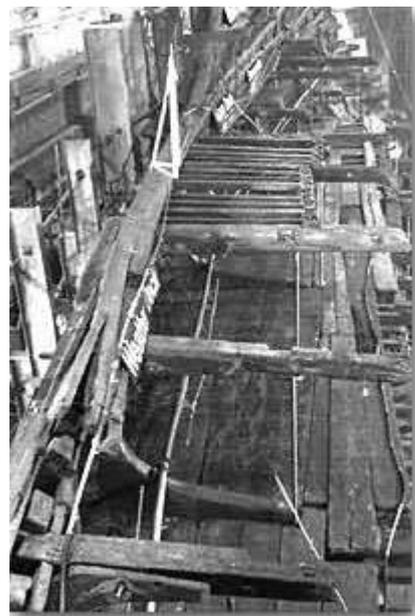
It has both shallow half beam rebates and deeper rebates for the deck beams cut into its upper face. This section of the deck clamp terminates in a butt before reaching the daille.

The deck clamp aft of the daille is composed of four scarfed sections with closely spaced deck beam rebates cut into them. This clamp is interrupted by a 500mm cut-out for a small port in the carpenter's cabin in M9, rather cavalier treatment for a major structural timber. As on the other decks, the deck clamps double up as stringers, with the forward section tying the tops of the frames in place.

Upper Deck Beams

The design and layout of the upper deck beams vary with their location. The beams forward of the aftercastle are similar in form and function to those of the orlop and main decks: they are regularly spaced and support carlings to house the half beam ends.

There are, however, significant differences between these beams and those of the decks below. In these beams the carling rebates have a double step, allowing the tops of the carlings to sit flush with the tops of the deck beams, and are therefore deeper and longer than those on the orlop and main deck beams. Because of this arrangement the rebates on each beam are staggered to avoid creating a weak spot.



Upper Deck beams

The carling rebates are much closer to the starboard side than on the other decks and we assume that there was a second set of carlings each side of the centreline of the ship (and therefore a second set of carling rebates in the beams).

The U20 beam has only one surviving rebate, on its stern face. Given the marked inward curve of the bow at this point, there may have been only one set of carlings forward of this deck beam. With the exception of the forward rebate in U30 and the opposing rebate in U20, all the carling rebates have a treenail protruding from them to hold the carlings in place.

Rebates in the deck clamp house the outboard ends of the beams and they are secured to the hanging knees with a single clench bolt passing through their width. A single large nail in the inboard end of each knee helps fasten them securely to the beams.



Deck beam rebate in U3 - the modern bolts in the knee show the position of the Tudor ones

The tops of the knees are also flush with the tops of the beams and the deck planks are nailed to both of them. There are no stanchion rebates in the surviving lengths of the beams, presumably any vertical support was closer to the centre of the ship. A possible arrangement would be a stanchion each side of the centreline. The outboard ends of the beams vary in construction, although all are angled to compensate for the inward slope of the hull at this point. The U20 and U30 deck beams have a vertical lap to allow them to fit in the deck clamp rebate, while the U40 beam has a horizontal lap and the U50 one has none at all.

Only one of these beams has produced a dendrochronology date so far, U30, with an earliest felling date of 1520. The hanging knee beside it, UHK30 has provided a date of 1517, suggesting that they were installed at the same time, possibly during the refit of 1527. The U40 deck beam is something of an oddity, constructed from a coniferous wood, possibly spruce, rather than oak. It is also slightly larger in section than the other upper deck beams. This timber appears to be a replacement, but without dating evidence this can only be supposition.

The central daille marks a discontinuity in the upper deck. Not only is the deck lower, but the support structures for the deck planking is different from that in the forward part of the ship. There are no half beams in this area of the ship, only closely spaced (c. 1m apart) deck beams, and these in turn have no carling rebates on their surviving lengths. There is a cluster of four deck beams set closely together on the border of U9/10, possibly to help take the weight of the gun in M10, and/or to help brace the mizzen mast. It is possible that there was a similar arrangement of beneath the front of the aftercastle, with three closely spaced beams.



Upper deck beams in U9/10

The middle beam is recorded as having protruded through what appears to be a port in the Barber Surgeon's cabin. Unfortunately this beam does not appear to have been recovered.

The beams are rebated into the deck clamps and bolted/nailed to the deck beams in the same manner as those in the forward part of the ship.

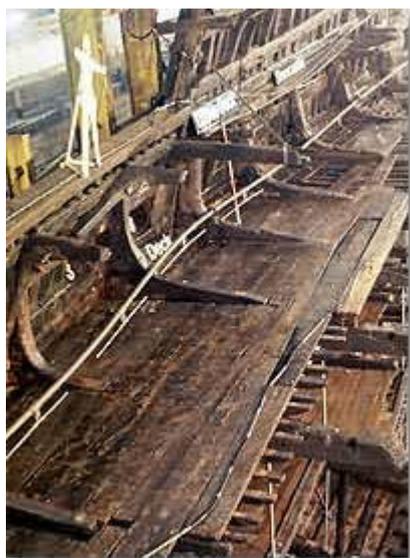
The outboard ends of the beams vary in design, seemingly without much reference to the surrounding structure. MR82T371 from U70 has a vertical lap joint, and MR83T298 has a horizontal locking lap joint, similar to those on some of the main deck half beams. Most of the beams in this part of the ship have a rough hewn, unfinished appearance, but without dating evidence it is not yet possible to place their position within the chronology of the ship.

Although MR83T296 has mortices on its lower face for the stern partition supports of the Carpenter's cabin, there is no other evidence for vertical support for these deck beams. There may have been a similar stanchion system to that postulated for the forward deck beams. Another suggestion is that these beams did not traverse the full width of the hull but terminated at a central set of carlings. This would seem very unlikely on structural grounds but there is no surviving evidence to support either hypothesis.

Upper Deck Knees

The upper deck beams are attached to the hull with hanging knees, leaving the upper deck free of obstructions. The knees are bolted and treenailed to the side of the ship and fastened to the deck beams with a single countersunk bolt through the main body of the knee. The inboard ends of the knees are fastened to the beams with a single large countersunk nail. The knees in the part of the ship forward of the daille are all fastened to the bow side of the deck beams, while those aft of the daille can be attached to either the bow or stern faces. The knees are L-shaped, with the lower arms having their outboard faces rebated to fit around the stringers. The inboard ends of the upper arms are chamfered towards the face of the beams they are supporting.

At least three of the knees in the stern part of the ship, MR81 T1484, MR 83 T1197 and MR83 T1198 have a ledge cut out of their upper arms to help support the beams.



Upper deck knees

Two of the knees in the forward part of the ship angled, UHK20 has its lower arm angled towards the bow to avoid a hawse hole, and the lower arm of UHK50 is also angled in the same direction. This knee was probably angled to allow it to be bolted to the hull, there is no frame directly below the upper arm. Although this timber might look like a modification, dendrochronology dating has given it an earliest possible felling date of 1474.

There is some evidence for possible modification in the U9/U10 area, the knees here have a number of unused treenail holes in them, suggesting that either the knees are reused or that the hull behind them has been altered.

Upper Deck Carlings

Carlings have only been found in the forward half of the upper deck and there is no surviving evidence for carlings aft of the central daille. These timbers have a lap joint at each end, with the exception of the stern end of the U6 carling which terminates in a butt just aft of the daille it rests on. As discussed in the section on the upper deck beams, the carlings are staggered and are closer to the side of the ship than those on the main and orlop decks. There are half beam rebates on both the port and starboard sides of the carlings, as well as surviving half beams.

It is highly probable that there was a second set of carlings each side of the centreline of the ship. These missing carlings probably formed two parallel lines with either hatches, gratings or a well between them. Since there is no carling rebate on the forward face of the U20 deck beam we assume that either the half beams extended from the starboard side to the central carlings, or the rebate was situated beyond the surviving end of the carling.



Upper Deck Half Beams

Half beams are used only in the part of the deck forward of the aftercastle, aft of that they are replaced with a system of closely spaced deck beams. There are two sets of surviving half beams, one stretches between the starboard side and the in-situ carlings, the other is housed in the inboard rebates of those carlings and would presumably have extended to a second line of carlings set closer to the centreline of the ship. The ends of the half beams are angled to fit in the carling rebates and are either similarly angled or end in a butt where they rest in the deck clamp rebates.

Upper deck carlings and half Beams

Subjectively, these half beams appear to be either part of a modification to the upper deck, or alternatively a hurried replacement. There are two features that may support such a hypothesis. Firstly, the half beams are not constructed from a single wood type. Instead they are made from a mixture of oak, poplar and a coniferous wood, possibly spruce. The use of a wood such as poplar, with its very high rate of water absorption, for important structural timbers, seems idiosyncratic at best. Secondly, a number of the half beams have a section of their outboard ends cut out to allow them to fit in the rebates in the deck clamp. Could these timbers have been reused?

Upper Deck Planks

Unlike the orlop and main decks, the upper deck has a flush surface, uninterrupted by rising knees. The planks are 45mm thick on average and either butt end to end or are keyed together with lap joints. As on the main deck the planks are flat-sawn with the upper faces generally being finished off with an adze. They are caulked the same way

as the main deck planks. There are significant differences in the construction of the deck fore and aft of the daille.

The planks in the forward half of the ship had a closely spaced pattern of nails to fasten them to the half beams, usually two or three nails per plank per half beam. The stern planks had a more widely spaced pattern of nails fastening them to the deck beams. Two nail holes per beam is the normal pattern, but clusters of two or three nails were not uncommon. The majority of the nails in both parts of the deck were set in chisel-cut countersinks. The design of the outboard planks differs between the bow and stern halves of the ship. While both sets of planks are curved along their length to fit against the hull, the stern ones have a 50mm high waterway rebated into the lining planking, whereas the forward planks are just chamfered to fit against the hull.



Upper deck planks - note the different levels fore and aft of the daille

There are four cut-outs for ventilation hatches in the forward part of the upper deck. The marks left by the hatch coamings are still visible on the upper surface of the planks as are the nail holes used to attach the coamings. These hatches were positioned above the guns on the main deck. There is no evidence for any such hatches in the after part of the deck.