Plank thickness

I. Objective

This is intended for future owners of Sixes intending to build replicas, as well as for current owners who will be re-planking their current boat, possibly as part of a total re-build.

The minimum thickness specified in the 1949 edition of the Lloyds scantlings is 16 mm. or .62 inches.

II. Principal conclusion

At least two American writers of books on building wooden boats, viz.

- McIntosh, David C., How to build a wooden boat (WoodenBoat Publications, Brooklin, Maine, 1987) p. 96
- Pardey, Larry, Details of classic boat construction: the hull, 2nd edition (Paradise Cay Publishing, Arcata, California, 1999) p. 224

as well as the blog of the construction of the Six Metre ***Cherokee***

http://www.moy.org/Exhibits/6MetreNewBuildCherokee/CherokeeBlog/tabid/500/Default.aspx

describe a planking technique whereby one edge of the plank is cut square and only the other edge is bevelled to fit the curves of the hull.

The analysis below suggests that this technique reduces the thickness of the plank, possibly below minimum specified by the Scantlings. It seems to be necessary to bevel both edges, normal to the curve of the frame, to avoid this reduction in thickness.

This "double bevelling" seems to be standard practice in the U.K. and continental Europe.

III. Factors affecting plank thickness

The final thickness of a new plank is the result of:

- the density of the wood used for planking,
- the thickness of the rough planed stock used for the plank,
- the amount of wood backed out of the plank to make it conform to the frame to which it is attached,
- whether both or only one edge of the plank has been bevelled to fit its neighbours,
- the amount of wood planed off the edges of two adjoining planks to turn them into a convex curve or off the outside face of a plank to give it a concave curve,
- the amount of wood removed during "longboarding" and final sanding.

IV. Density of the wood used for planking.

Lloyds specifies the following concerning the density of the wood to be used:

4. The Table scantlings for wood are to be based on the following standard weights :—

Keel	38 lbs. per cubic foot (=610 kilos. per cubic metre).
Stem Sternpost	
Deadwood Counter timbers	
Planking	35 lbs. per cubic foot (=560 kilos. per cubic metre).
Decks	27 lbs. per cubic foot (=430 kilos. per cubic metre).

Where the actual weight of the timber differs from the standard weight, the Table siding or thickness is to be increased or decreased according to the following formula, viz. :—

$$\frac{(S - W)}{(W)} T$$

where S = the standard weight for the material in lbs. per cubic foot (or kilos. per cubic metre),

W = the actual weight of the material in lbs. per cubic foot (or kilos. per cubic metre),

T = the siding or thickness given in the Tables,

V. Thickness of the wood backed out

This subject is closely related to the geometry of circles, namely chords and segment heights. Figure 1 below explains the terms radius, chord and segment height.

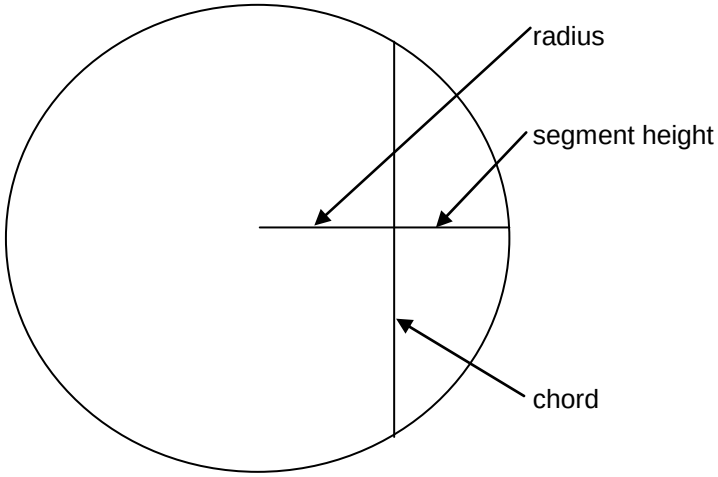

Figure 1. Radius, chord and segment height of a circle

The Web site **http://www.1728.com/circsect.htm** provides a more detailed explanation, including a calculator for calculating segment heights.

Figures 2 below shows how the minimum thickness of a plank on a convex curve equals the thickness of the plank stock, less the segment height.

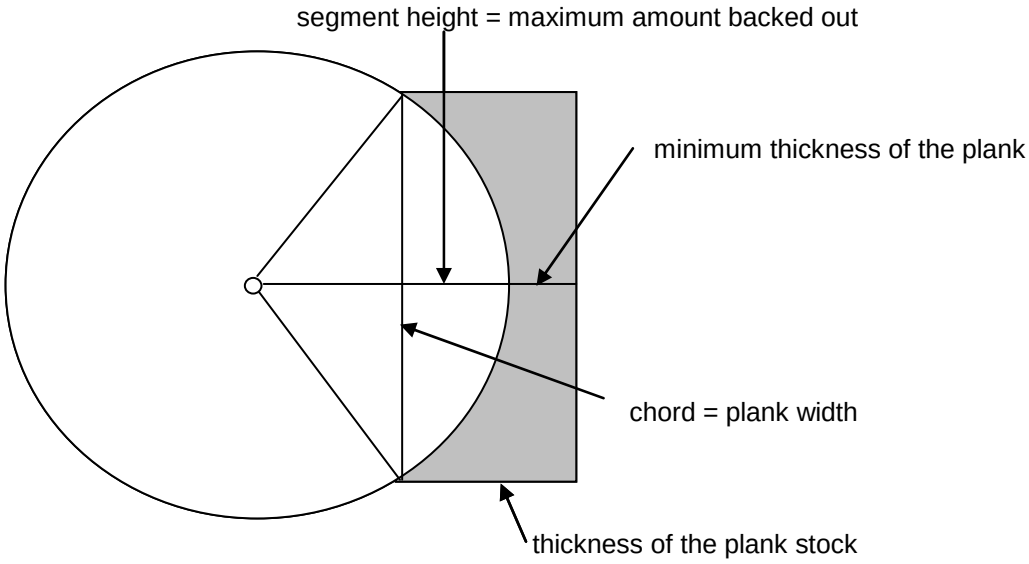

Figure 2. Minimum thickness of a plank on a convex curve

Figures 3 below shows how the minimum thickness of a plank on a concave curve also equals the thickness of the plank stock, less the segment height.

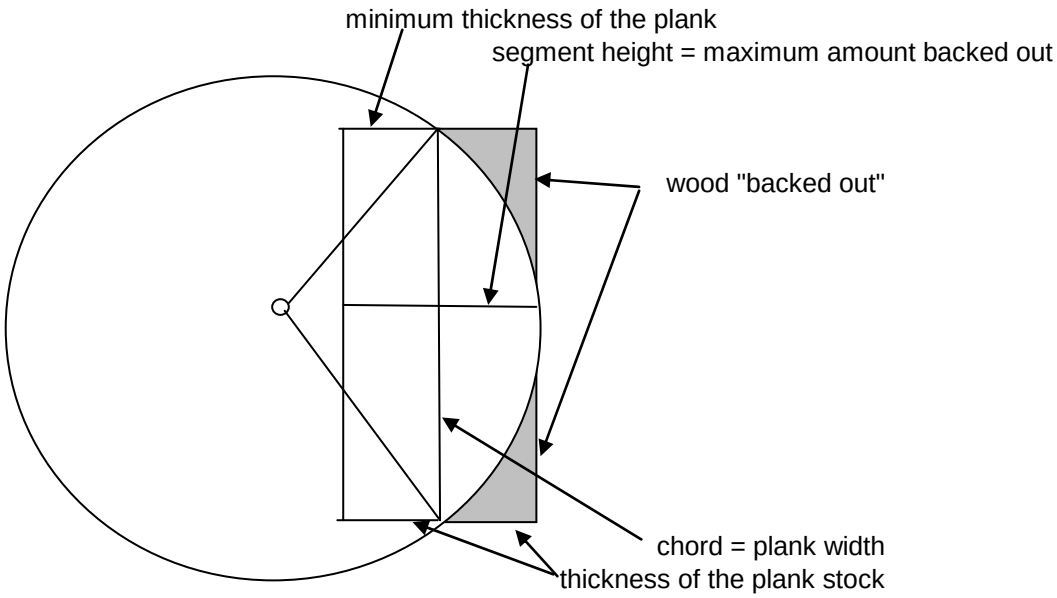

Figure 3. Minimum thickness of a plank on a concave curve

Figure 4 below shows the amount of wood to be backed out for four different plank widths and for radii ranging from 40 – 100 cm.

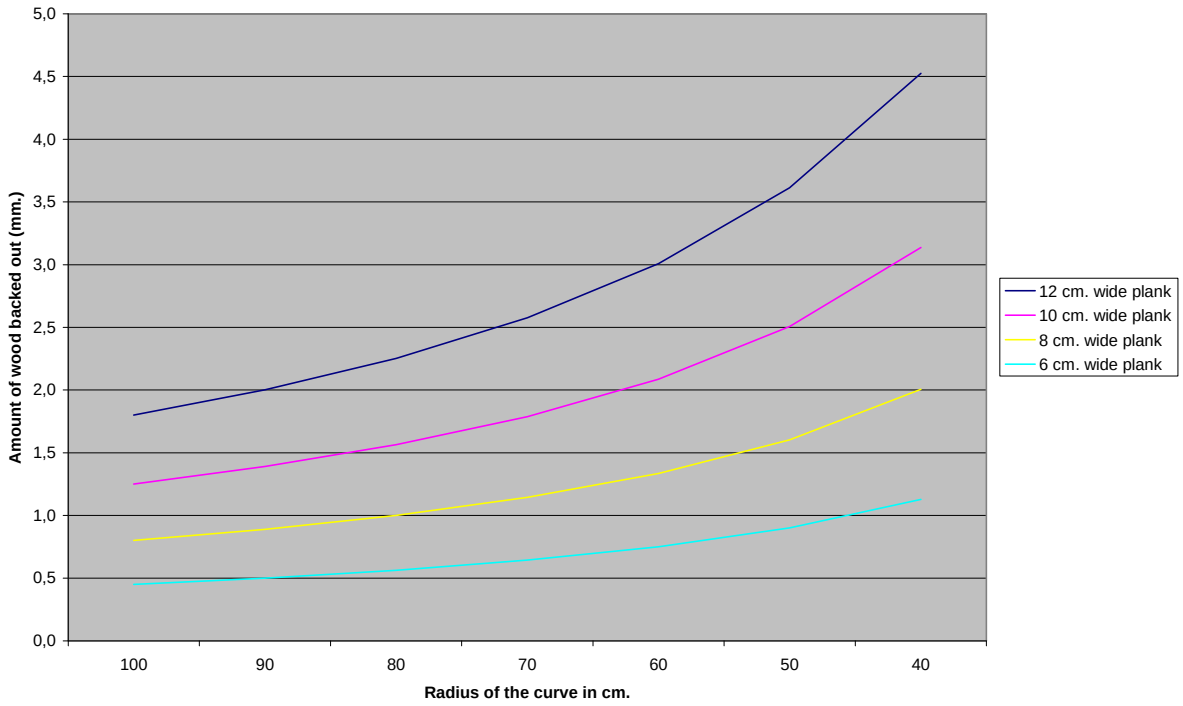

Figure 4. Amount of wood backed out of a plank for a given radius for four different plank widths

One begins to back out a millimetre of wood as of a 6 cm. wide plank on a 40 cm. radius - and one should probably allow another millimetre as a margin of error.

VI. Bevelling one or both edges of the plank

Figure 5 below show the effects of bevelling one edge of a plank and leaving the other edge at a right angle.

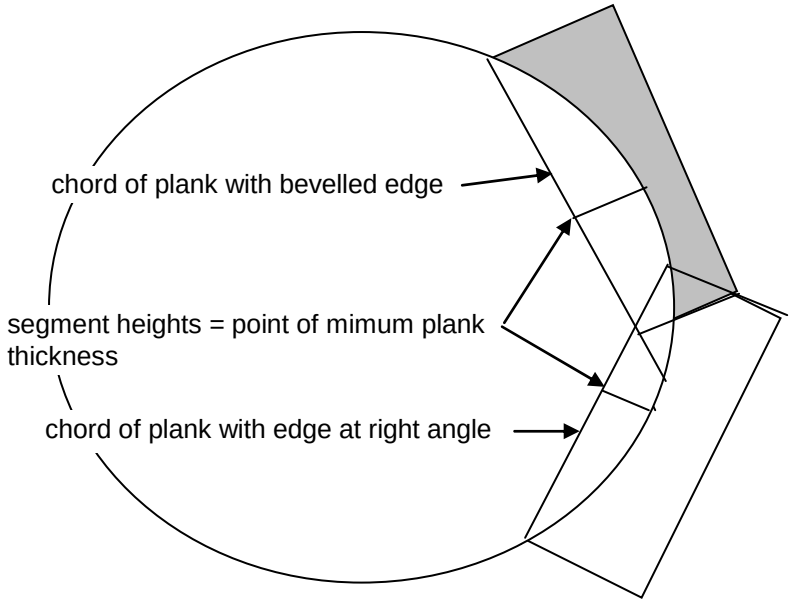

Figure 5. Segment heights of two adjacent planks of equal width, where the lower one has a right angle edge and the upper one is bevelled to fit the edge of the lower plank

One can see that the chord of the upper plank is longer than that of the lower one. Accordingly, the segment height of the upper plank is the greater of the two and its minimum thickness is less than that of the lower plank, perhaps by as much as 1-2 mm..

During the planing stage, the protruding edge of the lower plank will first have to be made equal to that of the upper plank – and then both edges will have to be planed further to make a curve. This will further reduce the minimum thickness, perhaps by as much as 1-2 mm.

Figure 6 below shows the case where both of the planks have been positioned in such a way that the shorter mid-line of the plank (across its thickness, rather than along its width) is aligned on a radius which results in their adjoining edges being equally bevelled.

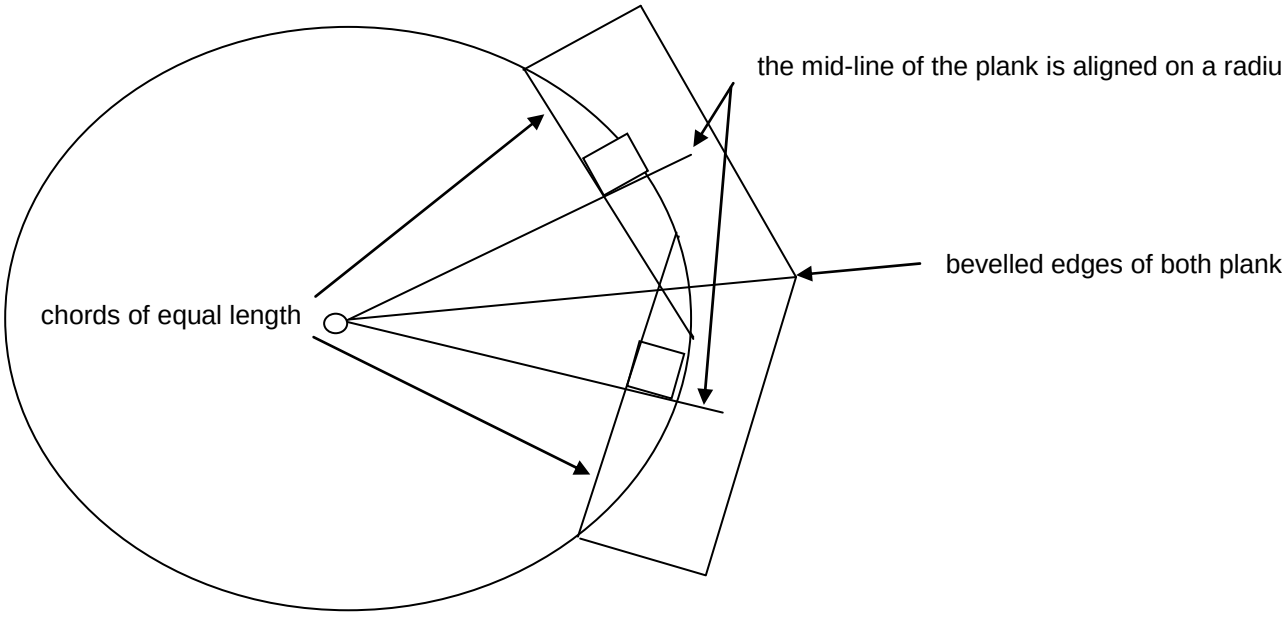

Figure 6. Two adjacent planks of equal width whose mid-lines have been aligned on radii

In this case, the minimum thickness can be calculated as in Figures 2 & 3 above (minimum thickness = thickness of the plank stock less the segment height), which was not the case for a plank with one edge at right angles. Similarly, during planing, the curve planed into the planks will follow the curve of the frame, without significantly reducing the minimum thickness.

VII. Planing a curve on to the exterior of planks

This is essentially the complement, on the exterior face of the plank, of backing out its interior face. It shouldn't materially affect the minimum thickness, but it might be wise to allow for a margin of safety of 1 mm, as mentioned above.

VIII. Longboarding and final sanding

It seems prudent to allow for another millimetre of plank thickness to disappear during these operations.

IX. Conclusion

Since backing out and exterior planing necessarily entail reducing the thickness of a plank, one might wish to vary the thickness of the plank stock used for planks according to the radius of curve of the hull where the plank will be attached. This would avoid using unnecessarily thick planking where the sides of the hull are flat.

In all, we have seen the following amounts removed from the planed stock:

- backing out and planing: up to 4 mm.
- bevelling with one edge at right angles: up to 4 mm.
- planing 1 mm.
- longboarding and sanding: 1 mm.

which can add up to 10 mm. for a target plank thickness of 16 mm. In addition, if the wood used is below the standard, the thickness of the plank stock will need to be increased as shown in Section III above.

One way to reduce the amount of wood backed out would be to make adjustments during lofting. At the points of maximum curvature, one could slightly flatten the curve of the frames and then use a thicker plank to make up for it. As a result, both the frame and the plank would gain in strength at a point of maximum stress.

Basil Carmody

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