# DRAFT TANZANIA STANDARD

## Guidelines for Construction of Wooden Boats for the Indian Ocean and Inland Waters



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## Abbreviations

BS British Standard
HIN Hull Identification Code
HP Horsepower
ISO International Organization for Standardization
KW Kilowatt
LOA Length Overall
LWL Length Waterline
MIC Manufacturers Identification Code
MOE Modulus of Elasticity
MOR Modulus of Rupture
TASAC Tanzania Shipping Agencies Corporation
UK United Kingdom
WBP Water and Boil Proof
AS/NZS Australian /New Zealand Standard

## 0 National Foreword

The Tanzania Bureau of Standards is the statutory national standards body for Tanzania, established under standards Act No. 3 of 1975, amended by Act No. 2 of 2009.

This draft Tanzania Standard is being prepared by BCDC 12 Timber structures technical committee under the supervision of the Building and Construction Divisional Committee (BCDC).

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# Guidelines for Construction of Wooden Boats for the Indian Ocean and Inland Waters

## 1 Scope

**1.1** These Guidelines, apply to the construction of any new wooden vessel of between 6metres length over all ($L_{OA}$) to less than 24metres length, constructed under the inspection of the overseeing authority. The Guidelines specifies minimum standard for the design, construction, inspection and certification of the hull, and outfit of wooden vessels for the Indian Ocean and Inland Waters.

**1.2** "Surveyor" refers to an officially appointed Surveyor by the overseeing authority

**1.3** For certification of build to this Standard, vessels are to be completed in accordance with the specifications and drawings approved by the overseeing authority. Any variations to the scantlings, materials, equipment and layout as set out in the approved specification, drawings, and these Guidelines, are to be submitted to the overseeing authority for approval, prior to the proposed variation being put in hand.

**1.4** Workmanship is to be in accordance with boatyard operating procedures approved by the overseeing authority and to the approval of the Surveyor.

**1.5** All vessels are to comply fully with current statutory requirements.

**1.6** Wooden vessels of unusual form and dimensions or of a design not covered by these Guidelines, may receive individual consideration for approval upon submission of full details to the overseeing authority.

**1.7** Compliance with these Guidelines does not relieve the designer or boatbuilder of a vessel of their responsibilities to the owner for the specification requirements or performance of the completed vessel.

**1.8** The boatbuilder is to provide the Surveyor(s) with full access to the facilities during normal working hours to carry out their duties in surveying for compliance with these Guidelines.

**1.9** These Construction Guidelines may be used as guidance for the repair of the wooden vessels.

**1.10** Vessel types are not covered by the requirements of these construction Guidelines including the following:

- Vessels of simple construction including vessels such as rafts and dug-out canoes;
- Vessels judged by the overseeing authority to be outside the scope of this guideline.

## 2 References

The following documents were referred on preparation of these Guidelines:

BS 1088:2018 - Marine plywood. Requirements

AS/NZS 2272:2006 - Plywood—Marine

TZS 656:2021 - Copper/chromium/arsenic composition for the preservation of timber — Specification

BS EN 301:2017- Adhesives, phenolic and aminoplastic, for load-bearing timber structures. Classification and performance requirements

BS 3452:1962 - Specification for Copper/Chrome water-borne wood preservatives and their application

ISO 2081:2018-Metallic and other inorganic coatings — Electroplated coatings of zinc with supplementary treatments on iron or steel

ISO 12215-1—Small craft - Hull construction and scantlings - Part 1: Materials: Thermosetting resins, glass-fibre reinforcement, reference laminate

ISO 12215-3—Small craft - Hull construction and scantlings - Part 3: Materials: Steel, Aluminium alloys, Wood, other materials

ISO 12215-4—Small craft - Hull construction and scantlings - Part 4: Workshop and manufacturing

ISO 12215-5—Small craft - Hull construction and scantlings - Part 5: Design pressures, design stresses,



scantling determination

ISO 12215-6 - Small craft - Hull construction and scantlings - Part 6: Structural arrangements and details

**Other references**

Merchant Shipping Cap.165

Merchant Shipping (Small Ships, Local Cargo Ship Safety, Small Ship Safety, Surveys and Inspections for Vessels Engaged on Local and Coastal Voyages, Inland Waters) Regulations, 2006

Rules and regulations for the classification of Yatchs and Small Craft, Part 2 Hull Construction, Lloyd's Register of Shipping

Uniform Shipping Laws Code 2008, Section 5M: Construction -Timber (CTH, NSW, NT, QLD, SA, TAS, VIC & WA)

The Commercial Timbers of Tanzania by J.M. Bryce and Revised by A.W. Chihongo. Third edition 2003, published by Tanzania Forestry Research Institute

Sea Fish Authority (UK), Construction Standards for Wooden fishing vessels

## 3 Terms and definitions

For the purpose of this Standard the following terms and definitions apply.

**3.1 Length**

**3.1.1** The overall length, $L_{OA}$, is the distance, in metres, measured parallel to the static load waterline from the fore side of the stern to the after side of the stern or transom, excluding rubbing strakes and other projections.

**3.1.2** The waterline length, $L_{WL}$, is the distance, in metres, measured on the static load waterline from the fore side of the stem to the after side of the stern or transom.

**3.1.3** The scantling length, $L$, is to be taken as:

$$\boldsymbol{L = \frac{L_{OA}+L_{WL}}{2}\ metres}$$ *(See Figure 1)*

**3.1.4** Amidships is to be taken as the middle of the static load waterline.

**3.2 Breadth/ Beam**

**3.2.1** The breadth/beam, $B$, is the extreme breadth, in metres, measured between the outer sides of the hull, excluding rubbing strakes or other projections.

**3.3 Depth**

**3.3.1** The depth, $D$, is the distance, in metres, at amidships, measured from the bottom of the keel, or ballast keel if fitted, to the top of the main deck or gunwale at side.

**3.3.2** It is assumed that a sailing or auxiliary craft is fitted with a ballast keel. If a centreboard is fitted the depth, $D$, is, in general, to be the measured depth increased by 15 percent, but will be considered for each individual design.

**3.4 Scantling dimensions**

**3.4.1** The dimensions of the structural parts; often described in terms of moulding (depth) and siding (width).

The **moulded dimension** of any piece is its dimension measured in from the outside toward the interior of the hull.

The **siding** is the direction at right angles to the moulded dimension that is not running along the length of the wood grain.



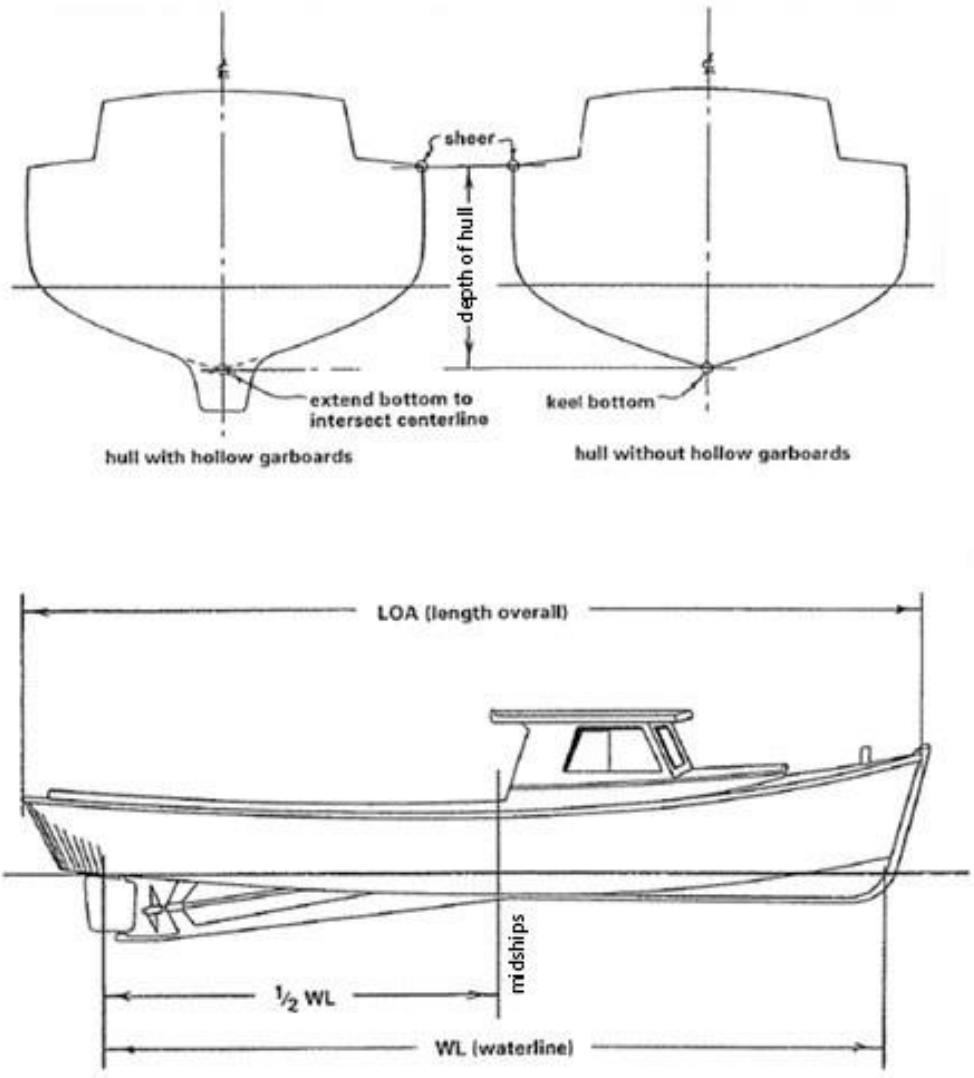



Figure 1: Boats leading dimensions

### 3.5 Speed

**3.5.1** The speed, V, is the maximum speed, in knots.

In general, the guideline applies to vessels operating at moderate speeds (maximum operating speed 20 knots). Vessels operating at higher speeds will require special consideration by the overseeing authority.

## 4 Materials and Fasteners

### 4.1 General Characteristics

**4.1.1** All materials used in the construction of a new vessel are to be in accordance with the approved building specification.

**4.1.2** When selecting materials and equipment to be used in the vessel construction, designers and boatbuilders of new vessels will need to pay special regard to the working conditions to which the vessel will be subjected, and should take all measures to ensure that any material or appliance fitted in accordance with the requirements of these Guidelines is suitable for the purpose intended, having regard to its location in the vessel, the area of operation, and the weather conditions which may be encountered by the vessel.



**4.1.3** Boatbuilders are advised that any requirement for goods or materials to comply with specified Guidelines shall be satisfied by compliance with a specification sufficiently detailed to permit assessment for goods or materials of an innovative nature (or subject to innovative processes of a manufacture such that they cannot comply with a specification) and which fulfil the purpose provided by the specified Guidelines; provided that the proposed Guidelines, code of practice, specification or technical description provides, in use, equivalent levels of safety, suitability and fitness for purpose.

**4.2 Timber species**

**4.2.1** The species of timber which may be used for the various constructional members *see Figure 2, 3* and *4* are given in Table 1 and Annex A. It is presumed that the designer will relate the known characteristics, e.g., swelling and shrinkage, strength, density, bending and working capabilities, of particular species to the constructional design.

**4.2.2** A general indication of their known performance in service has been experienced, but in view of the differences in construction methods and in the use of the craft, design considerations may influence the selection of species.

**4.2.3** The inclusion of a timber in Table 1 does not imply that all material available under the particular name is suitable for the use shown, and care must be exercised to ensure that an appropriate grade is obtained.

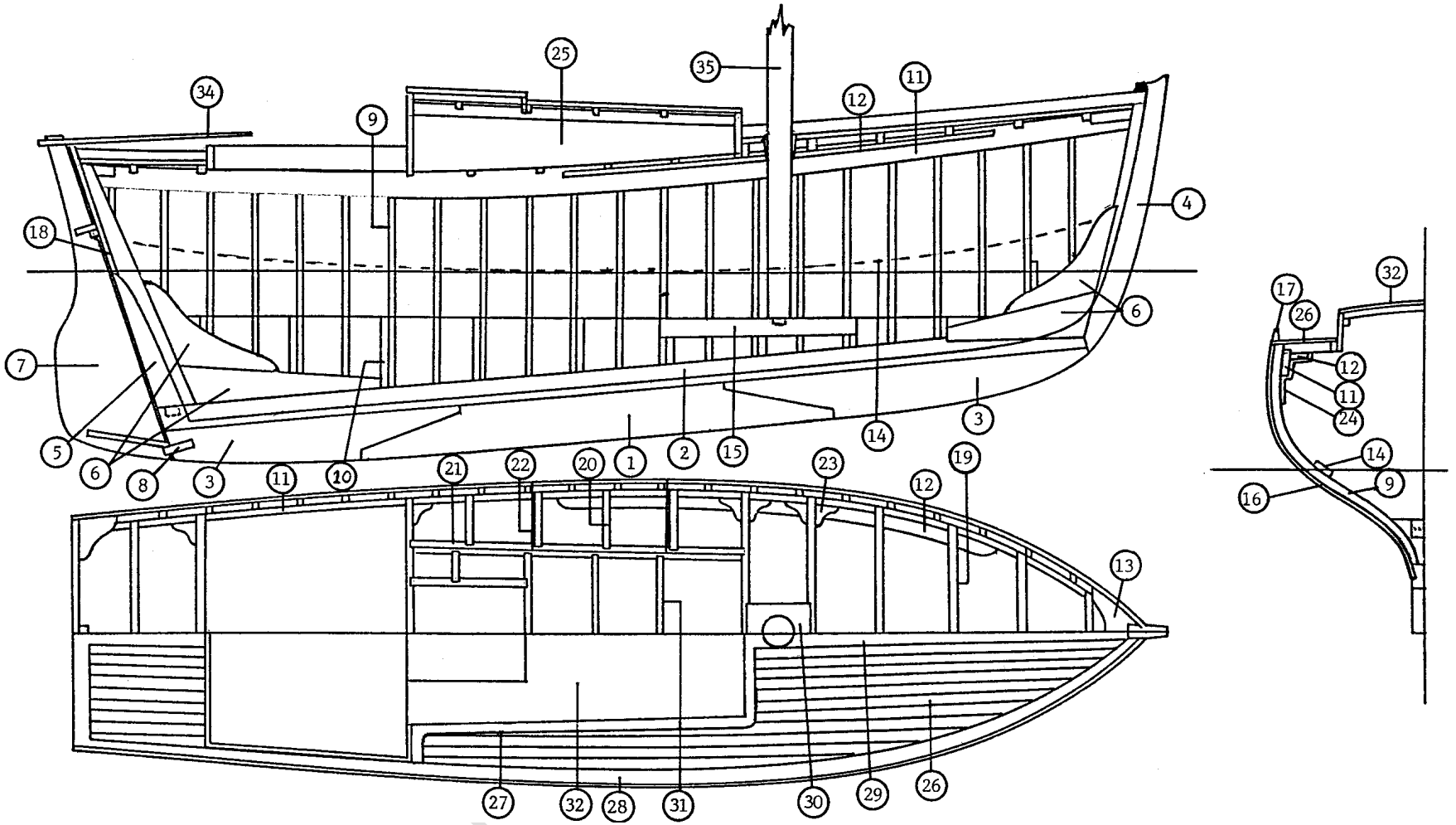


Figure 2: Component parts of a wooden hull

1. Ballast keel
2. Wood keel
3. False keel
4. Stem
5. Sternpost
6. Deadwood
7. Rudder
8. Rudder heel fitting
9. Frames or Timbers
10. Floors
11. Beam shelf
12. Clamp
13. Carling
14. Bilge Stringer
15. Mast set
16. Outside planking
17. Bulwark
18. Transom
19. Beams
20. Half beams
21. Carling
22. Tie rods
23. Lodging knees
24. Hanging knees
25. Coach roof coaming
26. Deck
27. Margin plank
28. Covering Board
29. King plank
30. Mast partner chock
31. Coach roof beams
32. Coach roof top
33. Keel bolts
34. Tiller
35. Mast

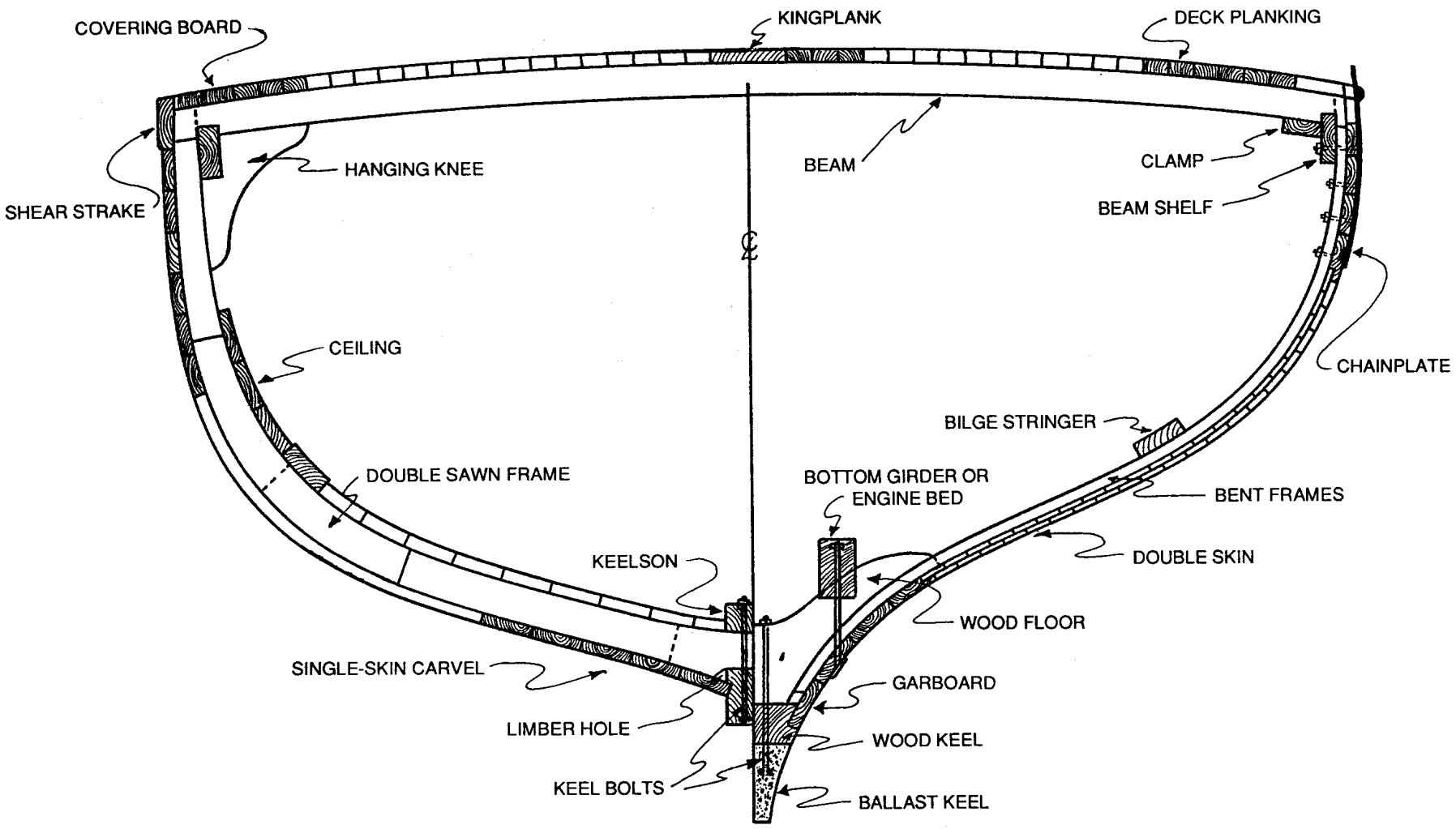
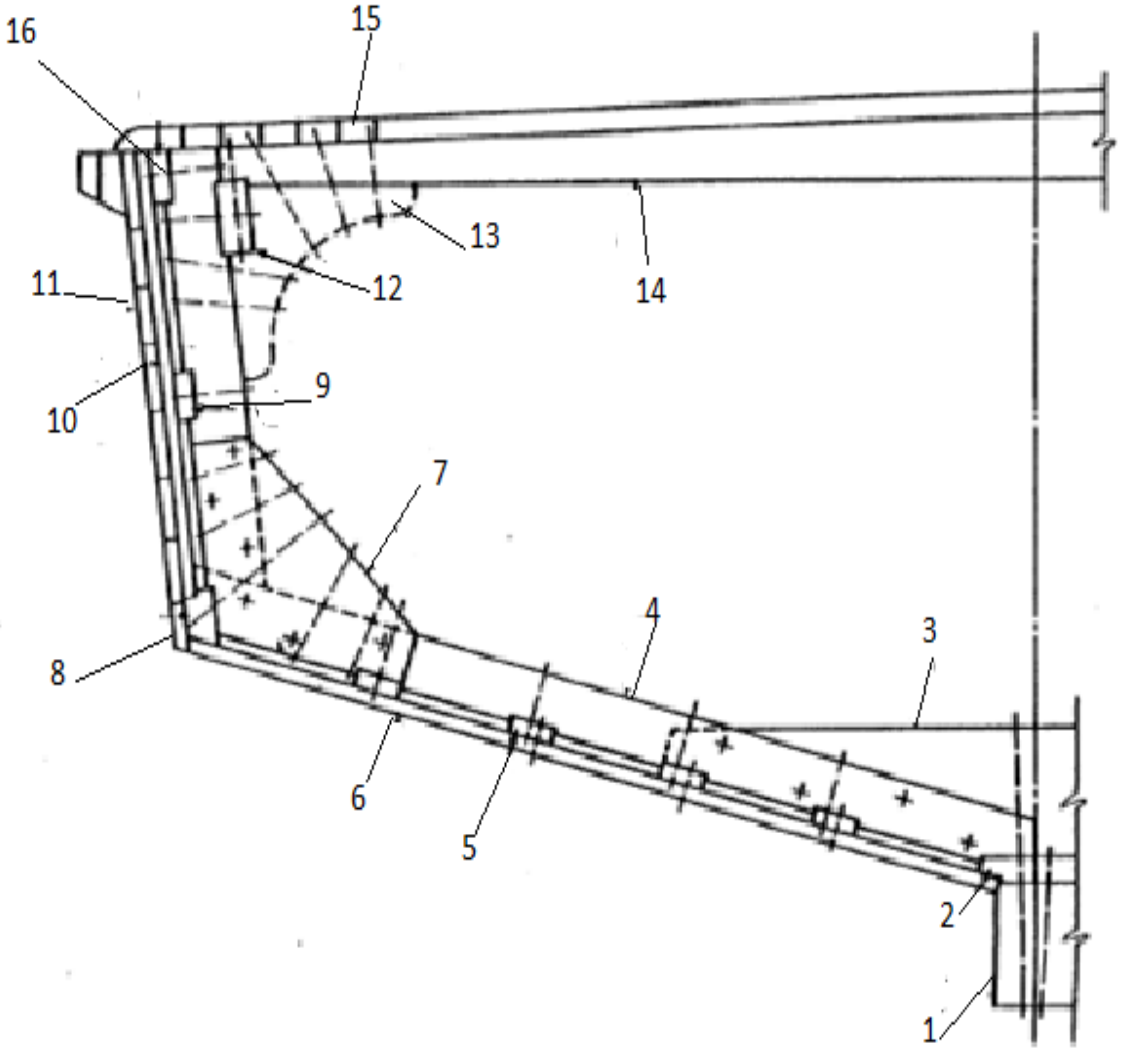



Figure 3: Cross section of a round bilge wooden hull




**Key**:

1. Keel
2. Hog
3. Hitch floor
4. Web frame
5. Bottom stringer
6. Bottom planking
7. Gusset or chock
8. Chine
9. Topside stringer
10. Topside frame
11. Topside planking
12. Beam shelf
13. Hanging knee
14. Deck beam
15. Deck plank
16. Sheer clamp

Figure 4: Typical section Chine Hull

Table 1*** Guidance on the selection of timbers for constructional members (Other type of timber species may be used for different construction members and should meet the requirements for density stated under Table 2)

| SN. | **Construction Members** | **Timber** |
|---|---|---|
| 1 | Keel, false keel, Deadwood, Ballast keel and Hog | Adina<br>Mkongo (East African Afzelia)<br>Muhuhu<br>Nkunya<br>Loliondo<br>Mkwaju<br>Mninga<br>Mwangaa (East African Afrormosia) |
| 2 | Stem | Muninga<br>Mvule<br>Mkongo (East African Afzelia)<br>Teak |
| 3 | Sternpost | Mkongo (East African Afzelia)<br>Mninga<br>Mninga maji<br>Muhuhu<br>Nkunya |
| 4 | Bilge and chine stringer<br>Beam shelf, stringer, Bulkheads and clamp | Mkongo (East African Afzelia)<br>East African Mahogan<br>Mtondoo<br>Mtandarusi<br>Mfimbo<br>Nkunya<br>Mninga<br>Teak |
| 5 | Floors, Engine beds | East African Afrormosia (Mwangaa)<br>Muhuhu<br>Nkunya<br>Knobthom<br>Mkwaju<br>Mninga<br>Teak |
| 6 | Frames | Mkongo (East African Afzelia)<br>Mtanga<br>Mvule<br>Nkunya<br>Mninga<br>Mkoko (Rhizophora mucronata) |
| 7 | Hull planking | Mkongo (East African Afzelia)<br>Muhuhu<br>Nkunya<br>Mninga/ mninga maji<br>Mvule<br>Mtondoo<br>Teak |
| 8 | Deck planking | Mkongo (East African Afzelia)<br>East African mahogany<br>East African Comphorwood<br>Muhuhu |

| SN. | Construction Members | Timber |
|---|---|---|
| | | Mkwaju<br>Mvule<br>Teak |
| 9 | Beams and carlings | Mkongo (East African Afzelia)<br>Muhuhu<br>Nkunya<br>Loliondo<br>Mkwaju<br>Mninga |
| 10 | Knees | Mkongo (East African Afzelia)<br>Muhuhu<br>Nkunya<br>Loliondo<br>Mkwaju<br>Mninga<br>Mkoko (Rhizophora mucronata) |

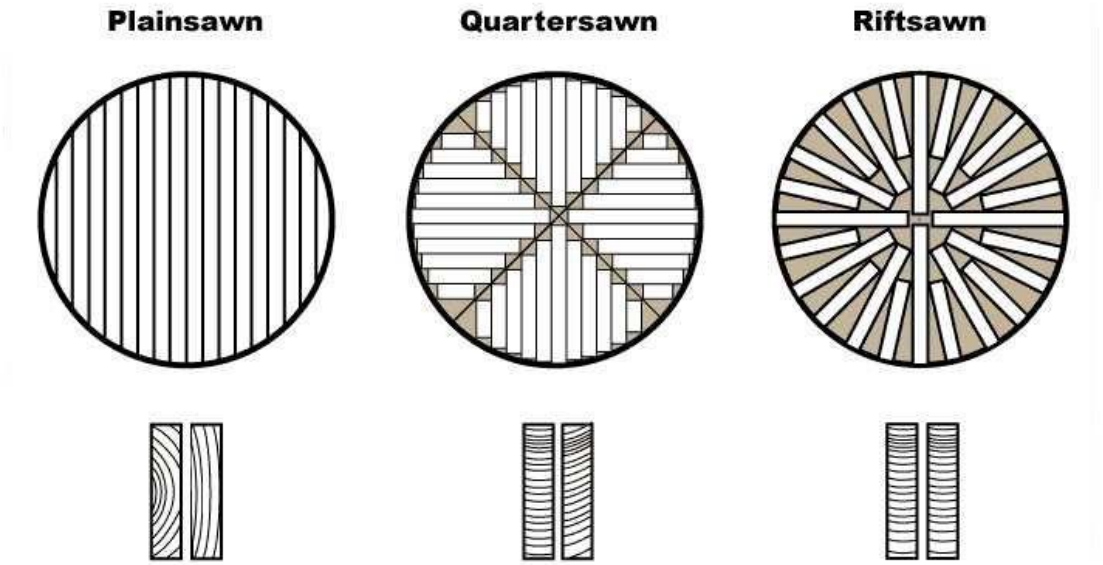
*** The species of timber which may be used for the various constructional members, *see Figure 2, 3* and *4* are given in Tables and Annex A. For woods with local names, one can refer to Annex A to identify the presented name.

**4.3 Timber quality**

**4.3.1** The timber is to be of good quality and properly seasoned and is to be free from heart rot, sapwood, decay, insect attack, splits,checks, shakes and other imperfections which would adversely affect the efficiency of the material. It is also to be generally free from knots, although an occasional sound intergrown knot would be acceptable.

**4.3.2** The timber for the centreline members is to be reasonably seasoned and, where there is a risk of excessive drying-out, it is to be coated with boiled linseed oil or varnish, as soon as erected, to prevent splitting.

**4.3.3** The material for hull and deck planking is to be generally plain grained and, for deck planking, is to be quarter sawn (*see Figure 5*).



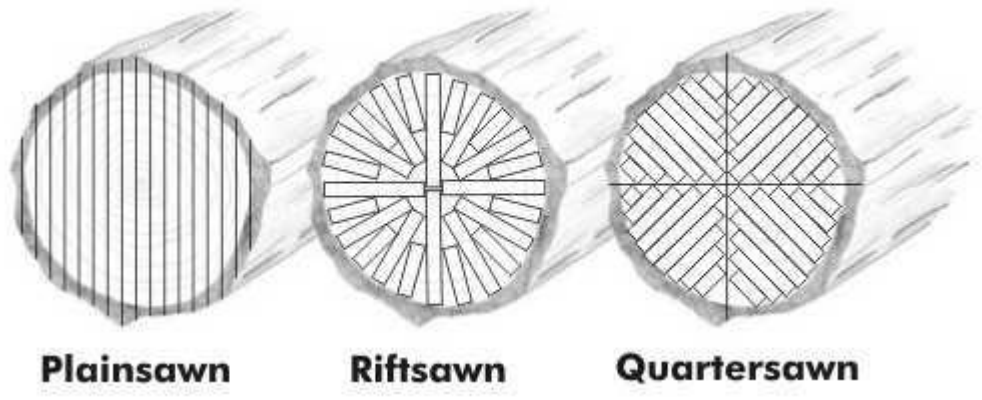



Figure 5: Sawing of Timber

**4.4 Timber moisture content**

**4.4.1** The timber is to be stored under dry conditions and is to have an air-dried moisture content of not more than about 20 % before use. Care is to be taken to avoid excessive drying-out during building.

**4.4.2** The moisture content of material which is to be glued is to be about 15 %. Contents slightly above this value are recommended when resorcinol glues are used, and contents slightly below this value are recommended when phenolic or urea-formaldehyde resins are used. It is recommended that the material to be used in laminating members should be kiln-dried to about 15 %.

**4.4.3** The moisture content of hull and deck planking which is to be sheathed using synthetic resins is to be as low as practicable, to avoid affecting the efficiency of the sheathing bond.

**4.5 Plywood**

**4.5.1** The plywood used in the hull and deck structure is to be of an approved high-grade marine quality with good quality face and core veneers of a durable hardwood species and made with high standards of workmanship in the lay-up and manufacture. The veneers are to be bonded with a WBP (water and boil proof) type adhesive, although in special circumstances an adhesive of slightly lesser durability will be considered. Material complying with BS 1088, or other equivalent specification, is acceptable.

**4.5.2** Plywood sheets are to be stored flat on a level bed and under dry, well-ventilated conditions. The moisture content is not to exceed 15%.

**4.6 Timber preservatives**

**4.6.1** Preservatives are to be of suitable types, either from the waterborne fixed salt group such as copper chrome type to BS 3452 and copper-chrome-arsenic types to TZS 656, or from the organic solvent group, such as naphthenates of zinc and copper and pentachlorophenol. Other types of preservatives will be considered.

**4.6.2** In the selection of type of preservative, due regard should be paid to the effect on varnish and paint coatings, and on synthetic resins, where sheathing is to be applied.

**4.7 Timber adhesives**

**4.7.1** The glues to be used in the construction and lamination of structural members are to be of a gap-filling resorcinol or phenolic type, such as those complying with BS EN 301, or other adhesives which have similar durability and can give a WBP bond.

**4.7.2** The glues are to be mixed and applied in accordance with the manufacturer's instructions with regard to the shop temperature and humidity requirements. Attention is also to be paid to the application techniques for the species of timber being glued, and the manufacturer's advice should be sought in the working of difficult timbers and the effect of preservatives on the adhesive.

**4.8 Metal fastenings**

**4.8.1** The materials used for fastenings are to be a suitable composition of the following metals: -

Copper

Gunmetal

Galvanized iron

Galvanized steel

Silicon bronze

Aluminium bronze

Stainless steel

Monel

**4.8.2** Steel and iron fastenings are to be hot-dipped galvanized, but black iron keel bolts may be coated with a suitable composition. Small screw fastenings below about 20 mm in length which cannot be satisfactorily hot-dipped may be electroplated zinc, provided that the coating is of a reasonable thickness and to an approved specification, such as ISO 2081 Grade Zn 10.

**4.8.3** Stainless steel fastenings are to be of a suitable grade of austenitic steel.

**4.8.4** Gunmetal fastenings may be used, but where increased strength and corrosion resistance is desired, it is recommended that silicon bronze be used. Aluminium bronze may be used, in the larger bolt sizes, where increased strength is desired. Brass fastenings are not to be used for structural purposes.

### 4.9 Other materials

**4.9.1** Other materials intended for structural use are to be of good quality, suitable for the purpose intended. Details of these materials are to be stated on the relevant construction drawings.

**4.9.2** Suitable arrangements are to be made to insulate aluminium alloys from timber and dissimilar metals. Paints containing either lead, mercury or copper are not to be used in conjunction with these alloys.

## 5 Determination of Scantlings

### 5.1 Application and General

**5.1.1** The scantlings of motor, sailing and auxiliary craft of conventional form and proportions, up to the length of 24 meters are to be determined from respective scantling tables.

**5.1.2** The scantlings will be specially considered where the craft is of unusual design, form or proportions or where either the speed exceeds 20 knots or the length exceed 24metres.

**5.1.3** Timber density

The scantlings for the timber members shown in Tables are based on the following standard densities, which are for an air-dried condition of about 15% moisture content: -

Table 2: Standard timber density

| SN. | Construction member | Minimum Density(kg/m$^3$) |
|---|---|---|
| 1 | Frames | 720 |
| 2 | Floors | |
| 3 | Keel | 640 |
| 4 | Stem | |
| 5 | Sternpost | |
| 6 | Deadwood | |
| 7 | Counter timbers | |
| 8 | Hull planking | 560 |
| 9 | Shelves and clamps | |
| 10 | Stringers | |
| 11 | Beams and knees | |
| 12 | Coach roof coamings | |
| 13 | Deck planking | 430 |

**5.1.4** Where the density of the proposed timber differs from the standard density shown in 5.1.3, the tabular siding, *s*, thickness or modulus, $sm^2$, is to be increased or decreased by direct proportion in relation to the ratio of the densities, i.e.



Required siding, thickness or modulus = Tabular siding, thickness or modulus $\times \frac{S}{W}$

Where:

$S$ = the standard density of the timber, in kg/m$^3$

$W$ = the density of the proposed timber, in kg/m$^3$

$m$ = the tabular moulding.

The tabular siding or thickness is, however, not to be decreased by more than 6 %, except where specifically allowed.

**5.1.5** The scantlings of laminate members are to be based on the density of the natural timber and are not to be corrected for the final density in the laminated condition.

**5.1.6** Laminated timber scantlings

Where the centerline assembly, bilge stringers, beam shelves, chine's or beams are of glued laminated construction, the scantlings are to be the same as those determined for solid timber, with the exception of frames and beams as indicated in 5.2.5.3.1 and 5.2.10.1.3, respectively.

**5.2 Scantlings for Round Bilge Vessels**

**5.2.1 Wood keel**

**5.2.1.1** The scantlings of wood keels or, for motor craft, the wood keel and hog are given in Table 3. The Rule moulding is to be maintained throughout but the siding may be tapered towards the ends where it is to be not less than the Rule siding of the stem or sternpost. The scantlings of craft having deep fin keels will be specially considered.

**5.2.1.2** The rabbet for the garboard strake is to have a faying surface not less than twice the thickness of the garboard strake or, for plywood, as given in Table 12

**5.2.1.3** When the length, *L*, does not exceed 10 m the wood keel is to be in one length. In larger craft, the keel should, where possible, be in one length but when a scarph is necessary in the centerline structure it is to have a length, L, not less than 6 times the moulding, *m*, of the item. The scarph is to be of the hooked or tabled type if bolted (*see Figure 6*), or plain type without lips if glued. The depth of the lips is to be about $\frac{1}{4}$ to $\frac{1}{7}$ of the moulding.

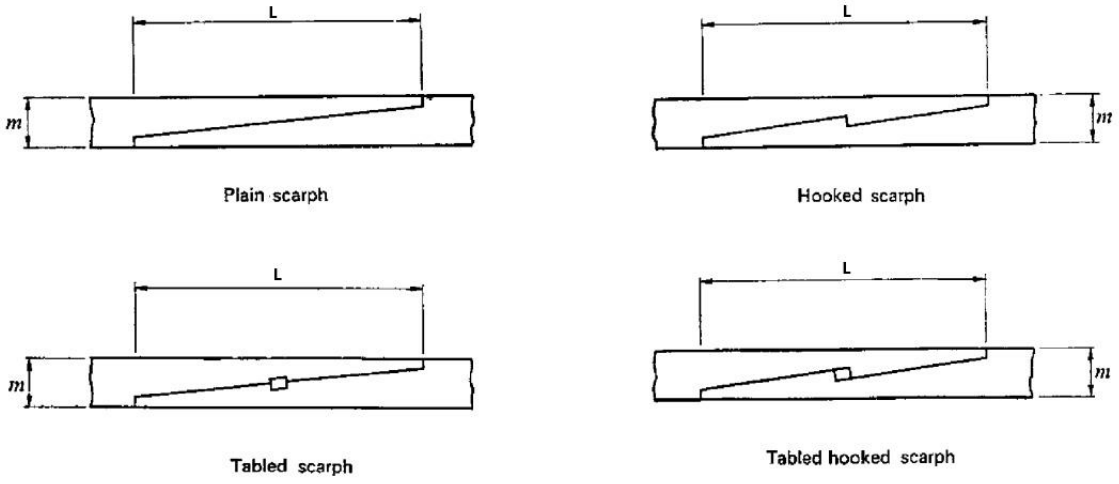



Figure 6: Common types of bolted scarphed joints

**5.2.1.4** Softwood stop waters are to be fitted in bolted scarphs in keels and other centreline structure, in way of plank back rabbet and in other positions where considered necessary by the Surveyor. For typical details, *see Figures.7* and *8.*

**5.2.1.5** Scarphs in the keel and hog are to be at least 1.5m apart and the keel scarph, where fitted, is to be clear of engine seating and, if practicable, of the mast step.

**5.2.1.6** Where the keel is cut for a centreboard the siding is to be increased.

**5.2.1.7** Where a mast passes through the deck, the heel is to be supported by a suitable mast step extending well forward and aft. The step is to be adequately fastened to the floors and to the wood keel



Table 3: Keel, hog, stem, stern post and fastenings for motor, sailing and auxiliary craft

| Length, L, m | Moulding and siding of keel | | | | Siding and moulding of stem at heel, mm | | Siding and moulding of stem at head and sternpost mm | | Diameter of bolts, mm, | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Sailing and auxiliary | | Motor | | | | | | | |
| | Moulding. mm | Siding, mm | Minimum siding of keel, mm | Sectional area of keel or keel and hog, $cm^2$ | Sailing and auxiliary | Motor | Sailing and auxiliary | Motor | Centreline structure | Keel scarph |
| 6 | 75 | 150 | 70 | 80 | 90 | 75 | 75 | 75 | 10 | 8 |
| 8 | 90 | 185 | 80 | 130 | 105 | 90 | 90 | 85 | 10 | 8 |
| 10 | 110 | 220 | 90 | 190 | 120 | 110 | 100 | 95 | 12 | 8 |
| 12 | 125 | 255 | 105 | 250 | 140 | 125 | 115 | 105 | 14 | 10 |
| 14 | 140 | 285 | 115 | 310 | 155 | 140 | 125 | 115 | 14 | 12 |
| 16 | 160 | 320 | 125 | 380 | 170 | 160 | 140 | 125 | 16 | 12 |
| 18 | 175 | 355 | 140 | 450 | 190 | 175 | 150 | 140 | 18 | 12 |
| 20 | 195 | 385 | 150 | 520 | 205 | 195 | 165 | 150 | 20 | 14 |
| 22 | 210 | 410 | 165 | 600 | 220 | 210 | 175 | 160 | 20 | 14 |
| 24 | 230 | 435 | 180 | 690 | 240 | 230 | 190 | 170 | 20 | 14 |

NOTES

1. In motor craft, the moulding of the keel is to be not less than the siding, and the moulding of the hog is to be not less than twice the thickness of the outside planking.
2. The Table scantlings are based on a timber having a standard density of 640 kg/m3 and where timber of a different density is to be used the scantlings are to be modified in accordance with 5.1.4.

**5.2.1.8** Where a wood false keel is fitted abaft the ballast keel a suitable scarph or tenon is to be arranged, *see Figure 8.*

**5.2.1.9** For size of fastenings, *see Table 3.*

**5.2.1.10** Structural arrangements in way of centreboard casing will be specially considered.

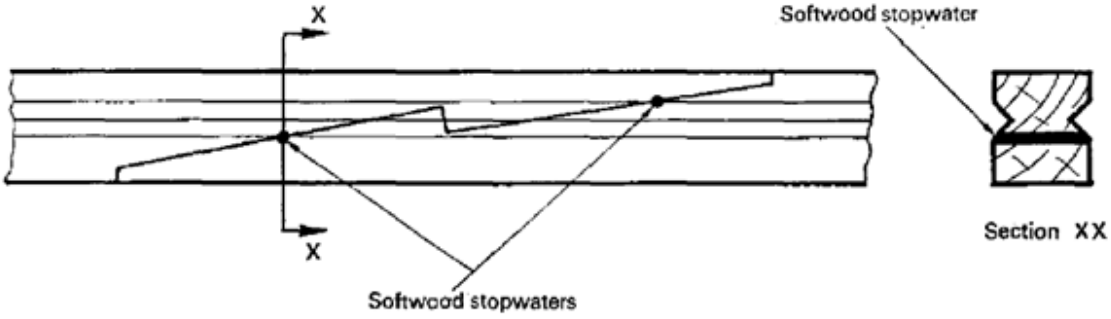



Figure 7: Typical hooked keel scarph showing position of stopwaters

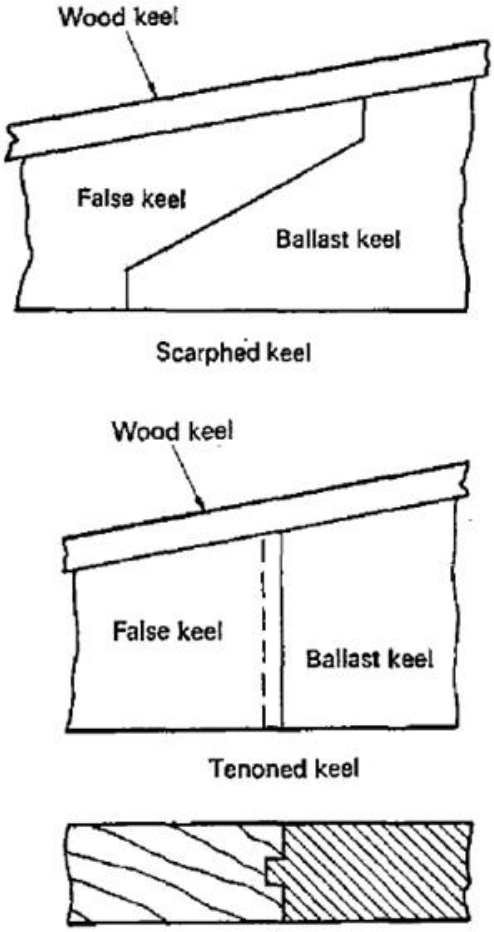



Figure 8: Typical connection of ballast keel to falsekeel

**5.2.2 Stem**

**5.2.2.1** The scantlings of the stem are given in Table 3 and are to be uniformly tapered from head to heel. The scantlings at the heel may be required to be increased, depending on the shape of the forefoot, to enable an adequate scarph to the keel to be arranged, *see Figure 8.*

**5.2.2.2** Where the hull form is such that there is a large radius at the stem head a suitable apron (or fashion pieces) is to be provided to give adequate landing for the outside planking.

**5.2.2.3** For size of fastenings, *see Table 3*.

**5.2.3 Sternpost**

**5.2.3.1** The scantlings of the sternpost are given in Table 3. The sternpost may be tapered to suit the form of the craft but the siding at the after edge of the back rabbet is to be not less than that required by Table 3 and care is to be taken to ensure there is adequate material to take the fastenings of the outside planking.

**5.2.3.2** The lower end of the sternpost is to be tenoned or half-lapped to the keel. An inside deadwood or knee is to be fitted and adequately through fastened to the sternpost, and false keel, if fitted,s*ee Figure 10*.

**5.2.3.3** For size of fastenings, *see Table 3.*

**5.2.4 Counter timber**

**5.2.4.1** The area of the counter timber at its forward end is to be not less than the Rule area of the sternpost and may gradually be reduced to 75 % of this area at its after end.

**5.2.4.2** The counter timber is to be securely fastened to the sternpost and it is recommended that, where practicable, the sternpost should be tenoned or scarphed to the counter timber and through fastened.

**5.2.4.3** For size of fastenings, *see Table 3*

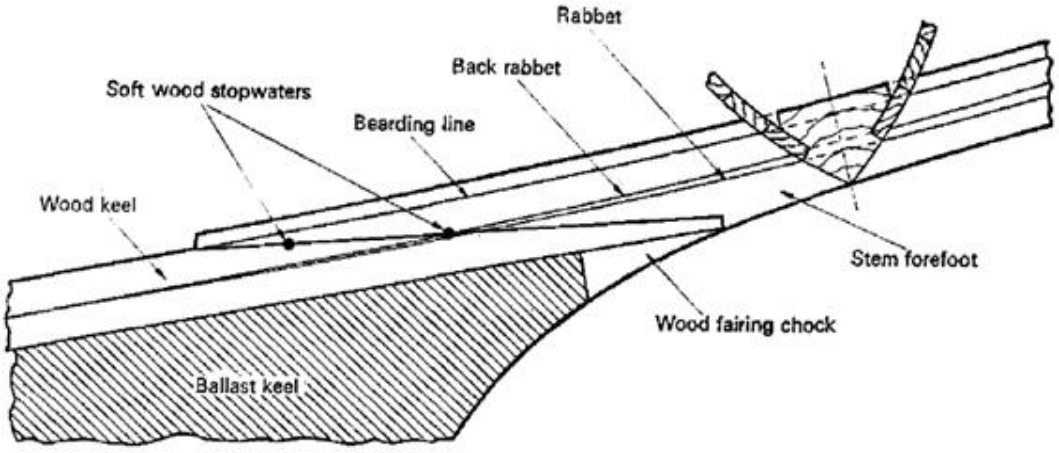



Figure 9: Typical scarph connection stem to woodkeel

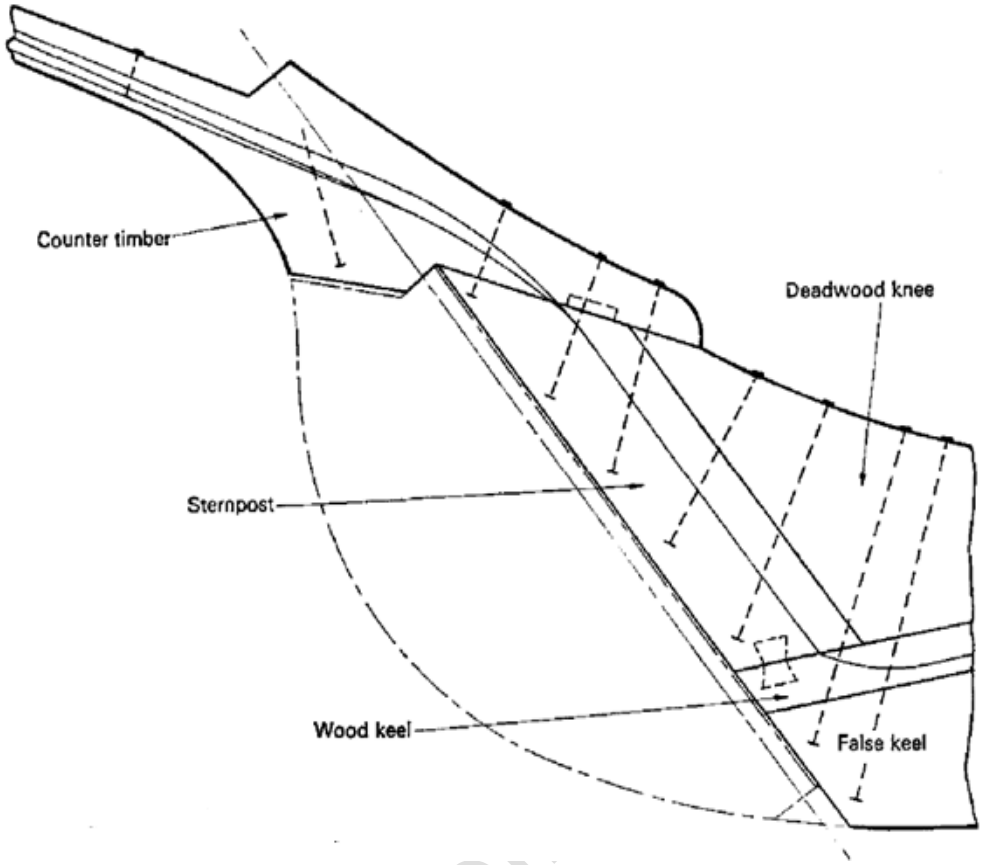



Figure 10: Typical connection of sternpost to keel and counter timber

**5.2.5 Framing**

**5.2.5.1** General

**5.2.5.1.1** The hull is to be provided with an efficient system of side and bottom framing in conjunction with stringers, bulkheads or web frames to provide transverse rigidity.

**5.2.5.1.2** The framing may be arranged transversely or longitudinally or may be a combination of both.

**5.2.5.1.3** All frames are to be bevelled or formed to fay closely against the planking.

**5.2.5.1.4** Where the heels of frames terminate at the centreline construction members they are to be let into and fastened to them unless floors are fitted at every frame.

**5.2.5.2** Types of frames

**5.2.5.2.1** The following types of frames may be used, subject to the limitations given in 5.2.5.2.3 and 5.2.5.2.4: -

Type 1 Bent frames only

Type 2 Grown frames only (Sawn frames)

Type 3 Laminated frames only

Type 4 Steel frames only

Type 5 Grown, laminated or steel frames with 1 bent frame between

Type 6 Grown, laminated or steel frames with 2 bent frames between

Type 7 Grown, laminated or steel frames with 3 bent frames between

**5.2.5.2.2** Alternative framing systems to those in 5.2.5.2.1 will be specially considered.

**5.2.5.2.3** The use of Type 1 is to be confined to craft having a depth, D, not exceeding 3.0 m for sailing and auxiliary or 2.7 m for motor craft, and Types 5, 6 and 7 are to be confined to depths, D, not

exceeding 3.6 m and 3.0 m, respectively.

**5.2.5.2.4** Where the depth, *D,* exceeds 3.6 m for sailing and auxiliary craft or 3.0 m for motor craft the framing must be Type 2, 3 or 4.

**5.2.5.3** Scantlings

**5.2.5.3.1** The scantlings and spacing of the various types of frames are given in Table 4.

**5.2.5.3.2** Where the actual frame spacing of timber frames differs from that given in Table 4 the strength of grown, bent or laminated frames is to be modified in direct proportion, i.e.

$$\text{Actual } (sm^2) = \text{Table } (sm^2) \times \frac{Actual\ spacing}{Table\ spacing}$$

where *s* and *m* are the siding and moulding, respectively; the Table siding is to be that after correction for density. *See 5.1.4.*

**5.2.5.3.3** In no case is the mean moulding of grown, bent or laminated frames to be less than two-thirds of the actual siding except where an increase in the siding is required by 5.2.5.3.6. In all cases the siding is to be suitable for the required fastenings.

**5.2.5.3.4** Where the spacing of steel frames differs from that given in Table 4 the section modulus is to be modified in direct proportion.

**5.2.5.3.5** The scantlings determined from Table 4 are to be maintained for $\frac{3}{5}L$ amidships. Forward of and abaft this region the following reductions may be made: -

| | |
|---|---|
| Bent or laminated frames | Siding reduced by 10 %. |
| Grown frames | Moulding at heel and siding at head and heel reduced by 20 %. |
| Steel frames | Thickness reduced by 10 percent. |

**5.2.5.3.6** In sailing and auxiliary craft, the framing adjacent to the mast is to be increased each side as given below or equivalent arrangements provided: -

| | | |
|---|---|---|
| Type 1: | Bent frames only | Three grown or laminated frames of Type 2 or 3 scantlings *(see Table 4.5.1*) are to be fitted or, alternatively, the siding of three bent frames increased by 60 %. |
| Type 2: | Grown frames only | The siding of three frames increased by 50 % |
| Type3: | Laminated frames only | |
| Type 4: | Steel frames only | Reverse angles or face flats of the size required for plate floors are to be fitted on two frames if *D* does not exceed 3.3 m or on three frames when *D* is 3.3 m or greater. |
| Types 5, 6 and 7: | Grown, laminated or steel frames with bent frames between | The siding of three grown or laminated frames increased by 50 % or reverse angles or face flats fitted to three steel frames |

**5.2.5.3.7** Where internal ballast is fitted the frames may be required to be increased in strength.

**5.2.5.4** Grown frames

**5.2.5.4.1** Grown frames are to be cut to shape from timber having the required curvature of grain.

**5.2.5.4.2** The siding of each grown frame is to be uniform over its length and the moulding is to be a fair taper from heel to head.

**5.2.5.4.3** Grown frames may be butted or scarphed. Scarphs are to be glued and have a length not less than 6 times the siding. Where frames are butted, the butts are to be close fitted and side clamps arranged. The clamps are to have a sectional area not less than that of the frame and a length, not less than 12 times the frame siding. The clamp is to be through fastened to the frame by not



less than three fastenings on each side of the butt and is to fay closely to the planking.

**5.2.5.5** Bent frames

**5.2.5.5.1** The siding and moulding of bent frames are to be uniform over the length of the frame. Each frame is to be in one piece from keel to gunwale and, where the form is suitable, may be continuous from gunwale to gunwale.



Table 4: Frames for Motor. Sailing and Auxiliary Craft

| Depth, D, m | | Type 1 Bent wood frames only | | | Type 2 Grown frame only | | | | Type 3 Laminated frames only | | | Type 4 Steel frames only | | | Type 5, 6, and 7 Combination of grown, laminated and steel frames with intermediate bent wood frames | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Motor | Sailing and auxiliary | Siding, mm | Moulding. mm | Frame Spacing ,mm | Siding, mm | Moulding, mm | | Frame Spacing, ,mm | Siding, mm | Moulding mm | Frame Spacing mm | Frame | | Frame Spacing mm | Intermediate bent wood frame | | Spacing of grown. Laminated or steel frames mm | | |
| | | | | | | At heel | At head | | | | | Scantling mm | Modulus $cm^3$ | | Siding, mm | Moulding mm | One bent frame between Type 5 | Two bent frame between Type 6 | Thee bent frame between Type 7 |
| 1.5 | 1.8 | 24 | 19 | 155 | 24 | 31 | 24 | 205 | 25 | 25 | 205 | 30 x30 x3 | 0.7 | 205 | 25 | 20 | 365 | 470 | 545 |
| 1.8 | 2.1 | 34 | 25 | 170 | 34 | 40 | 31 | 230 | 31 | 34 | 230 | 30 x 30 x 3 | 0.8 | 230 | 31 | 23 | 405 | 505 | 580 |
| 2.1 | 2.4 | 40 | 30 | 185 | 42 | 50 | 37 | 255 | 37 | 43 | 255 | 35 x35 x4 | 1.2 | 255 | 37 | 26 | 440 | 540 | 620 |
| 2.4 | 2.7 | 48 | 36 | 200 | 52 | 61 | 46 | 280 | 43 | 51 | 280 | 45 x45 x4.5 | 2.0 | 280 | 40 | 29 | 475 | 580 | 655 |
| 2.7 | 3.0 | 56 | 40 | 215 | 62 | 74 | 55 | 305 | 50 | 61 | 305 | 50 x50 x5 | 3.0 | 305 | 43 | 33 | 515 | 620 | 695 |
| 3.0 | 3.3 | 65 | 45 | 230 | 72 | 87 | 65 | 330 | 57 | 74 | 330 | 60 x60 x5.5 | 4.9 | 330 | 47 | 37 | 565 | 665 | 745 |
| 3.3 | 3.6 | | | | 81 | 100 | 80 | 355 | 62 | 87 | 355 | 65 x65 x 8 | 7.9 | 355 | 50 | 43 | 620 | 725 | 800 |
| 3.6 | 3.9 | | | | 90 | 117 | 98 | 380 | 69 | 105 | 380 | 75 x 65 x 8.5 | 11.5 | 380 | | | | | |
| 3.9 | 4.2 | | | | 100 | 140 | 117 | 405 | 78 | 126 | 405 | 85 x65 x 8.5 | 14.6 | 405 | | | | | |

NOTES

1. For Imitation on use of Types 1, 5, 6 and 7, *see 5.2.5.2.3* and 5.2.5.2.4
2. The Table scantlings of timber frames are based on a timber having a standard density of 720 kg/$m^3$, and where timber of a different density is to be used the scantlings are to be modified in accordance with 5.1.4.
3. The frame spacing given in the Table is measured from centre to centre or, for steel frames, from heel to heel of angles.
4. Where the spacing differs from that given in the Table, the value of s$m^2$ (or, for steel frames. the section modulus) is to be modified in direct proportion.
5. Where Types 5, 6 and 7 are adopted, the scantlings of the grown, laminated, or steel frames are to be as required for Types 2, 3 or 4. respectively.

**5.2.6 Floors**

**5.2.6.1** General

**5.2.6.1.1** Wood floors are to be cut from timber having a suitable grain or may be laminated.

**5.2.6.1.2** Where, at the ends, the frames are continuous across the centreline structure, floors are not required but, where practicable, the frames are to be attached to the centreline structure by two through fastenings.

**5.2.6.1.3** Limber holes are to be provided in the bottom structure as required for efficient drainage of the craft.

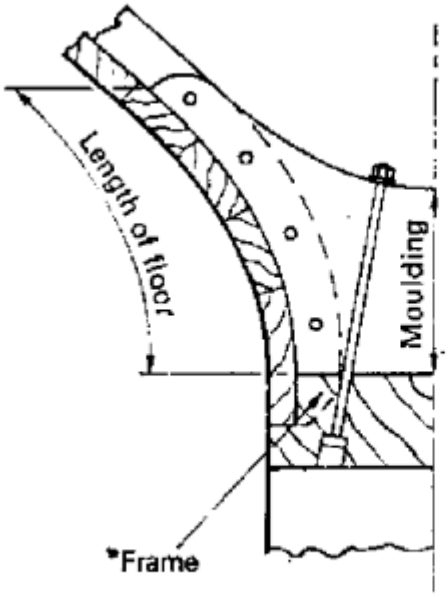
**5.2.6.2** Type of floors

**5.2.6.2.1** The type of floor to be fitted is dependent on the frame type adopted as follows; -

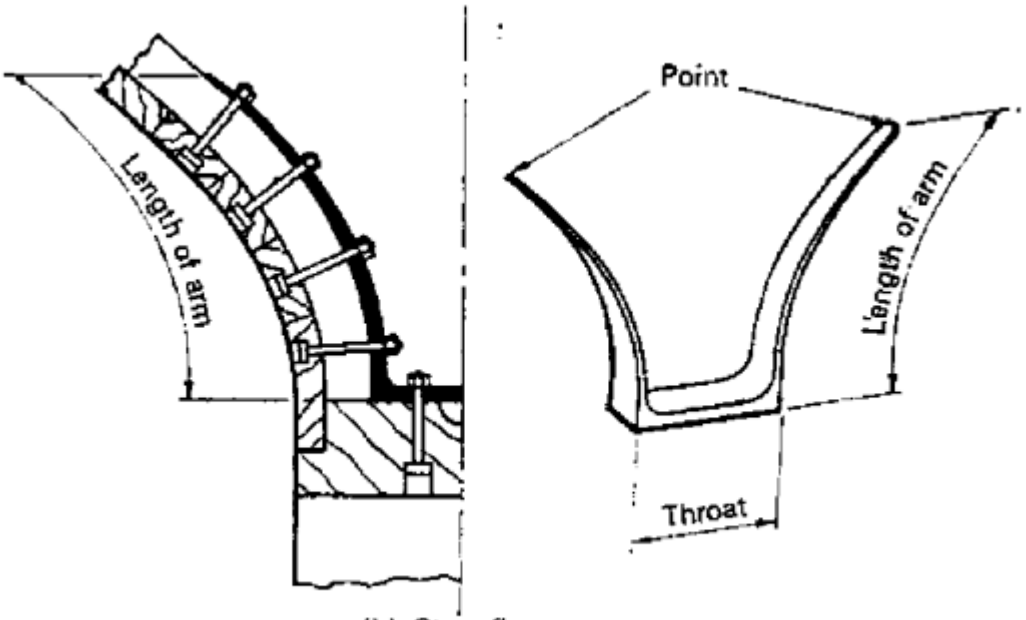
| | | |
|---|---|---|
| Type 1: | Bent frames *only* | (a) Strap floors on every frame within *3/5 L* amidships (on alternates if *D* does not exceed 2.7 m for sailing and auxiliary craft or 2.4 m for motor craft) and on every third frame forward and aft. |
| | | (b) Angle floors spaced as for strap floors in (a). |
| | | (c) Where *3/5 L* amidships falls within the waterline length floors are to be on alternates to end of waterline. |
| | | (d) The fitting of wood floors in association with bent frames will be specially considered. |
| Type 2: | Grown frames *only* | (a) Wood floors on every frame. |
| Type 3: | Laminated frames *only* | (b) Steel floors on every frame. |
| | | (c) Strap floors on every frame. |
| | | (d) Angle floors on every frame. |
| Type 4: | Steel frames only | (a) Steel plate floors at every frame. |
| Types 5 and 6: | Grown, laminated or steel frames with l or 2 bent frames | (a) On grown and laminated frames as for Type 2. |
| | | (b) On steel frames as for Type 4. |
| | | (c) On bent frames as for Type 1 within 3/5L amidships. If *D* does not exceed 2.4 m no floors are required on bent frames outside 3/5L amidships. |
| Type 7: | Grown, laminated or steel frames with 3 bent frames | (a) As for Types 5 and 6 but a floor as required for Type 1 is to be fitted to the middle-bent frame. |



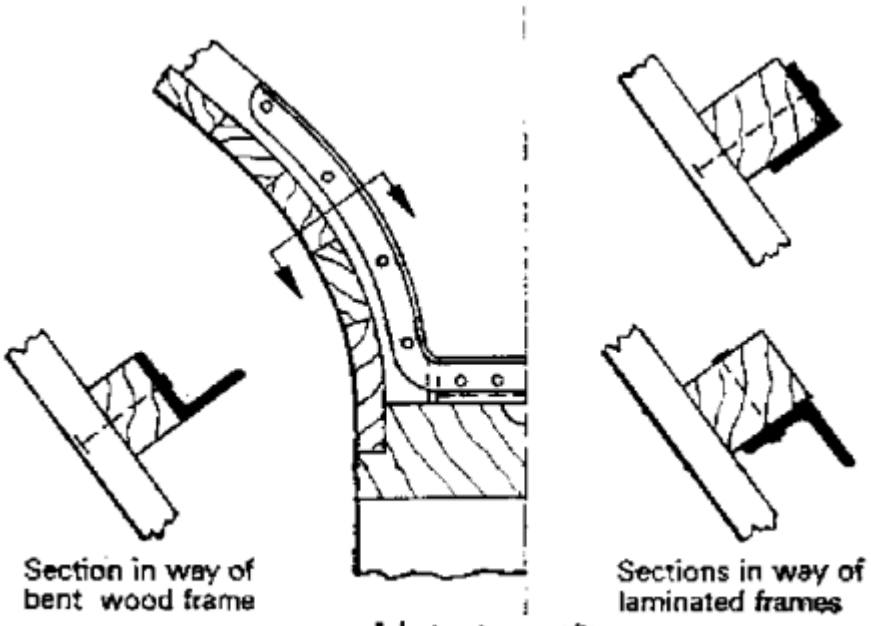
 




(a) Wood floor




(b) Strap floor



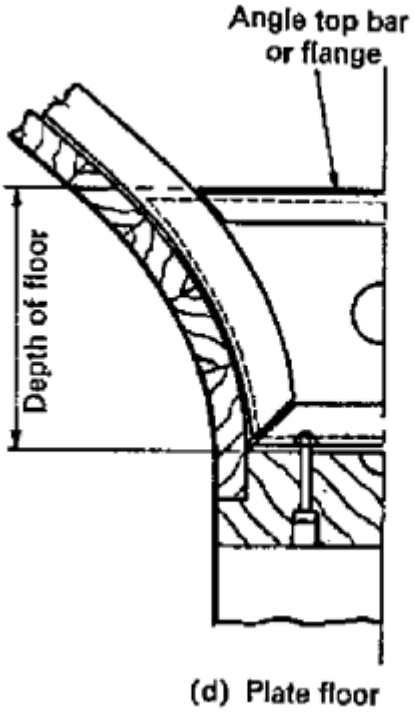




Figure 11: Typical floors

*To be checked into centreline member where required by 5.2.5.1.4

**5.2.6.3** Scantlings and construction

**5.2.6.3.1** The scantlings of floors are to be as given in Table 5 and the lengths of arms, etc., are to be

measured as shown in figure 11. At the ends of the craft the length of arms need not exceed one-third the length of the frame.

**5.2.6.3.2** The cross-sectional area at the ends of the arms is to be not less than half that given in Table 5 for the middle line.

**5.2.6.3.3** Where bolts attaching the ballast keel pass through wood floors, the siding of the floors for the breadth of keel is to be not less than 3 times the bolt diameter. It may be tapered to the Rule siding at the ends of the floors.

**5.2.6.3.4** Angle steel floors are to be fitted on top of bent frames and it is recommended that this arrangement be adopted when angle floors are fitted to grown frames.

**5.2.6.3.5** Where angle floors are fitted to grown frames it is recommended that they be fitted so that the frame fits into the bosom of the angle with a lug fitted to take the throat fastening.

**5.2.6.3.6** Steel plate floors are to be stiffened at the upper edge with a reverse angle, face flat or a flange having the same breath as the Rule angle. The thickness of flanged floors is to be increased by 10 %. The bottom angle in way of the keel is to be 2.5 mm thicker than the floor, and its flange is to be sufficient to take the ballast keel bolts or throat fastenings.

**5.2.6.3.7** In the machinery space of motor craft, steel plate floors are to be stiffened at the upper edge with a face flat and the thickness of the floors increased by 1 mm above that required by Table 5.

Table 5: Floors for motor, sailing and auxiliary craft

| Depth, D. m | | Floors on grown or laminated frames | | | | | | | Floors on bent wood frames | | | | Steel plate floors on grown or steel frames, mm | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Motor | Sailing and auxiliary | Length of arms. mm | | Strap floors. mm | | Wood floors at middle line | | Steel angle bar mm | Length of arms mm | Strap floors. mm | | Steel angle bar mm | For 3/5L amid-ship | At ends beyond 3/5L amid-ship |
| | | For 3/5L amid-ship | Beyond 3/5L amid-ship | At throat | At point | Moulding mm | Siding mm | | | At throat | At point | | | |
| 1.5 | 1.8 | 380 | 250 | 25 xl0 | 20 x 10 | 55 | 25 | 30 x30 x5 | 250 | 25 x 6 | 15 x 6 | 25 x 25 x 5 | 150 x3 | 110 x3 |
| 1.8 | 2.1 | 430 | 300 | 35 x 13 | 30 x10 | 75 | 35 | 35 x35 x6 | 300 | 25 x 9 | 17 x 6 | 25 x 25 x 5 | 190 x3 | 140 x 3 |
| 2.1 | 2.4 | 480 | 350 | 45 x 16 | 40 x10 | 95 | 45 | 45 x45 x5 | 350 | 25 x12 | 19 x 6 | 30x30x5 | 230 x4 | 170x4 |
| 2.4 | 2.7 | 530 | 390 | 50 x 19 | 45 x 10 | 115 | 55 | 50 x50 x5 | 390 | 27 x12 | 21 x 6 | 35 x35 x5 | 260 x4 | 190 x4 |
| 2.7 | 3.0 | 580 | 430 | 55 x22 | 50 x 12 | 135 | 62 | 55 x55 x6 | 430 | 29 x 15 | 24 x6 | 40 x40 x4 | 280 x4 | 210 x4 |
| 3.0 | 3.3 | 630 | 480 | 62 x25 | 53 x 14 | 155 | 70 | 65 x65 x7 | 480 | 32 x16 | 26 x6 | 40 x40 x4 | 300x5 | 230 x4 |
| 3.3 | 3.6 | 680 | 530 | 70 x28 | 56 x 16 | 170 | 80 | 75 x75 x7 | 530 | 35 x17 | 29 x6 | 40 x40 x4 | 320 x5 | 240 x4 |
| 3.6 | 3.9 | 730 | 570 | 75 x 31 | 60 x 18 | 185 | 90 | 80x80x7 | - | - | - | - | 340 x6 | 250 x5 |
| 3.9 | 4.2 | 780 | 620 | 80 x31 | 63 x20 | 200 | 100 | 90x75 x7 | - | - | - | - | 360 x6 | 260 x5 |

NOTE

The Table scantlings of timber floors are based on a timber having a standard density of 720 kg/m$^3$ and where timber of a different density is to be used the scantlings are to be modified in accordance with 5.1.4

Table 6: Floor fastenings for motor, sailing and auxiliary craft

| Depth, D, mm | | Diameter of bolts in throat, mm | | Diameter of bolts at arms, mm | |
|---|---|---|---|---|---|
| Motor | Sailing and auxiliary | Grown laminated or steel frame | Bent frame | Grown laminated or steel frame | Bent frame |
| 1.5 | 1.8 | 8 | 6 | 6 | 6 |
| 1.8 | 2.1 | 10 | 8 | 8 | 6 |
| 2.1 | 2.4 | 12 | 8 | 8 | 6 |
| 2.4 | 2.7 | 12 | 10 | 10 | 8 |
| 2.7 | 3.0 | 14 | 12 | 12 | 8 |
| 3.0 | 3.3 | 18 | 12 | 12 | 10 |
| 3.3 | 3.6 | 20 | 12 | 12 | 10 |
| 3.6 | 3.9 | 20 | - | 14 | - |
| 3.9 | 4.2 | 20 | - | 16 | - |

NOTES
1. Throat to keel; not less than 2 bolts (*see 5.2.6.4.3*).
2. Arms to frames:
3. Bolts when arm length does not exceed 250 mm,
4. Bolts when arm length exceeds 250 mm.

**5.2.6.4** Fastenings

**5.2.6.4.1** The size of the floor fastenings are to be as given in Table 6.

**5.2.6.4.2** There are to be not less than three fastenings in each arm where the length of arm does not exceed 250 mm or four when the arm is 250 mm or greater.

**5.2.6.4.3** The throat is to be attached to the wood keel by not less than two through bolts where practicable.

**5.2.7 Beam shelf and clamp, bilge stringers, breast hooks and bottom girders**

**5.2.7.1** Beam shelf

**5.2.7.1.1** The cross-sectional area of beam shelf for 3/5L amidships is to be as given in Table 7. Outside this length the area may be gradually reduced to the ends where it may be 25 % less than that amidships.

**5.2.7.1.2** The area of beam shelf determined from Table 7 is to be that clear of beams; the section removed for the beam end is not to impair the efficiency of the shelf.

**5.2.7.1.3** Where the beam shelf is not fitted in one length, a plain glued scarph is to be arranged. Scarphs are to be suitably positioned in relation to joints in other longitudinal members and to hanging knees, etc. The face of the scarph is generally to be in the vertical plane.

**5.2.7.1.4** Where there is a raised deck, it is recommended that the main beam shelf be carried to the ends. Where, however, this is not done suitable arrangements are to be made to maintain the longitudinal continuity of the shelf, and the frame scantlings in way may be required to be increased.

**5.2.7.1.5** The beam shelf is to be attached to each frame by one through fastening where the moulding of the shelf does not exceed 180 mm and by two through fastenings where the moulding exceeds 180mm. The size of fastenings is given in Table 7.

**5.2.7.1.6** Where the framing is of Type 5, 6 or 7 (*see 5.2.5.2.1*), chocks are to be fitted between the intermediate bent frames and the shelf.

**5.2.7.1.7** Lugs are to be fitted to steel frames to take the shelf fastenings.

**5.2.7.1.8** Where steel frames are fitted in association with steel beams, a beam shelf is not required but a deck stringer plate; a sheer strake and a stringer angle of the scantlings given in the Table 15 are to be fitted. Beam knees are also to be provided in accordance with 5.2.10.5.2.

**5.2.7.1.9** For size of fastenings, *see Table 7.*

**5.2.7.2** Beam clamp

**5.2.7.2.1** In way of the mast in sailing and auxiliary craft, a clamp is to be fitted to the inboard side of the shelf with its upper surface faying closely to the underside of the beams. Alternatively, the clamp



may be fitted below the shelf and it is to fay closely to the shelf and to the frames.

**5.2.7.2.2** The length of the clamp is generally to be not less than the breadth of the craft in way of the mast, and its cross-sectional area is to be not less than 75 % of the beam shelf area at the centre and may be tapered to 50 % of this section at the ends.

**5.2.7.2.3** The clamp is to be through fastened to the beams or frames as appropriate

**5.2.7.2.4** Where steel construction is adopted, *see 5.2.10.5.6.*

**5.2.7.3** Bilge stringer

**5.2.7.3.1** A bilge stringer is to be fitted where the framing is Type 1 (bent only) or Type 7 (three bents between grown, laminated or steel), or where the length, *L,* exceeds 9.0 m for Types 2, 3, 5 and 6. For steel construction (Type 4), *see 5.2.7.3.9*

**5.2.7.3.2** The cross-sectional area of bilge stringers for 3/5L amidships is to be as given in Table 7. Outside this length the area may be gradually reduced to the ends where it may be 25 % less than amidships. The greatest dimension of the stringer is to be fitted against the frames.

**5.2.7.3.3** Scarphs in the port and starboard stringers are to be staggered and suitably positioned in relation to joints in other members. The face of the scarph in the stringer is to be cut parallel to the frames.

**5.2.7.3.4** Stringers are to be attached to each frame by one through fastening where the moulding of the stringer does not exceed 180 mm and by two through fastenings when the moulding exceeds 180 mm.

**5.2.7.3.5** Where the framing is of Type 5, 6 or 7 (5.2.5.2.1), chocks are to be fitted between the intermediate bent frames and the stringer.

**5.2.7.3.6** Lugs are to be fitted to steel frames to take the stringer fastenings.

**5.2.7.3.7** As an alternative to the fitting of a bilge stringer two or more side stringers may be fitted. Where two side stringers are fitted the cross-sectional area of each is to be not less than 60 % of the Rule area for the bilge stringer.

**5.2.7.3.8** For size of fastenings, *see Table 7*.

**5.2.7.3.9** For bilge stringers, etc., in steel construction, the arrangements are to be as follows: -

(a) Where the framing is Type 4 (steel frames) a bilge stringer is to be fitted where the depth from top of floor to deck at side amidships exceeds 2.4m unless a cabin deck is fitted.

(b) A side keelson is to be fitted when the half-breadth at the top of the floor amidships exceeds 2.4 m.

(c) The scantlings of the bilge stringer and side keelson are given in Table 7. These are to extend as far forward and aft as practicable.

(d) Bilge stringers and side keelsons are to be welded to the frames or attached by frame lugs with not less than two rivets.

Table 7: Beam shelf and bilge stringer scantlings and fastenings for motor, sailing and auxiliary craft

| **Length, L, m** | **Cross-sectional area of beam-shelf, cm²** | | **Cross-sectional area of bilge stringer, cm²** | | **Diameter of bolts, mm,** | | | **Steel side keelson and bilge stringer angles, mm** |
|---|---|---|---|---|---|---|---|---|
| | **Sailing and auxiliary** | **Motor** | **Sailing and auxiliary** | **Motor** | **Arms of breast-hook** | **Beam shelf stringers** | **Hanging knees** | |
| 6 | 29 | 32 | 25 | 22 | 8 | 6 | 6 | |
| 8 | 40 | 40 | 32 | 29 | 8 | 6 | 6 | |
| 10 | 50 | 50 | 40 | 35 | 8 | 6 | 6 | |
| 12 | 70 | 60 | 50 | 50 | 10 | 8 | 8 | |
| 14 | 90 | 80 | 65 | 60 | 12 | 8 | 8 | 60 x60 x 4.0 |
| 16 | 110 | 100 | 80 | 70 | 12 | 8 | 8 | 60 x60 x 5.5 |
| 18 | 130 | 110 | 90 | 85 | 12 | 10 | 10 | 65 x65 x 6.5 |
| 20 | 150 | 130 | 105 | 100 | 14 | 12 | 12 | 75 x65 x 5.5 |
| 22 | 170 | 150 | 120 | 110 | 14 | 12 | 12 | 75 x 65 x 6.5 |
| 24 | 190 | 170 | 140 | 125 | 14 | 12 | 12 | 75 x 65 x 7.0 |



NOTE

The Table scantlings for the beams shelf and bilge stringer are based on a timber having a standard density of 560 kg/m$^3$ and where timber of a different density is to be used the scantlings are to be modified in accordance with 5.1.4.

**5.2.7.4** Breast hooks

**5.2.7.4.1** The beam shelf and stringer ends are to be efficiently attached to the centreline construction. Breast hooks and transom quarter knees are to be fitted as necessary.

**5.2.7.4.2** The ends of the craft are to be suitably strengthened, and particular attention is to be given to this where there is a large overhang.

**5.2.7.4.3** For size of fastenings, *see Table 7*.

**5.2.7.5** Bottom girders

**5.2.7.5.1** The engine seating's are to be of substantial construction to suit the power of the machinery.

**5.2.7.5.2** The longitudinal girders forming the engine seating's are to extend as far forward and aft as practicable and are to be adequately supported by transverse floors and/or brackets.

**5.2.7.5.3** Additional side girders may be required in the machinery space and in the bottom of the craft forward.

**5.2.8 Watertight Bulkheads**

**5.2.8.1** General

**5.2.8.1.1** Every vessel shall be provided with watertight bulkheads as required by Regulation 36 of Merchant Shipping (Small ships, Local Cargo Ship Safety, Small Ship Safety, Surveys and Inspection for Vessels Engaged on Local and Coastal Voyages, Inland Waters).

Regulation 36:

Subdivision of passenger vessels and certain cargo-passenger vessels
(1) On:
(a) passenger vessels 20m and above in length; and
(b) passenger vessels and cargo-passenger vessels less than 20m in length, that are certified to carry 50 passengers or more and to operate in open waters;

**5.2.8.1.2** Watertight bulkheads may be constructed of timber or steel. Other materials shall be subject to special consideration by the overseeing authority.

**5.2.8.1.3** Watertight bulkheads shall be pierced to the least possible extent, and where they are pierced proper steps shall be taken to maintain their watertight integrity.

**5.2.8.2** Timber Bulkheads

**5.2.8.2.1** Timber bulkheads shall be constructed to the scantlings shown in Table 8. Such bulkheads shall have vertical stiffeners fastened into the grounds and to the deck beams.

**5.2.8.2.2** The timber grounds shall be bedded into non-setting mastic or other material approved for this purpose and be through fastened to the hull planking.

**5.2.8.2.3** The planking on timber bulkheads may be fitted either into rabbets or on to the face of the bulkhead grounds. It may also be fastened to the face of deep or web frames where such frames are fitted and fastened to the hull planking and are not less in size than the scantlings for web frames.

**5.2.8.2.4** Planked bulkheads shall be laid diagonally with two equal thicknesses having a material acceptable to the Authority between these layers.

Table 8: Timber bulkheads

| | Planking | | Stiffener | | |
|---|---|---|---|---|---|
| Height of bulkhead | Double planked | Ply- wood | Stiffener spacing | Moulding | Siding |
| m | mm | mm | mm | mm | mm |
| 1.0 | 20 | 10 | 400 | 70 | 35 |
| 1.5 | 30 | 15 | 400 | 85 | 45 |



| | Planking | | Stiffener | | |
|---|---|---|---|---|---|
| Height of bulkhead | Double planked | Ply- wood | Stiffener spacing | Moulding | Siding |
| 2.0 | 40 | 20 | 400 | 100 | 55 |
| 2.5 | 50 | 25 | 450 | 115 | 65 |
| 3.0 | 60 | 30 | 450 | 135 | 75 |
| 3.5 | 70 | 35 | 450 | 150 | 85 |
| 4.0 | 80 | 40 | 450 | 165 | 95 |

NOTES
1. The height of the bulkhead is to be measured from the top of the keel to the underside of the deck beam at the centre line of the vessel.
2. Where stiffener spacing differs from the basic stiffener spacing shown in the Table planking thickness shall be increased and may be decreased for every increase or decrease respectively in the resulting span between stiffeners as follows:
   (i) Planking-3 mm per 30 mm difference
   (ii) (ii) Plywood-3 mm per 50 mm difference.
3. If the stiffener spacing shown in the table is not used then the stiffener scantlings are to be adjusted by maintaining the section modulus of stiffener per millimetre of stiffener spacing
4. In the case of a collision bulkhead the table planking thickness is to be increased by 25 % and the section modulus of the stiffener is to be not less than 1.25 times the table modulus.
5. Where collision bulkhead stiffeners are glued and fastened to the bulkhead, the required increase, based on the section modulus will be specially considered.

**5.2.8.3** Steel Bulkheads

**5.2.8.3.1** The scantlings of steel watertight bulkheads are given in Table 9.

**5.2.8.3.2** In collision bulkheads the spacing of stiffeners is to be not greater than 460 mm,

**5.2.8.3.3** At the level of the decks below the upper deck, angles or flats are to be suitably attached to the bulkheads for taking the fastenings of the wood deck.

**5.2.8.3.4** Steel bulkheads are to be attached to wood frames of the size required for grown frames or to a boundary angle of the size required for steel frames.

Table 9: Bulkhead plating and stiffeners for motor, sailing and auxiliary craft

| **Bulkhead plating and spacing of stiffeners** | | | **Stiffeners with free ends** | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Depth of bulkhead at middle line** | **Thickness of plating, mm** | **Spacing of stiffener, mm** | **Overall length of stiffener, m** | **Height of upper deck above top of stiffener, m** | | | | |
| | | | | **0** | **0.6** | **1.2** | **1.8** | **2.4** |
| | | | | **Modulus, cm$^3$** | | | | |
| 1.5 | 2.5 | 300 | 1.5 | 2.5 | 4.6 | 6.6 | 8.7 | 11.0 |
| 1.8 | 3.0 | 325 | 1.8 | 4.8 | 8.0 | 11.0 | 14.0 | 17.0 |
| 2.1 | 3.5 | 350 | 2.1 | 8.0 | 13.0 | 17.0 | 22.0 | 27.0 |
| 2.4 | 4.0 | 375 | 2.4 | 13.0 | 20.0 | 26.0 | 33.0 | 39.0 |
| 2.7 | 4.5 | 400 | 2.7 | 20.0 | 29,0 | 37.0 | 46.0 | 55.0 |
| 3.0 | 5.0 | 425 | 3.0 | 29.0 | 40.0 | 52.0 | 63.0 | 75.0 |
| 3.3 | 5.0 | 450 | 3.3 | 40.0 | 55.0 | 70.0 | 85.0 | - |
| 3.6 | 5.5 | 475 | 3.6 | 56.0 | 75.0 | 93.0 | - | - |
| 3.9 | 5.5 | 500 | 3.9 | 75.0 | 98.0 | 120.0 | - | - |
| 4.2 | 6.0 | 525 | 4.2 | 98.0 | 125,0 | - | - | - |
| 4.5 | 6.0 | 550 | 4.5 | 125.0 | 160.0 | - | -- | -- |
| 4.8 | 6.5 | 575 | 4.8 | 160.0 | - | - | - | - |

NOTES
1. When the spacing of stiffeners differs from that given in the table, the thickness of the plating is to be modified at the rate of 0.5 mm for each 100 mm difference in spacing. The modulus of the stiffeners is to be modified in direct proportion to the stiffener spacing.
2. The moduli given in the Table are for unbracketed stiffening sections in association with plating.
3. Where stiffening sections are bracketed at the top and bottom the Table modulus, corrected in accordance with Note 1, is to be multiplied by the factor, $F_t$ determined from the following formula:-



$$F_t = 0.8 - \frac{h}{3.75(h+l)}$$

where

*h* = height of upper deck above top of stiffener in metres.

*l* = length of stiffener, in metres.

**5.2.9 Hull planking**

**5.2.9.1** General

**5.2.9.1.1** The outside planking may be single skin (carvel or clinker), strip, double skin, single skin plywood or cold moulded laminations.

**5.2.9.1.2** The thickness for single skin carvel or strip construction is to be as given in Table 10.

Table 10: Outside and deck planking for motor,sailing and auxiliary craft

| Length, *L*, m | Basic thickness, mm |
|---|---|
| 6 | 19 |
| 8 | 21.5 |
| 10 | 24 |
| 12 | 28 |
| 14 | 32 |
| 16 | 36 |
| 18 | 39 |
| 20 | 41.5 |
| 22 | 43.5 |
| 24 | 45.5 |

NOTES

1. The Table thicknesses of outside and deck planking are based on a timber having a standard density of 560 kg/m$^3$ and 430 kg/m$^3$ respectively, and where timber of a different density is to be used the thickness is to be modified in accordance with 5.1.4.
2. For frame and beam spacing corrections, *see 5.2.9.1.3* and *5.2.11.1.3*. respectively.
3. The basic thicknesses are applicable to single skin carvel or strip outside planking and to a laid deck. For corrections for other types of construction, *see 5.2. 9.1.4* for outside planking and 5.2.11.1.5, 5.2.11.1.6 and 5.2.11.1.7 for deck planking.

**5.2.9.1.3** Where the frame spacing differs from that given in Table 5 the thickness of planking determined from Table 9 is to be modified as follows:-

| | | |
|---|---|---|
| Type 1: | bent frames | 1.5 mm per 25 mm difference |
| | Other frame types | 1.5 mm per 38 mm difference |

**5.2.9.1.4** The thickness determined from Table 9, after correction for frame spacing and, except for plywood, density of timber, may be reduced for the type of planking as follows:-

| | |
|---|---|
| Clinker | 10 percent |
| Diagonal double skin | 10 percent |
| Cold moulded laminate | The reduction will depend on the framing or stiffening system adopted and will be a maximum of 25 % |
| Single skin plywood | |

**5.2.9.2** Single skin

**5.2.9.2.1** Butts of the outside planking are to be spaced not less than 1.2 m apart and no butts are to be in the same frame space unless there are three strakes between, *see Figure 12*. The arrangement of butts at the ends of the craft is to be to the Surveyor's satisfaction.

**5.2.9.2.2** The butts in the garboard strake are to be kept clear of the keel scarph. Butts in the sheer strake are to be clear of butts in the covering board.



**5.2.9.2.3** Butts in the planking are to be strapped or scarphed.

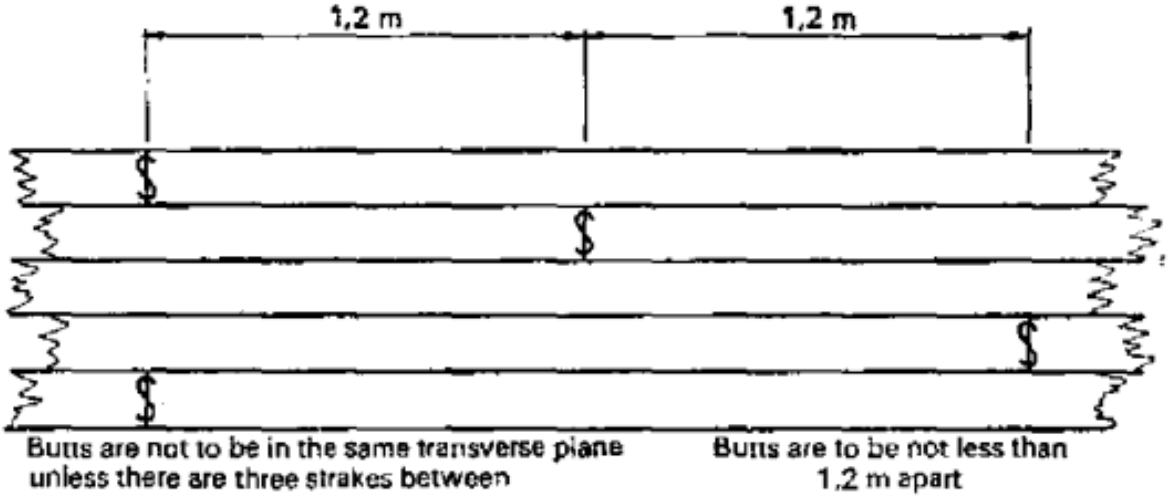



Figure 12: Spacing of butts

**5.2.9.2.4** Wood or metal butt straps are to be arranged between the frames but a drainage space is to be left between the strap and the frame. The breadth is to be sufficient to overlap the adjacent planks by about 12 mm.

**5.2.9.2.5** Wood butt straps are to have the same thickness as the planking. Metal straps are to be not less than 1/6 of the planking thickness, *see Figure 13*.



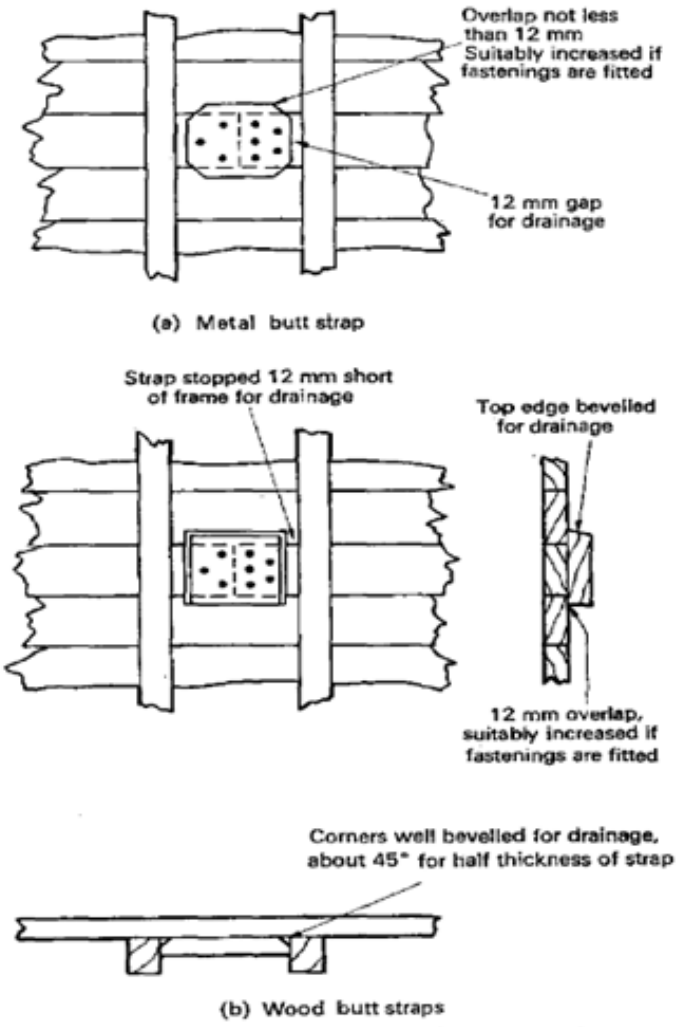



Figure 13: Typical butt straps on single skin hull planking

**5.2.9.2.6** The planking and the straps are to be through fastened. The size of the fastenings is to be as required by Table 10 for planking to frames, and the number is to be as follows:-

| Width of planking, mm | Number of fastenings in each plank end |
|---|---|
| Under 100 | 3 |
| 100 and under 200 | 4 |
| 200 and under 250 | 5 |

**5.2.9.2.7** The length of a scarph is to be not less than four times the thickness of the planking. The scarph is to be positioned on the frame, and glued and fastened to it.

**5.2.9.2.8** In sailing and auxiliary craft, the garboard and adjacent strakes are to be of increased width at the after end to give a reasonable plank fun, and the garboard strake is to be in as long a length as possible.

**5.2.9.2.9** Where, with planks of normal breadth, the length of snapped ends exceeds 250 mm, the planks are to be checked into the centreline structure (*see Figure 14*). The sizes of the fastenings are to be as for the garboard strake (*see 5.2.9.2.11*).

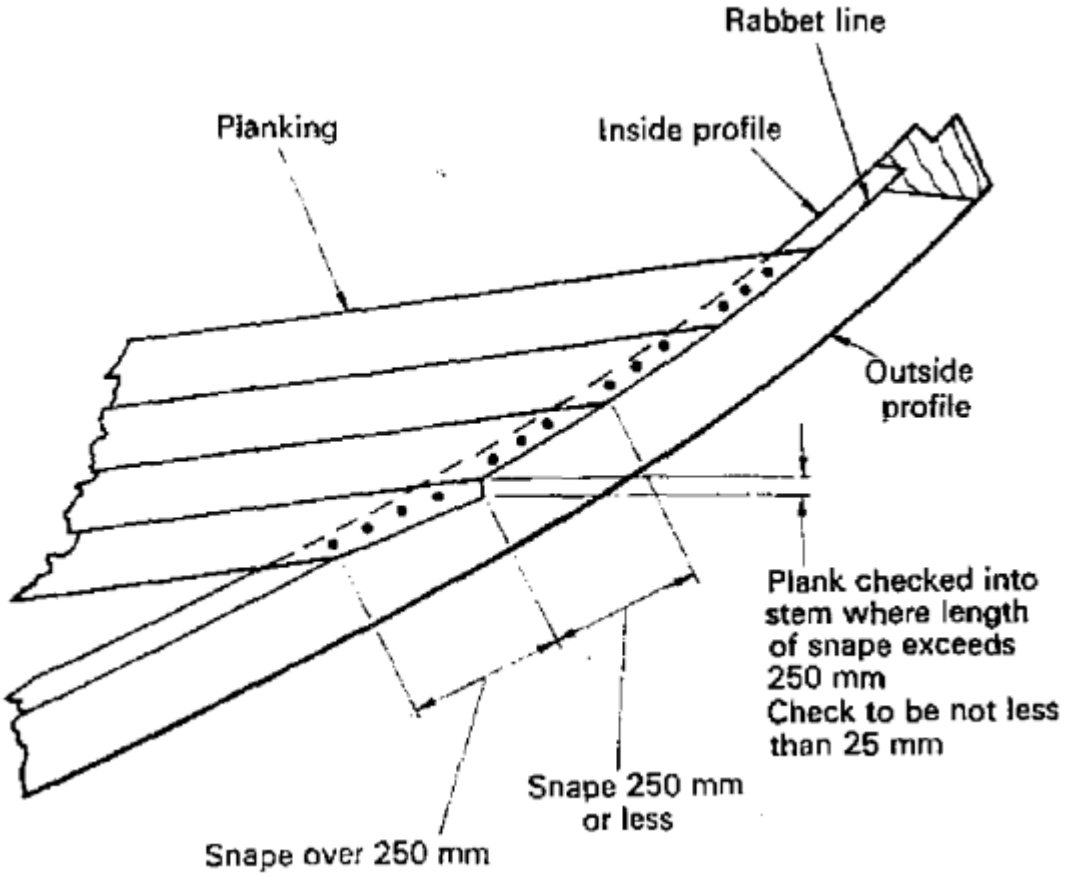



Figure 14: Connection of single skin planking to centreline structure (for normal breadth of planking)

**5.2.9.2.10** When strip planking is adopted, the top and bottom edges are to be rounded and hollowed respectively. Each plank is to be glued and edge fastened to the one below with non-ferrous fastenings, *see Figure 15* Suitable stealer planks may be fitted to suit planking arrangements.

**5.2.9.2.11** The garboard strakes are to be screw fastened to the keel or hog. The screws are to be of the size required by Table 10 for outside planking to Type 2 grown frames. They are to be reeled, and are to be spaced not more than twelve diameters apart in each row and are to enter the keel or hog to a depth at least equal to the thickness of the garboard. In way of deadwoods a combination of dumps and screws may be used.

**5.2.9.2.12** The size and number of fastenings attaching the outside planking to the frames are to be as given in Table 10. The types of fastenings are dependent on the framing as follows:-

| | | |
|---|---|---|
| Type 1: | Bent frames | All through fastenings |
| Type 2: | Grown frames | Through fastenings to be arranged in way of beam shelf, bilge (or side) stringer, and tuck (in a sailing or auxiliary craft). The remainder may be screws |
| Type 3: | Laminated frames | |
| Type 4: | Steel frames | Nut and screw bolts |
| Types 5, 6 and 7: | Grown, laminated or steel frames with bent frames between | Bent, as for Type 1 Grown and laminated, as for Types 2 and 3 Steel, as for Type 4 |

**5.2.9.2.13** Where frames are increased in way of the mast (see 5.2.5.3.6), they are to be through fastened

throughout.

**5.2.9.3** Double skin

**5.2.9.3.1** Double skin planking may be arranged as follows: -

(a) Both diagonal,
(b) Inner diagonal, outer fore and aft,
(c) Both fore and aft.

**5.2.9.3.2** The outer skin is to be approximately 3/5 of the total thickness, and the diagonal planking is to be at approximately 45°.

**5.2.9.3.3** The inner skin is to be either screw or nail fastened to the frames, and the outer skin is to be through fastened to the frames. In arrangements 5.2.9.3.1 (a) and (b) through fastenings are to be fitted at the plank crossings, and in 5.2.9.3.1 (c) the inner skin is to be screw fastened to the outer between frames, *see Figure 15*.

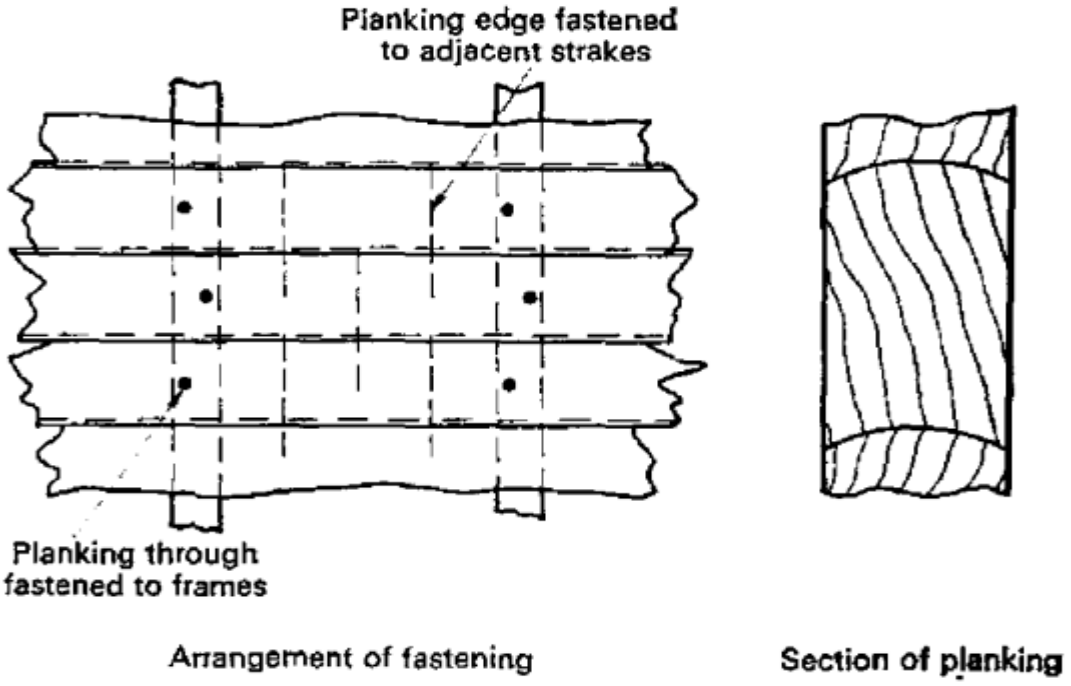



Figure 15: Strip planking

Table 11: Fastenings for outside end deck planking in motor, sailing end auxiliary craft

| Planking thickness, mm | Size of fastenings | | | | | | | | | | Number of fastenings per plank | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Outside planking | | | | | | | Deck planking | | | Width of plank | | | | |
| | Grown, laminated or steel frames | | | | | Bent frames | | Wood screws diameter | | Bolt, mm | Under 100 mm | 100 mm and under 150mm | 150 mm and under 180mm | 180 mm and under 205mm | 205mm and under 225mm |
| | Bolt, mm | Wood screws diameter | | Cooper bolt nails*size | | Cooper bolt nails size | | | | | | | | | |
| | | mm | gauge | mm | gauge | mm | gauge | mm | gauge | | | | | | |
| 19 | 6 | 5 | 10 | 4.5 | 7 | 2.5 | 12 | 4.5 | 8 | 5 | 2 | 2 | 3 | 3 | 3 |
| 20.5 | 6 | 5 | 10 | 5 | 6 | 3 | 11 | 5 | 10 | 5 | 2 | 2 | 3 | 3 | 3 |
| 22 | 6 | 5 | 10 | 6,5 | 3 | 3.5 | 10 | 5 | 10 | 6 | 2 | 2 | 3 | 3 | 3 |
| 23.5 | 6 | 5 | 10 | 6.5 | 3 | 3.5 | 10 | 5 | 10 | 6 | 2 | 2 | 3 | 3 | 3 |
| 25 | 6 | 5.5 | 12 | 6.5 | 3 | 3.5 | 9 | 5 | 10 | 6 | 1 | 2 | 2 | 3 | 3 |
| 26.5 | 6 | 5.5 | 12 | 6.5 | 3 | 3.5 | 9 | 5.5 | 12 | 6 | 1 | 2 | 2 | 3 | 3 |
| 28 | 6 | 5.5 | 12 | 6.5 | 3 | 4.5 | 7 | 5.5 | 12 | 6 | 1 | 2 | 2 | 3 | 3 |
| 29.5 | 6 | 5.5 | 12 | 6.5 | 3 | 4.5 | 7 | 5.5 | 12 | 6 | 1 | 2 | 2 | 3 | 3 |
| 31 | 8 | 6.5 | 14 | 7.5 | 1 | 5 | 6 | 5.5 | 12 | 6 | 1 | 2 | 2 | 3 | 3 |
| 32.5 | 8 | 6.5 | 14 | 7.5 | 1 | 5 | 6 | 6.5 | 14 | 8 | 1 | 2 | 2 | 3 | 3 |
| 34 | 8 | 6.5 | 14 | 7.5 | 1 | 5.5 | 5 | 6.5 | 14 | 8 | 1 | 2 | 2 | 3 | 3 |
| 36.5 | 8 | 7 | 16 | 7.5 | 1 | 5.5 | 5 | 6.5 | 14 | 8 | 1 | 2 | 2 | 3 | 3 |
| 37 | 8 | 7 | 16 | 7.5 | 1 | 5.5 | 5 | 6.5 | 14 | 8 | 1 | 2 | 2 | 2 | 3 |
| 38.5 | 8 | 7 | 16 | 9.5 | 3/0 | 5.5 | 5 | 7 | 16 | 8 | 1 | 2 | 2 | 2 | 3 |
| 40 | 10 | 8 | 18 | 9.5 | 3/0 | 6 | 4 | 7 | 16 | 8 | 1 | 2 | 2 | 2 | 3 |
| 41.5 | 10 | 8 | 18 | 9.5 | 3/0 | 6 | 4 | 7 | 16 | 8 | 1 | 2 | 2 | 2 | 3 |
| 43 | 10 | 8 | 18 | 9.5 | 3/0 | - | - | 8 | 18 | 10 | 1 | 2 | 2 | 2 | 3 |
| 44.5 | 10 | 8 | 18 | 9.5 | 3/0 | - | - | 8 | 18 | 10 | 1 | 2 | 2 | 2 | 3 |
| 46 | 12 | 8.5 | 20 | 11 | 5/0 | - | - | 8 | 18 | 10 | 1 | 2 | 2 | 2 | 3 |
| 47.5 | 12 | 8.5 | 20 | 11 | 5/0 | - | - | 8 | 18 | 10 | 1 | 2 | 2 | 2 | 3 |
| 49 | 12 | 8.5 | 20 | 11 | 5/0 | - | - | 8 | 18 | 10 | 1 | 2 | 2 | 2 | 3 |
| 50.5 | 12 | 10 | 24 | 12.5 | 7/0 | - | - | 8.5 | 20 | 12 | 1 | 2 | 2 | 2 | 3 |
| 52 | 12 | 10 | 24 | 12.5 | 7/0 | - | - | 8.5 | 20 | 12 | 1 | 2 | 2 | 2 | 3 |

*·For grown or laminated frames only.

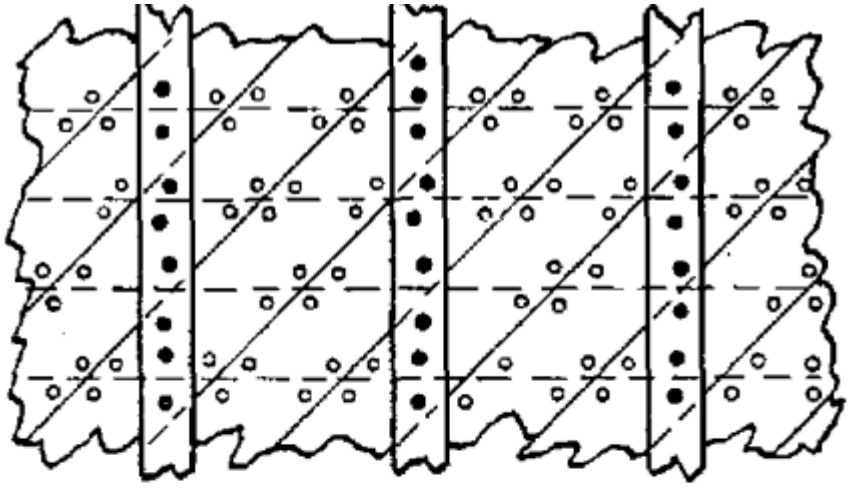
NOTES

1. The diameter of the wood screws given in the Table is the nominal diameter of the unthreaded shank.
2. The gauge of wood screws given in the Table is British Standard Gauge, and that of copper boat nails is Imperial Standard Wire Gauge.

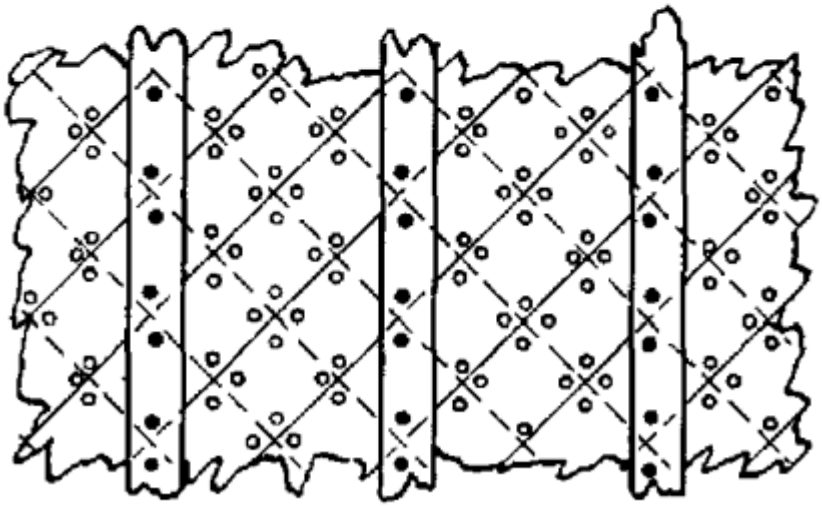
**5.2.9.3.4** In arrangements 5.2.9.3.1 (a) and (b) oiled calico dipped in linseed oil or an equivalent membrane is to be laid between the skins, and in 5.2.9.3.1 (c) it is recommended that resorcinol glue be used between the skins.

**5.2.9.3.5** The arrangement at the gunwale is to be such as to ensure that the covering board can be made watertight.

Typical methods are shown in Figure 16.



(a)



(b)

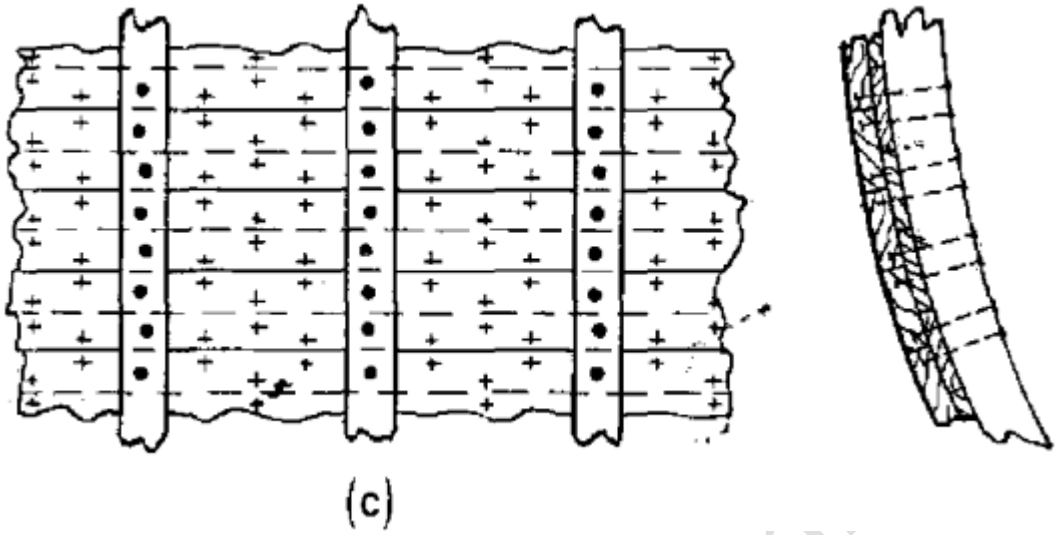



Figure 16: Arrangement of fastening in double skin hull planking

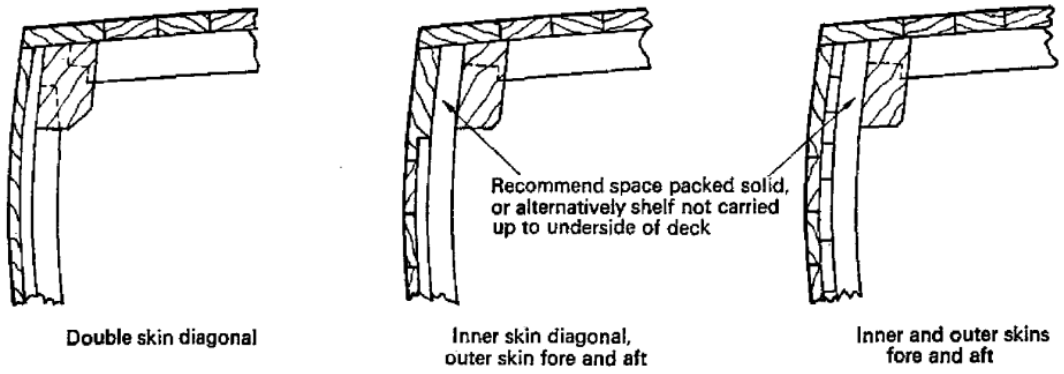



Figure 17: Detail of gunwale for double skin planking

**5.2.9.4** Plywood planking

**5.2.9.4.1** Plywood is to be fitted in as large panels as practicable having due regard to the form of the craft. Panel butts are to be staggered between the bottom, side and deck and arranged clear of the mast, ballast keel and engine seating.

**5.2.9.4.2** The width of longitudinal seam landings on the centreline structure, chine and gunwale members and on any longitudinal stringers is to be not less than that required by Table 11. Seams are to be glued and fastened with one or two rows of fastenings (*see Table 11*), and arranged to give maximum spacing of fastenings of 50 mm.

**5.2.9.4.3** Butts and seams are to be scarphed or strapped where necessary. The length of a scarph is to be not less than 8 times the hull thickness. The scarph is to be glued and, if made in situ, fitted with a backing strap of a width not less than 10 times the hull thickness. The strap is to be glued and fastened to the hull with two rows of fastenings of the size given in Table 12 and spaced about 8 times the hull thickness.

**5.2.9.4.4** Butt straps are to be of the width given in Table 13 and the same thickness as the hull planking. The strap is to be glued and double or treble fastened to the hull planking. The size of fastenings is to be as given in Table 13

**5.2.9.4.5** The hull planking is to be attached to the frames by fastenings of the size given in Table 11, spaced generally not more than 75 mm apart.

**5.2.9.5** Hull sheathing

**5.2.9.5.1** Whilst it is not a requirement of the Rules that the outside planking be sheathed, if this is done it must be efficiently carried out to the Surveyor's satisfaction.

**5.2.9.5.2** Copper sheathing should be bedded on bitumastic treated paper or felt. The sheets are to be dressed to ensure that the sheathing is in close contact with the bedding. They are to overlap each other by about 22 mm; the vertical laps are to face aft and the horizontal laps are to face upwards. Fastening is to be by coppering nails spaced at not more than 40 mm at the sheet edges. In addition, the panel is to be tack fastened at spacings of not more than 75 mm vertically and 150 mm horizontally. The sheathing is to be stopped short of the rabbet line and a wrapper piece fitted.

**5.2.9.5.3** Where synthetic sheathing is used, care is to be taken to ensure that the moisture content of the timber is as low as is practicable. All seams and fastening holes to be splined or dowelled or stopped with a compound which is compatible with the manufacturer's recommendations. Wherever possible, the sheathing is to be fitted around the wood keel and deadwood before the ballast keel is fitted.

Table 12: Plywood planking: overlaps and fastenings for motor, sailing and auxiliary craft

| | Minimum breadth of landing between | | | | | Fastenings | | |
|---|---|---|---|---|---|---|---|---|
| Plywood planking thickness, mm | Hull planking and keel or chine, mm | | | Hull or deck planking and shelf or longitudinal, mm | | Wood screws | | Cooper boat nails, gauge |
| | | | | | | Gauge | Diameter mm | |
| 6 | 25 | Single fastened | | Single fastened | 25 | 8 | 4.2 | 10 |
| 8 | 28 | | | | 28 | 10 | 4.9 | 10 |
| 10 | 32 | | | | 32 | 10 | 4.9 | 8 |
| 13 | 44 | Double fastened | | | 35 | 12 | 5.6 | 8 |
| 16 | 50 | | | Double fastened | 44 | 12 | 5.6 | 6 |
| 19 | 57 | | | | 50 | 14 | 6.3 | 6 |
| 22 | 63 | | | | 57 | 14 | 6.3 | 3 |
| 25 | 63 | | | | 57 | 16 | 7.0 | 3 |

NOTES
1. The gauge of wood screws given in the Table is British Standard Gauge. and that of copper boat nails is Imperial Standard Wire Gauge.
2. The diameter of the wood screw is the nominal diameter of the unthreaded shank.

Table 13: Plywood planking: butts and butt straps for motor, sailing and auxiliary craft

| Plywood planking thickness, mm | Breath of butt strap, mm | | Wood screws | | Cooper boat nails, gauge |
|---|---|---|---|---|---|
| | | | Gauge | Dia, mm | |
| 6 | 150 | Double fastened | 8 | 4.2 | 10 |
| 8 | 175 | | 10 | 4.9 | 10 |
| 10 | 200 | | 10 | 4.9 | 8 |
| 13 | 250 | | 12 | 5.6 | 8 |
| 16 | 280 | | 12 | 5.6 | 6 |
| 19 | 330 | Triple fastened | 14 | 6.3 | 6 |
| 22 | 355 | | 14 | 6.3 | 3 |
| 25 | 380 | | 16 | 7.0 | 3 |

NOTES
1. The gauge of wood screws given in the Table is British Standard Gauge. and that of copper boat nails is Imperial Standard Wire Gauge.
2. The diameter of the wood screw is the nominal diameter of the unthreaded shank.

### 5.2.10 Beams

**5.2.10.1** Scantlings-Timber

**5.2.10.1.1** The scantlings of ordinary beams, half beams and strong beams are to be not less than those given in Table 14.



**5.2.10.1.2** Where the actual beam spacing differs from that given in Table 14, the strength of ordinary and half beams is to be modified in direct proportion, i.e.

Actual *(sm²)* = Table *(sm²)* x $\frac{actual\ spacing}{table\ spacing}$

where *s* and *m* are the siding and moulding, respectively; the Table siding is to be that after correction for density. *see 5.1.4.*

**5.2.10.1.3** Where laminated beams are fitted their siding may be reduced by 15%.

**5.2.10.1.4** Strong beams are to be fitted at ends of openings when two or more beams are cut. They may also be required to be fitted in way of the mast.

**5.2.10.2** End attachments

**5.2.10.2.1** All beams are to be fastened to the shelf by dovetails or dowels, *see Figure. 18*.

**5.2.10.2.2** As an alternative to 5.2.10.2.1, where a plywood deck is fitted the beams need not be dovetailed or dowelled but may be carried past the shelf and checked over it. The depth of the check is to be about one-quarter of the depth of the beam and the beam is to be screw or dump fastened to the shelf.

**5.2.10.2.3** Hanging knees are to be fitted as required by Table 14 and are to be arranged at the mast and other strong beams to give a suitable disposition over the length of the craft.

**5.2.10.2.4** Hanging knees may be steel straps, flanged plates, angle bar, or grown or laminated timber.

**5.2.10.2.5** The dimensions of strap-hanging knees are given in Table 14 but at the ends of the craft the length of arms need not exceed one-third of the length of the frame or beam. Angle knees are to have equivalent strength.

**5.2.10.2.6** The minimum moulding at the throat of grown or laminated knees is to be 60% or 40%, respectively, greater than that required by Table 5 for ordinary grown frames at the heel.

**5.2.10.2.7** Each arm is to be connected to the beam and to the frame by four bolts of the diameter given in Table 7. The bolts need not pass through the deck or outside planking.

**5.2.10.2.8** Bulkheads of substantial construction glued and screwed to the beams and frames will be accepted in lieu of hanging knees.

**5.2.10.2.9** Lodging knees are to be fitted to the beams in way masts and at ends of deck openings unless a plywood deck is fitted.

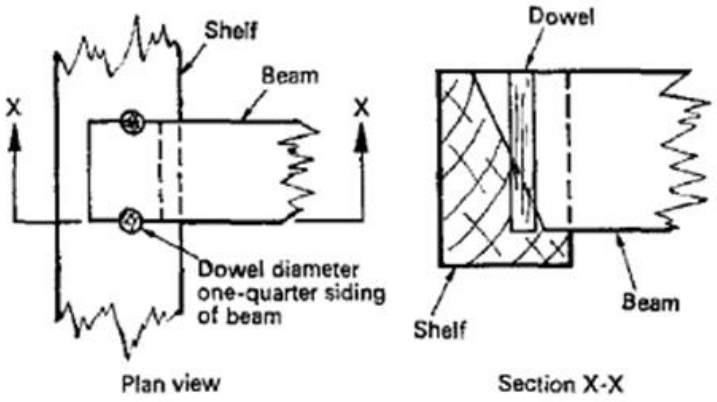



Figure 18: Dowel fastening of beam at shelf

**5.2.10.3** Local reinforcements

**5.2.10.3.1** The beams and deck are to be suitably strengthened in way of masts, coachroof ends, windlass, cleats, sheet winches etc. Where a mast is stepped on the deck the structural arrangements will be specially considered.

**5.2.10.3.2** All deck openings are to be properly framed with carlings fitted to receive the half beams.

**5.2.10.4** Cabin deck

**5.2.10.4.1** Where the depth amidships from top of wood keel to top of beam at side amidships is 3 m or greater, cabin deck beams are to be fitted. The strength of these beams is to be at least 60 % of that required for upper deck beams, and the beams are to be efficiently attached to the craft's side.

**5.2.10.5** Steel construction

**5.2.10.5.1** Where steel beams are fitted, steel deck stringer plates and tie plates of dimensions given in Table 14 are to be arranged.

**5.2.10.5.2** The scantlings of steel beams are given in Table 15. Where the spacing differs from that given in the Table the section modulus is to be modified in direct proportion. The Table scantlings apply over the midship $\frac{3}{5}L$. Outside this, the thickness may be reduced by 10 %. Half beams are to be of the size required by the Table for the same length with one row of pillars and are to be attached to the carlings or coaming plates.

**5.2.10.5.3** Cabin deck beams are to be fitted where the depth amidships from top of floor to top of beam at side is 3.2 m or greater. Beam knees are to be fitted on alternates and the remaining beams are to be fastened by lugs to the frames.

**5.2.10.5.4** Beam knees are to have arms not less than $2\frac{1}{2}$ times the depth of the beam, a distance across the throat of not less than 60 % of the length of the arms and a thickness as given in Table 15

**5.2.10.5.5** Strong beams are to be fitted in accordance with 5.2.10.1.4.

**5.2.10.5.6** Where masts are wedged to the deck the arrangements in way of the mast are to include the following:-

(a) Mast deck plates of a length and breadth of not less than three times the diameter of the mast hole, and a thickness equal to that of the stringer plate required by Table 15

(b) Two diagonal tie plates, of the size given in Table 15 for tie plates, are to be fitted on the beams each side of the craft.

(c) A collar is to be fitted around the opening to take the wedges.

Table 14: Beams and hanging knees for motor, sailing and auxiliary craft

| Length of beam, m | Spacing of ordinary beams centre to centre, mm | Ordinary beams 3/5L amidship | | | | Ordinary beams beyond 3/5L amidship, half beam throughout | | | | Beams in way of masts and at ends of deck openings | | | | Strap hanging knees to deck beams | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | At middle | | At ends | | At middle | | At ends | | At middle | | At ends | | | Length of arm, mm | | At throat, mm | At point, mm |
| | | Siding, mm | Moulding, mm | Siding, mm | Moulding, mm | Siding, mm | Moulding, mm | Siding, mm | Moulding, mm | Siding, mm | Moulding, mm | Siding, mm | Moulding, mm | Number on each side | For 3/5L amidship | Beyond 3/5L amidship | | |
| 1.8 | 250 | 30 | 45 | 30 | 30 | 26 | 33 | 26 | 26 | 39 | 55 | 39 | 39 | 3 | 300 | 240 | 22 x 8 | 19 x 4 |
| 2.1 | 275 | 36 | 53 | 36 | 36 | 32 | 40 | 32 | 32 | 46 | 65 | 46 | 46 | 4 | 325 | 260 | 22 x10 | 22x 4 |
| 2.4 | 300 | 41 | 60 | 41 | 41 | 36 | 45 | 36 | 36 | 52 | 74 | 52 | 52 | 4 | 350 | 280 | 25 x 12 | 22x 6 |
| 2.7 | 325 | 46 | 66 | 46 | 46 | 40 | 50 | 40 | 40 | 58 | 83 | 58 | 58 | 5 | 375 | 300 | 30 x16 | 25 x 6 |
| 3.0 | 350 | 51 | 72 | 51 | 51 | 43 | 54 | 43 | 43 | 63 | 90 | 63 | 63 | 5 | 400 | 320 | 34 x19 | 30x 6 |
| 3.3 | 375 | 55 | 78 | 55 | 55 | 46 | 58 | 46 | 46 | 68 | 97 | 68 | 68 | 6 | 425 | 340 | 38 x19 | 35 x 6 |
| 3.6 | 400 | 59 | 83 | 59 | 59 | 50 | 63 | 50 | 50 | 73 | 104 | 73 | 73 | 6 | 450 | 360 | 42 x22 | 40 x 8 |
| 3.9 | 425 | 62 | 88 | 62 | 62 | 53 | 66 | 53 | 53 | 77 | 110 | 77 | 77 | 7 | 475 | 380 | 46 x22 | 40 x 8 |
| 4.2 | 450 | 66 | 94 | 66 | 66 | 56 | 70 | 56 | 56 | 82 | 117 | 82 | 82 | 7 | 500 | 400 | 50x25 | 45 x 8 |
| 4.5 | 475 | 69 | 99 | 69 | 69 | 58 | 74 | 58 | 58 | 86 | 124 | 86 | 86 | 8 | 525 | 420 | 52x25 | 45 x 8 |
| 4.8 | 500 | 72 | 103 | 72 | 72 | 61 | 78 | 61 | 61 | 90 | 129 | 90 | 90 | 8 | 550 | 440 | 55 x27 | 50 x 10 |
| 5.1 | 525 | 75 | 108 | 75 | 75 | 63 | 82 | 63 | 63 | 94 | 135 | 94 | 94 | 9 | 575 | 460 | 58 x27 | 50 x 11 |
| 5.4 | 550 | 79 | 112 | 79 | 79 | 65 | 86 | 65 | 65 | 98 | 140 | 98 | 98 | 9 | 600 | 480 | 61 x30 | 50 x 11 |
| 5.7 | 575 | 82 | 117 | 82 | 82 | 67 | 91 | 67 | 67 | 102 | 146 | 102 | 102 | 10 | 625 | 500 | 64 x30 | 52 x12 |
| 6.0 | 600 | 85 | 121 | 85 | 85 | 69 | 96 | 69 | 69 | 107 | 151 | 107 | 107 | 10 | 650 | 520 | 67 x30 | 52 x12 |
| 6.3 | 625 | 88 | 125 | 88 | 88 | 70 | 100 | 70 | 70 | 112 | 156 | 112 | 112 | 11 | 675 | 540 | 70x33 | 54x14 |
| 6.6 | 650 | 91 | 130 | 91 | 91 | 71 | 105 | 71 | 71 | 119 | 163 | 119 | 119 | 11 | 700 | 560 | 72 x33 | 54 x14 |
| 6.9 | 675 | 96 | 137 | 96 | 96 | 73 | 112 | 73 | 73 | 127 | 172 | 127 | 127 | 12 | 725 | 580 | 74 x33 | 57 x16 |
| 7.2 | 700 | 102 | 145 | 102 | 102 | 75 | 120 | 75 | 75 | 135 | 180 | 135 | 135 | 12 | 750 | 600 | 78 x36 | 57 x16 |

NOTES

1. The length of a wood beam is to be measured amidships to the inside of the beam shelf.
2. The Table scantlings of timber beams are based on a timber having a standard density of 560 kg/m$^3$ and where timber of a different density is to be used the scantlings are to be modified in accordance with 5.1.4.
3. Where the beam spacing differs from that given in the Table, *sm$^2$* is to be modified in direct proportion, *see 5.2.10.1.2*.

4. The siding of a laminated beam may be reduced by 15%.

Table 15:Longitudinal steel items for motor, sailing and auxiliary craft

| Length, m | Upper deck sheerstrake and stringer plate 3/5L amidship, mm | Upper deck sheerstrake and stringer plate at ends and cabin deck stringer plate, mm | Upper deck tie plates, mm | Upper deck stringer angle, mm | cabin deck tie plates, mm | cabin deck stringer angle, mm |
|---|---|---|---|---|---|---|
| 10 | 220 x3.5 | 170 x3.5 | 100 x 3.5 | 45 x 45 x 3.5 | - | - |
| 12 | 250 x3.5 | 200 x3.5 | 100 x 3.5 | 45 x.45 x.4 | - | - |
| 14 | 290 x3.5 | 230 x3.5 | 115 x 3.5 | 50 x.50.x.4 | - | - |
| 16 | 335 x4 | 240 x4 | 120 x 4 | 50 x.50.x 4.5 | 75 x.4 | 50 x 50 x4 |
| 18 | 375 x4.5 | 250 x4 | 130 x 4.5 | 50 x 50 x 5 | 85 x.4 | 50 x 50 x 4 |
| 20 | 410 x4.5 | 280 x4 | 140 x 4.5 | 50 x 50 x 5 | 90 x.4 | 55 x 55 x.4 |
| 22 | 455 x5 | 300 x4.5 | 150 x 5 | 55 x 55 x 5.5 | 100 x 4.5 | 60 x 60 x.4 |
| 24 | 500 x5.5 | 325 x4.5 | 150 x 5.5 | 60 x 60 x 5 | 110 x 4.5 | 60 x 60 x 4.5 |

Table 16: Steel angle beams at upper and cabin decks for motor, sailing and auxiliary craft

| Length of beam, m | Spacing of beams, mm | Upper deck beams, mm | | | | Upper deck beams, mm | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Without pillars | Thickness of knee | With one row of pillars | Thicknes s of knee | Without pillars | Thickness of knee | With one row of pillars | Thickness of knee |
| 2.4 | 305 | 65 x 50 x 5 | 4 | - | - | 65 x 50 x 3.5 | 3.5 | - | - |
| 2.7 | 330 | 65 x 50 x6 | 4 | - | - | 65 x 50 x 4 | 4 | - | - |
| 3.0 | 355 | 70 x 55 x6 | 4.5 | - | - | 65 x 50 x 4.5 | 4 | - | - |
| 3.3 | 380 | 75 x 65 x 6.5 | 4.5 | - | - | 65 x 65 x 5.5 | 4.5 | - | - |
| 3.6 | 405 | 85 x 65 x6.5 | 5 | 50 x 50 x 5 | 4 | 65 x 65x 7 | 4.5 | 40 x40 x 4.5 | 3.5 |
| 3.9 | 430 | 90 x 65 x7 | 5 | 65 x 50 x4 | 4.5 | 75 x 65x 6 | 5 | 50 x40 x 3.5 | 4 |
| 4.2 | 455 | 100 x 65 x6.5 | 5,5 | 65 x 50 x 4.5 | 4.5 | 75 x 65 x6.5 | 5 | 50 x50 x.4 | 4 |
| 4.5 | 470 | 100 x 65 x7 | 6 | 65 x 50 x 5 | 5 | 75 x 65 x7.5 | 5.5 | 50 x50 x 4.5 | 4.5 |
| 4.8 | 482 | 110 x 65 x7.5 | 6 | 65 x 60 x 5.5 | 5 | 85 x 65 x7 | 5.5 | 65 x50 x 4 | 4.5 |
| 5.1 | 495 | 125 x 65 x 7.5 | 6.5 | 65 x 65 x 6 | 5.5 | 100 x 65 x5 | 6 | 65 x50 x 4.5 | 5 |
| 5.4 | 508 | 135 x 65 x 7.5 | 6.5 | 75 x 65 x 5.5 | 5,5 | 100 x 65 x7 | 6 | 65 x50 x 5 | 5 |
| 5.7 | 520 | 145 x 65 x 7.5 | 7 | 75 x 65 x6 | 6 | 110 x 65 x7.5 | 6,5 | 65 x50 x 5.5 | 5.5 |
| 6.0 | 532 | 140 x 75x10 | 7 | 85 x 65 x 5 | 6 | 120 x 70 x 7.5 | 6.5 | 70 x60 x 5.5 | 5.5 |
| 6.3 | 545 | 140 x 75 x12 | 7.5 | 90 x 75 x6.5 | 6.5 | 135 x75 x7.5 | 7 | 75 x65 x 6 | 6 |
| 6.6 | 558 | 150 x 75x12 | 7.5 | 95 x 75 x7,5 | 6.5 | 140 x 75x 8 | 7 | 75 x65 x 6.5 | 6 |
| 6.9 | 570 | 165 x 75 x12 | 8 | 100 x 75 x 8 | 7 | 145 x75 x 8.5 | 7.5 | 85 x 65 x6.5 | 6.5 |
| 7.2 | 585 | 175 x 75 x12 | 8 | 100 x75 x 9 | 7 | 160 x 75 x 8.5 | 7.5 | 95 x65 x 6.5 | 6.5 |

NOTES
1. The length of a steel angle beam is to be measured to the toe of the frame amidships.
2. Where the beam spacing differs from that given in the Table. The section modulus (without plating) is to be modified in direct proportion.

**5.2.11** Deck planking

**5.2.11.1** General

**5.2.11.1.1** Decks may consist of:-

(a) Laid planks,
(b) Plywood,
(c) Plywood sheathed with a laid deck.

**5.2.11.1.2** The thickness of laid deck is to be as given in Table 10

**5.2.11.1.3** Where the beam spacing differs from that given in Table 14, the Table thickness is to be modified at the rate of 1.5 mm per 50 mm difference.

**5.2.11.1.4** Where teak or other approved timber having a density exceeding 720 kg/m$^3$ is used the thickness



may be reduced by 12 %.

**5.2.11.1.5** Where plywood is used the thickness may be reduced by 30%.

**5.2.11.1.6** Where plywood is sheathed with a laid deck the combined thickness may be 30% less than the thickness in Table 10 provided that:-

(a) the combined density of the plywood and sheathing is not less than 430 kg/m$^3$,
(b) the thickness of the plywood is not less than 30 percent of the combined thickness and in no case is less than 6 mm, and

**5.2.11.1.7** where the laid planking is less than 19 mm, the seams are filled with an approved flexible seam compound,

**5.2.11.1.8** Where the deck is covered with canvas, nylon, glass reinforced plastics or other approved sheathing, the thickness may be reduced by 1.5 mm.

**5.2.11.1.9** All exposed canvas seams are to be sewn and not overlapped and tacked. Securing of canvas by tacks should be used only where the edges are protected by listings, etc. The canvas is to be suitably bedded to the deck.

**5.2.11.2** Laid decks

**5.2.11.2.1** Butts of the deck planking are to be spaced not less than 1.2 m apart and no butts are to be in the same transverse plane unless there are three strakes between. *see Figure12*.

**5.2.11.2.2** The material for laid decks is to be quarter sawn.

**5.2.11.2.3** Butts are to be arranged on a beam and are to be of the scarph or caulked lip type unless the siding of the beam is sufficient to allow a caulked square butt to be used. *see Figure 19*.

**5.2.11.2.4** Deck planks are to be attached to the beams by either screw fastenings from above, or side fastening by nails, *see Figure 20*.

**5.2.11.2.5** Where the beam spacing has been increased it may be necessary to fit horizontal dowels in the planking between the beams.

**5.2.11.2.6** The number and size of screws are to be as given in Table 11. Deck covering boards are to be screw fastened to the sheer strake and beams. The screws to the sheer strake are generally to be spaced not more than 12 diameters apart.

**5.2.11.2.7** Where steel beams are fitted, the fastenings are to be either nut and screw bolts or round head wood screws fitted from the underside of the beams. The number and size of bolts or screws are to be as given in Table 11.

**5.2.11.3** Plywood decks

**5.2.11.3.1** Plywood decks are to be fitted in panels as large as practicable.

**5.2.11.3.2** Butts are to be clear of those in the side planking and are not to be placed in the vicinity of the mast. They are to be on a strong beam or are to be strapped.

**5.2.11.3.3** Seams are to be strapped or scarphed or may be arranged on a longitudinal member having a width sufficient to give a landing of not less than that required by Table 12. Butts and seams are to be sealed watertight.

**5.2.11.3.4** Plywood decks are to be glued or bedded to the beams and at the deck edges. They are also to be fastened to the beams and at the edges by screws or barbed nails, as required by Table 12. The fastenings in beams and butts landing on structural members are to be as required for deck edges. If a strap is fitted, it is to be as required by 5.2.9.4.4 for hull plywood planking.

**5.2.11.3.5** Where plywood decks are laid on steel beams, liners are to be fitted where stringer and tie plates are used. Liners are to be the same width as the beam and the same thickness as the plates.

**5.2.11.4** Plywood sheathed with laid deck

**5.2.11.4.1** Plywood decks sheathed with a laid deck are to comply with the requirements of 5.2.11.3.1 to 5.2.11.3.3.

**5.2.11.4.2** Where thickness of the laid sheathing on plywood decks exceeds 50% of the total thickness, the requirements of 5.2.11.2.1 and 5.2.11.2.2 are to be complied with. The sheathing is to be fastened through the plywood to the beams as for a laid deck, *see 5.2.11.2.4* to *5.2.11.2.6.*

**5.2.11.4.3** Where the laid sheathing is less than 50 % of the total thickness the butts are to be suitably

positioned, and the fastenings may pass through the plywood only and are to be in accordance with 5.2.11.3.4.

**5.2.11.4.4** The laid sheathing is to be glued to the plywood with a resorcinol glue.

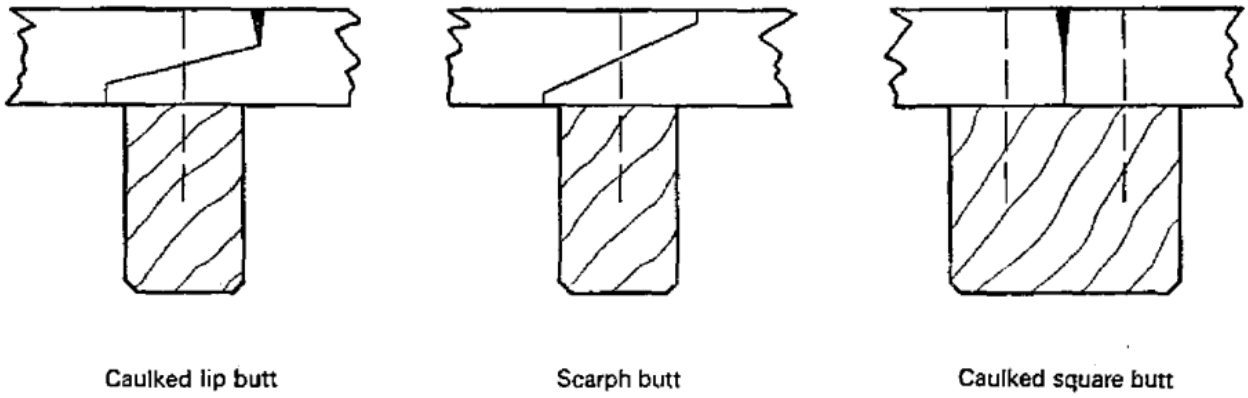
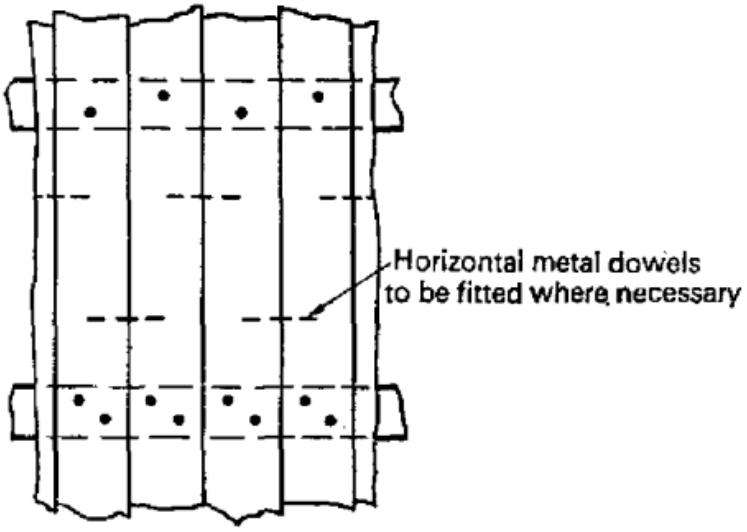
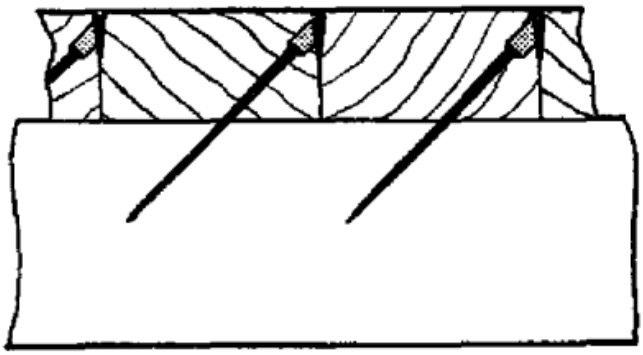


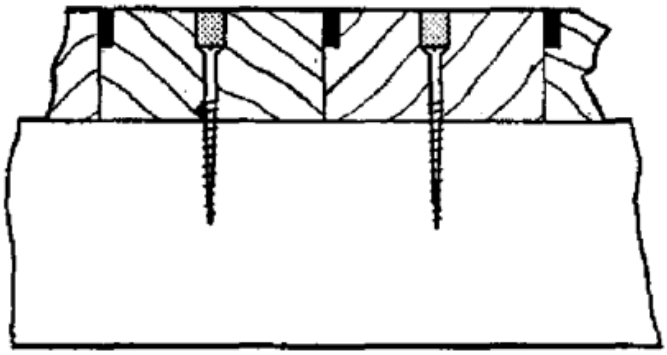

Figure 19: Butts of deck planking




Plan view showing arrangement of single or double fastenings



Secret fastening



Screw fastening

Figure 20: Deck fastening (laid decks)

**5.2.11.5** Watertightness

**5.2.11.5.1** Laid decks are to be caulked and payed or an acceptable deck seaming compound, applied in accordance with the manufacturers' recommendations, may be used. Wood dowels are to be glued.

**5.2.11.5.2** All weather decks are to be hose tested on completion.

**5.2.11.6** Deck fittings

**5.2.11.6.1** Fittings fixed to the deck are to be bedded on a suitable mastic compound to maintain the watertightness of the deck.

**5.2.11.6.2** It is recommended that in way of heavy fittings such as windlasses, winches, fairleads, etc., the deck planking and the fastening holes be coated with a suitable wood preservative prior to the application of the mastic.

**5.2.11.6.3** Guard rail stanchions are to be bedded on a suitable mastic compound and are to have not less than three fastenings through the palm, one of which is to be a through fastening.

**5.2.12** Pillars or Stanchions

**5.2.12.1** Pillar Load

The load on a pillar is to be obtained from the following equation:

$w = 0.715\ bhs$ tonnes

where:

$w$ = load in tonnes

*b* = mean breadth in metres of area supported

*s* = spacing of pillars in metres

*h* = height in metres above the deck supported, as defined below:

(a) *h* for a pillar below an exposed deck on which cargo is carried is the distance from the deck supported, to a point 3.65 metres above the exposed deck. Where it is intended to carry deck cargoes in excess of 2640 kg /m$^2$ this head is to be increased in proportion to the added loads which will be imposed on the structure.

(b) Where tween deck cargo is carried and its mass is greater or less than 2640 kg /m$^2$,*h* is also to be suitably adjusted.

(c) *h* for a pillar below the freeboard deck is to be measured to a point not less than 0.02L + 0.75 metres above the freeboard deck.

(d) *h* for a pillar below the superstructure deck is to be measured to a point not less than 0.02L + 0.50 metres above the superstructure deck.

**5.2.12.2** Permissible Load

(a) The permissible load pillar can carry is to be equal to or greater than the pillar load was determined above (5.2.12.1). The permissible load may be obtained from the equation:

$$wa = \frac{A}{1000}\left(l - 17\left(\frac{l}{a}\right)\right) tonnes$$

where:

*wa* = Permissible load on the pillar in tonnes

*A* = Area of the pillar in square millimetres

*l* = The unsupported length of the pillar in metres

a = The diameter of a circular pillar or the shorter side of a rectangular pillar in millimetres.

Table 17 gives pillar loadings for a representative selection of round and rectangular pillars.

Table 17: Permissible load on timber pillars

| Permissible load on timber pillars | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| a (mm) | Unsupported length of pillar (m) | | | | | | | |
| | Rectangular section | | | | Round section | | | |
| | 1 | 2 | 3 | 4 | 1 | 2 | 3 | 4 |
| 50 | 1.7 | 0.8 | | | 1.3 | 0.6 | | |
| 60 | 2.6 | 1.6 | 0.5 | | 2.0 | 1.2 | 0.4 | |
| 70 | 3.7 | 2.5 | 1.3 | | 2.9 | 2.0 | 1.0 | |
| 80 | 5.0 | 3.7 | 2.3 | 1.0 | 4.0 | 2.9 | 1.8 | 0.8 |
| 90 | 6.6 | 5.0 | 3.5 | 2.0 | 5.2 | 4.0 | 2.8 | 1.6 |
| 100 | 8.3 | 6.6 | 4.9 | 3.2 | 6.5 | 5.2 | 3.8 | 2.5 |
| 110 | 10.2 | 8.4 | 6.5 | 4.6 | 8.0 | 6.6 | 5.1 | 3.6 |
| 120 | 12.4 | 10.3 | 8.3 | 6.2 | 9.7 | 8.1 | 6.5 | 4.9 |
| 130 | 14.7 | 12.5 | 10.3 | 8.1 | 11.5 | 9.8 | 8.1 | 6.3 |
| 140 | 17.2 | 14.8 | 12.5 | 10.1 | 13.5 | 11.7 | 9.8 | 7.9 |
| 150 | 20.0 | 17.4 | 14.9 | 12.3 | 15.7 | 13.7 | 11.7 | 9.7 |
| 160 | 22.9 | 20.2 | 17.4 | 14.7 | 18.0 | 15.8 | 13.7 | 11.6 |
| 170 | 26.0 | 23.1 | 20.2 | 17.3 | 20.4 | 18.2 | 15.9 | 13.6 |
| 180 | 29.3 | 26.3 | 23.2 | 20.2 | 23.0 | 20.6 | 18.2 | 15.8 |
| 190 | 32.9 | 29.6 | 26.4 | 23.2 | 25.8 | 23.3 | 20.7 | 18.2 |
| 200 | 36.6 | 33.2 | 29.8 | 26.4 | 28.7 | 26.1 | 23.4 | 20.7 |

NOTE:
In the above table (a) is the shorter side of a rectangular pillar or the diameter of a circular pillar in millimeters.

**5.2.12.3** The scantlings of pillars and stanchions of a material other than timber shall be determined



from the appropriate calculations.

**5.2.12.4** Pillars or stanchions may be placed directly under beams, deck opening corners or deck longitudinals, The spacing of pillars fitted under longitudinals between bulkheads shall not exceed 5 times the beam spacing = 500 mm in the fore and aft direction nor shall they be placed more than 25 % of the beam from the vessel's centreline.

**5.2.12.5** Supports under pillars or stanchions are to be of sufficient strength to distribute the loads effectively.

**5.2.13** Engine Seating

The engine seating is to be of dimensions commensurate with the power of the machinery fitted thereto. They should

(i) be of a length not less than twice the distance between the extreme holding down bolts;
(ii) distribute the load over as many transverses as possible;
(iii) terminate on a substantial transverse member; and
(iv) be checked over and securely fastened through all transverse floors and the hull planking.

**5.2.14** Coachroofs and deckhouses

**5.2.14.1** General

Coachroofs and deckhouses are to be substantially constructed and efficiently connected to the carlings and beams.

**5.2.14.2** Coachroofs

**5.2.14.2.1** The scantlings of a coachroof are to be as given in Tables 18 and 19.

Table 18: Coachroof coaming and deck thicknesses for motor, sailing and auxiliary craft

| Length, L, m | Coaming thickness, mm | Coach roof deck thickness, mm |
|---|---|---|
| 6 | 17 | 13 |
| 8 | 19 | 15 |
| 10 | 22 | 17 |
| 12 | 24 | 19 |
| 14 | 26 | 22 |
| 16 | 29 | 24 |
| 18 | 32 | 26 |

NOTES

1. The Table thickness of coachroof coamings and deck are based on a timber having a standard density of 560 kg/m3 and 430 kg/m$^3$, respectively, and where timber of a different density is to be used the thickness is to be modified in accordance with 5.1.4.
2. Where the coachroof coaming or deck is of plywood the Table thickness may be reduced by 30 %.
3. If the deck is covered with canvas or other approved sheathing the Table thickness may be reduced by 1.5 mm.
4. Where the beam spacing differs from that given in Table 19, the deck thickness is to be modified at the rate of 1.5 mm per 50 mm difference.

Table 19: Coachroof and deckhouse beams for motor, sailing and auxiliary craft

| Length of beam, m | Spacing centre to centre, mm | At middle of beam | | At ends of beam | |
|---|---|---|---|---|---|
| | | Siding, mm | Moulding, mm | Siding, mm | Moulding, mm |
| 1.2 | 255 | 28 | 41 | 28 | 28 |
| 1.5 | 280 | 30 | 44 | 30 | 30 |
| 1.8 | 305 | 34 | 48 | 34 | 34 |
| 2.1 | 330 | 38 | 53 | 38 | 38 |
| 2.4 | 355 | 41 | 57 | 41 | 41 |
| 2.7 | 380 | 43 | 60 | 43 | 43 |
| 3.0 | 405 | 44 | 63 | 44 | 44 |
| 3.3 | 430 | 44 | 65 | 44 | 44 |
| 3.6 | 455 | 46 | 68 | 46 | 46 |
| 3.9 | 480 | 48 | 71 | 48 | 48 |

| Length of beam, m | Spacing centre to centre, mm | At middle of beam | | At ends of beam | |
|---|---|---|---|---|---|
| | | Siding, mm | Moulding, mm | Siding, mm | Moulding, mm |
| 4.2 | 505 | 50 | 75 | 50 | 50 |
| 5.2 | 590 | 58 | 86.5 | | |

NOTE
1. The Table scantlings are based on a timber having a standard density of 560 kg/m$^3$ and where timber of a different density is to be used the scantlings are to be modified in accordance with 5.1.4.
2. Where the beam spacing differs from that given in the Table, the strength of the beam is to be modified in direct proportion.

**5.2.14.2.2** Where the coachroof deck is of plywood the thickness determined from Table 18 may be reduced by 30 %

**5.2.14.2.3** Where plywood is sheathed with a laid deck the combined thickness may be 30% less than the thickness in Table 17 provided that:-

(a) the combined density of the plywood and sheathing is not less than 430 kg/m$^3$
(b) the thickness of the plywood is not less than 30% of the combined thickness and in no case is less than 6 mm, and
(c) where the laid planking is less than 19 mm, the seams are d with an approved flexible seam compound.

**5.2.14.2.4** If the coachroof deck is covered with canvas or other approved sheathing the thickness determined from Table 18 may be reduced by 1.5 mm.

**5.2.14.2.5** Where the coachroof beam spacing differs from that given in Table 18 the strength of the beams is to be modified in direct proportion and the deck thickness is to be modified at the rate of 1.5 mm per 50 mm difference.

**5.2.14.2.6** On small coachroofs where it is desired to dispense with beams the deck thickness will be specially considered.

**5.2.14.2.7** The coachroof and side deck are to be adequately stiffened in way of the mast. Where a mast is stepped on the coachroof the structural arrangements will be specially considered.

**5.2.14.3** Deckhouses

The scantlings of a deckhouse are dependent on the size of the house but the general standard of strength is to be that required for a coachroof and proposals will be specially considered.

**5.3 Scantlings for Hard Chine Vessels**

**5.3.1** Keel and Hog

**5.3.1.1** The keel shall be sided and moulded as indicated in Table 20, except in the case of single planked hard chine displacement vessels when they shall be as indicated in Table 3. The siding and moulding shown therein may be varied in accordance with the notes to these Tables.

**5.3.1.2** The minimum hog siding and moulding shall be as shown in Table 20 except in the case of single planked hard chine displacement vessels when they shall be as indicated in Table 3 but may be varied in accordance with the notes to these Tables.

Table 20: Hard Chine vessels – Keel and Hog

| Hard Chine Vessels - Keel and Hog | | | | | | |
|---|---|---|---|---|---|---|
| Measured length m | Keel | | | Hog | | |
| | Section area mm$^2$ | Siding mm | Moulding mm | Section area mm$^2$ | Siding mm | Moulding mm |
| 5 | 7350 | 70 | 105 | 4200 | 120 | 35 |
| 6 | 8625 | 75 | 115 | 5400 | 135 | 40 |
| 7 | 10625 | 85 | 125 | 6750 | 150 | 45 |
| 8 | 12150 | 90 | 135 | 8250 | 165 | 50 |
| 9 | 14250 | 95 | 150 | 9900 | 180 | 55 |
| 10 | 16800 | 105 | 160 | 10 725 | 195 | 55 |



| Hard Chine Vessels - Keel and Hog | | | | | | |
|---|---|---|---|---|---|---|
| Measured length m | Keel | | | Hog | | |
| | Section area $mm^2$ | Siding mm | Moulding mm | Section area $mm^2$ | Siding mm | Moulding mm |
| 11 | 18700 | 110 | 170 | 12600 | 210 | 60 |
| 12 | 21600 | 120 | 180 | 14625 | 225 | 65 |
| 13 | 23750 | 125 | 190 | 16800 | 240 | 70 |
| 14 | 27000 | 135 | 200 | 19 125 | 255 | 75 |
| 15 | 29400 | 140 | 210 | 20250 | 270 | 75 |
| 16 | 33750 | 150 | 225 | 22800 | 285 | 80 |
| 17 | 36425 | 155 | 235 | 25500 | 300 | 85 |
| 18 | 40425 | 165 | 245 | 28800 | 320 | 90 |
| 19 | 44200 | 170 | 260 | 31825 | 335 | 95 |
| 20 | 48600 | 180 | 270 | 35000 | 350 | 100 |
| 21 | 51800 | 185 | 280 | 36500 | 365 | 100 |
| 22 | 56550 | 195 | 290 | 39900 | 380 | 105 |
| 23 | 60000 | 200 | 300 | 43450 | 395 | 110 |
| 24 | 65100 | 210 | 310 | 47150 | 410 | 115 |

NOTES:

1. Keel siding and moulding may be varied provided section area is maintained and siding is sufficient to provide 0.25 times the table siding on each side of the shaft tube.
2. Hog siding and moulding may be varied provided section area is maintained and
   (i). Siding is sufficient for garboard plank landings of at least 1.75 times prank thickness on either side of keel: and
   (ii). Moulding is sufficient to provide 2.5 times plank thickness.
3. Vessels over 24 metres measured length will be specially considered by the Authority.

**5.3.1.3** The keel and hog may be either laminated or of solid timber construction. Where of solid timber construction the keel and hog in vessels less than 10 metres in length shall be in one length, and for vessels 10 metres in length and over where the keel or hog is not in one length it shall be efficiently scarphed.

**5.3.1.4** Where a keel or hog is scarphed, such scarphs shall be in accordance with 5.2.1

**5.3.2** Stem

**5.3.2.1** Stem scantlings at the heel shall in no case be less in siding and moulding than the scantlings for the keel determined from 5.3.1 and Table 20.

**5.3.2.2** The scarph of the stem to keel shall not be less than 2.5 times the keel moulding in length.

**5.3.3** Transom

**5.3.3.1** Transom thickness shall be obtained from Table 21 and associated notes, except in the case of single planked hard chine displacement vessels when the transom thickness shall be obtained from Table 22

**5.3.3.2** Transom should have space to allow for at least two outboard engines to be fitted for passengers and cargo vessels.

Table 21: Hard Chine Vessels Transom

| Hard Chine Vessels - Transom | | | | | |
|---|---|---|---|---|---|
| Measured length m | Thickness plywood mm | *Stiffeners | | Margin | |
| | | Siding mm | Moulding mm | Siding mm | Moulding mm |
| 5 | 12 | 50 | 25 | 75 | 35 |
| 6 | 12 | 55 | 25 | 80 | 40 |
| 7 | 12 | 60 | 25 | 85 | 45 |
| 8 | 12 | 60 | 30 | 90 | 45 |



| Hard Chine Vessels - Transom | | | | | |
|---|---|---|---|---|---|
| Measured length m | Thickness plywood mm | *Stiffeners | | Margin | |
| | | Siding mm | Moulding mm | Siding mm | Moulding mm |
| 9 | 16 | 65 | 30 | 95 | 50 |
| 10 | 16 | 70 | 30 | 100 | 50 |
| 11 | 19 | 70 | 35 | 105 | 50 |
| 12 | 19 | 75 | 40 | 110 | 55 |
| 13 | 19 | 80 | 40 | 120 | 60 |
| 14 | 24 | 85 | 45 | 125 | 60 |
| 15 | 24 | 90 | 45 | 130 | 65 |
| 16 | 24 | 95 | 45 | 140 | 65 |
| 17 | 24 | 95 | 50 | 145 | 70 |
| 18 | 24 | 100 | 50 | 150 | 75 |
| 19 | 24 | 105 | 50 | 160 | 75 |
| 20 | 24 | 110 | 55 | 165 | 80 |
| 21 | 30 | 115 | 55 | 170 | 80 |
| 22 | 30 | 115 | 60 | 180 | 85 |
| 23 | 30 | 120 | 60 | 185 | 90 |
| 24 | 30 | 125 | 65 | 190 | 90 |

• Stiffeners spaced at 450mm centre to centre.

NOTES:

1. Where planking is used table thickness is to be increased by 25%.
2. Where stiffener spacing varies from the standard spacing of 450mm used in the table stiffener scantlings are to be adjusted by maintaining the section modulus of the stiffener per millimetre of stiffener spacing.
3. Transom thickness may be decreased if the stiffener spacing is less than the basic 450mm as follows:
   (i). Plywood-3mm per 50mm
   (ii). Planking-3mm per 30mm.
4. Plywood may be in multiple thicknesses to obtain the total thickness shown in the table.
5. The table scantlings are for hardwood of 960 kg/m$^3$ density and marine grade waterproof plywood.
6. Vessels over 24 metres measured length will be specially considered by the Authority.

Table 22: Transom

| Transom | | | | | |
|---|---|---|---|---|---|
| Measured length m | Thickness mm | *Stiffeners | | Margin | |
| | | Siding mm | Moulding mm | Siding mm | Moulding mm |
| 5 | 28 | 50 | 25 | 75 | 35 |
| 6 | 30 | 55 | 25 | 80 | 40 |
| 7 | 32 | 60 | 25 | 85 | 45 |
| 8 | 34 | 60 | 30 | 90 | 45 |
| 9 | 36 | 65 | 30 | 95 | 50 |
| 10 | 38 | 70 | 30 | 100 | 50 |
| 11 | 40 | 70 | 35 | 105 | 50 |
| 12 | 42 | 75 | 40 | 110 | 55 |
| 13 | 44 | 80 | 40 | 120 | 60 |
| 14 | 46 | 85 | 45 | 125 | 60 |
| 15 | 48 | 90 | 45 | 130 | 65 |
| 16 | 50 | 95 | 45 | 140 | 65 |
| 17 | 52 | 95 | 5O | 145 | 70 |
| 18 | 54 | 100 | 50 | 150 | 75 |

| Transom | | | | | |
|---|---|---|---|---|---|
| Measured length m | Thickness mm | *Stiffeners | | Margin | |
| | | Siding mm | Moulding mm | Siding mm | Moulding mm |
| 19 | 56 | 105 | 50 | 160 | 75 |
| 20 | 58 | 110 | 55 | 165 | 80 |
| 21 | 60 | 115 | 55 | 170 | 80 |
| 22 | 62 | 115 | 60 | 180 | 85 |
| 23 | 64 | 120 | 60 | 185 | 90 |
| 24 | 66 | 125 | 65 | 190 | 90 |

• Stiffeners spaced at 450 mm centre to centre.

NOTES:

1. Table thickness is for single thickness planked construction. Where diagonal or multiple skin construction is adopted, the thickness may be reduced to 0.75 of that in the table.
2. Where stiffener spacing is less than the standard spacing or 450 mm used in the table stiffener scantlings may be adjusted by maintaining the section modulus of stiffener per millimetre of stiffener spacing. For example:
   Vessel 20 m length-propose to use spacing-of 300 mm with siding of 100 mm:
   Modulus per millimetre at table scantlings and spacing = 123
   Required moulding = $\sqrt{\frac{123\times300\times6}{100}}$ = 47 mm
3. Where the stiffener spacing is less than the basic 450 mm the transom thickness may be decreased for every decrease in the resulting space between the stiffeners at the rate of 3 mm per 30 mm decrease.

**5.3.3.3** Transoms shall have stiffeners, spaced at not more than 450 mm centres, together with margins. The stiffeners and margins shall have scantlings derived from Table 21 except in the case of single planked hard chine displacement vessels when the scantlings shall be obtained from Table 22.

**5.3.3.4** A substantial knee shall be fitted and through bolted through the transom and the hog.

**5.3.4** Web Frames

**5.3.4.1** The scantlings for web frames are to be derived from Table 23. If the basic web frame spacing shown in Table 23 is not adopted, the scantling of the web frame shall be adjusted by maintaining the section modulus of the frame per millimetre of frame spacing.

**5.3.4.2** Where a web frame is notched in excess of 12.5% of its depth to accommodate longitudinals, the moulding of the web frame shall be increased to maintain the required sectional area in way of the notch.

**5.3.4.3** A floor timber of siding equal to that of the web frame, is to be used to connect the web frame members across the top of the keel and hog

**5.3.4.4** Gussets or chocks shall be used to connect the bilge and topside sections of web frames. These shall be of adequate scantling and through fastened by bolts. Where web frames are not in one-piece suitable strengthening shall be provided in way of any joint.

**5.3.4.5** Where web frames are used, intermediate frames of dimensions and spacings determined for bent frames are required to be fitted between the web frames.

Table 23: Transverse web frames

| Transverse Web Frames | | | |
|---|---|---|---|
| Measured length m | Web frames | | |
| | *Spacing mm | Siding mm | Moulding mm |
| 5 | 500 | 20 | 60 |
| 6 | 550 | 25 | 65 |
| 7 | 600 | 25 | 75 |
| 8 | 650 | 30 | 80 |



| Transverse Web Frames | | | |
|---|---|---|---|
| Measured length m | Web frames | | |
| | *Spacing mm | Siding mm | Moulding mm |
| 9 | 700 | 30 | 90 |
| 10 | 750 | 35 | 95 |
| 11 | 800 | 35 | 105 |
| 12 | 850 | 40 | 110 |
| 13 | 900 | 45 | 120 |
| 14 | 950 | 45 | 125 |
| 15 | 1000 | 50 | 135 |
| 16 | 1050 | 50 | 140 |
| 17 | 1100 | 55 | 150 |
| 18 | 1150 | 60 | 155 |
| 19 | 1200 | 60 | 165 |
| 20 | 1250 | 65 | 170 |
| 21 | 1300 | 65 | 180 |
| 22 | 1350 | 70 | 185 |
| 23 | 1400 | 75 | 195 |
| 24 | 1450 | 75 | 200 |

• Spacing is measured from frame centre to frame centre.

NOTES:

1. Where the basic spacing shown in the table is not adopted, frame scantlings are to be adjusted by maintaining the section modulus of the frame per millimetre of frame spacing
2. Frames of the above siding and moulding may be notched to a depth of not more than 12.5% of the moulding to house longitudinal stringers,

**5.3.5** Intermediate Frames in Longitudinally Planked Hard Chine Hulls

Intermediate frames, of dimensions and spacing's determined for the frames in round bilge hulls having the same measured length, are required to be provided and fitted between the web frames. These frames should be housed into the chine a distance of not more than 10mm for their full cross-sectional area and dead nailed to the sheer clamp.

**5.3.6** Floors

**5.3.6.1** Floors shall be fitted at each transverse web frame and between web frames at not more than 450 mm centres

**5.3.6.2** The siding and moulding of floors shall be determined from Table 24

Table 24: Hard Chine Vessels Floor

| Hard Chine Vessels - Floor | | |
|---|---|---|
| | *Floors | |
| Measured length | Siding | Moulding at centre line |
| m | mm | mm |
| 5 | 35 | 90 |
| 6 | 35 | 100 |
| 7 | 40 | 110 |
| 8 | 40 | 120 |
| 9 | 45 | 130 |
| 10 | 50 | 140 |
| 11 | 50 | 150 |
| 12 | 55 | 160 |
| 13 | 60 | 180 |
| 14 | 60 | 190 |
| 15 | 65 | 200 |

| Hard Chine Vessels - Floor | | |
|---|---|---|
| | *Floors | |
| Measured length | Siding | Moulding at centre line |
| 16 | 70 | 210 |
| 17 | 70 | 220 |
| 18 | 75 | 230 |
| 19 | 80 | 250 |
| 20 | 80 | 260 |
| 21 | 85 | 270 |
| 22 | 90 | 280 |
| 23 | 90 | 290 |
| 24 | 95 | 300 |

* Floors spaced at 450mm centres.

NOTES:

1. Where floor spacing is less than 450mm, floor scantlings may be adjusted by maintaining the section modulus of the floor at the vessel's centre line per millimetre of floor spacing
2. Vessels over 24 metres measured length will be specially considered by the Authority.

**5.3.6.3** Where floors are fitted in the throat of a web frame then the siding may be reduced to that of the web frame, provided the moulding is increased to maintain the section area at the vessel's centreline.

**5.3.6.4** Intermediate floors between web frames shall extend and be fastened to a stringer.

**5.3.7** Stringers

**5.3.7.1** The scantlings of bottom stringers shall be determined from Table 24 and associated notes.

Table 25: Hard Chine vessels bottom stringers

| Bottom stringers | | | | |
|---|---|---|---|---|
| Measured length | Spacing | Total section area per side | Moulding | Siding |
| m | mm | $mm^2$ | mm | mm |
| 5 | 215 | 2760 | 20 | 46 |
| 6 | 245 | 4032 | 24 | 56 |
| 7 | 270 | 5544 | 28 | 66 |
| 8 | 295 | 7056 | 28 | 84 |
| 9 | 260 | 8448 | 32 | 66 |
| 10 | 280 | 9728 | 32 | 76 |
| 11 | 300 | 11248 | 38 | 74 |
| 12 | 320 | 12464 | 38 | 82 |
| 13 | 280 | 14060 | 38 | 74 |
| 14 | 300 | 15580 | 38 | 82 |
| 15 | 325 | 17200 | 40 | 86 |
| 16 | 345 | 18400 | 40 | 92 |
| 17 | 310 | 20160 | 40 | 84 |
| 18 | 330 | 21600 | 40 | 90 |
| 19 | 340 | 22680 | 42 | 90 |
| 20 | 355 | 24192 | 42 | 96 |
| 21 | 325 | 25872 | 42 | 88 |
| 22 | 340 | 27048 | 42 | 92 |
| 23 | 355 | 28336 | 44 | 92 |
| 24 | 370 | 30184 | 44 | 98 |

NOTES:

1. Where stringer spacing varies from the table, stringer scantlings are to be adjusted by maintaining the section



modulus of stringer per millimetre of stringer spacing

2. Where the spacing of web frames supporting bottom or side stringers varies from the table spacing the scantlings of stringers shall be increased or may be decreased for any increase or decrease respectively in web frame spacing by increasing or decreasing the section modulus in accordance with-the formula:

$Z_1 = Z\left(\frac{S_1^2}{S^2}\right)$

Where Z = section modulus of table stringer as adjusted for stringer spacing, if applicable.

$Z_1$ = required section modulus at new. spacing

$S_1$ = table spacing for web frames

$S$ = new spacing for web frames

3. Vessels over 24 metres measured length will be specially considered by the Authority.

**5.3.7.2** A reduction in scantlings to 60% of the scantlings determined from Table 25 may be made for side stringers.

**5.3.7.3** Stringers should run for the full length of the vessel wherever possible.

**5.3.7.4** Where practicable, stringers should be in one length. If not in one length stringers shall be scarphed.

**5.3.7.5** Where stringers are scarphed, scarphs shall be not less in length than 6 times the dimension of the edge or face scaphed, and suitably fastened.

**5.3.7.6** Feather edge scarphs shall be suitably fastened and glued.

**5.3.8** Chines

**5.3.8.1** The minimum scantlings for chines shall be determined from Table 26

Table 26: Hard Chine vessels Chines

| Vessels Chines | | | |
|---|---|---|---|
| Measured length | Sectional area | Siding | Moulding |
| m | $mm^2$ | mm | mm |
| 5 | 1458 | 27 | 54 |
| 6 | 1800 | 30 | 60 |
| 7 | 2312 | 34 | 68 |
| 8 | 2628 | 36 | 73 |
| 9 | 3200 | 40 | 80 |
| 10 | 3872 | 44 | 88 |
| 11 | 4560 | 48 | 95 |
| 12 | 5354 | 52 | 104 |
| 13 | 6272 | 56 | 112 |
| 14 | 6844 | 58 | 118 |
| 15 | 7688 | 62 | 124 |
| 16 | 8712 | 66 | 132 |
| 17 | 9248 | 68 | 136 |
| 18 | 10366 | 72 | 144 |
| 19 | 10952 | 74 | 148 |
| 20 | 12168 | 78 | 156 |
| 21 | 12800 | 80 | 160 |
| 22 | 13440 | 82 | 164 |
| 23 | 14450 | 85 | 170 |
| 24 | 15480 | 88 | 176 |

**5.3.8.2** The ratio of siding to moulding of chines is generally not to be greater than 1 to 2. In any case the siding shall be sufficient to provide a faying surface equal to 2.5 times the thickness of the bottom planking.

**5.3.8.3** Where practicable, chines should be in one length. If not in one length chines shall be scarphed.

**5.3.8.4** Where chines are scarphed, scarphs shall be not less in length than 6 times the siding and suitably fastened.

**5.3.8.5** The ends of diagonal planking and plywood shall be protected at the chine edge.

**5.3.9** Chines for Single Planked Vessels

(a) The dimensions of chines are to be determined from Table 27
(b) Where practicable, chines should be in one length, but may be scarphed, in which case the scarphs shall be not less in length than 6 times the moulding and be edge bolted.

Table 27: Chines and Stringers (Single planked hulls)

| Measured length | Chines | | | Stringers | | |
|---|---|---|---|---|---|---|
| | Section area | siding | moulding | Section area per side | siding | Moulding |
| m | $mm^2$ | mm | mm | $mm^2$ | mm | mm |
| 5 | 1950 | 30 | 65 | 5400 | 60 | 30 |
| 6 | 2450 | 35 | 70 | 5850 | 65 | 30 |
| 7 | 3000 | 40 | 75 | 7350 | 70 | 35 |
| 8 | 3600 | 45 | 80 | 8400 | 80 | 35 |
| 9 | 4250 | 50 | 85 | 9600 | 80 | 40 |
| 10 | 4950 | 55 | 90 | 11400 | 95 | 40 |
| 11 | 6000 | 60 | 100 | 14175 | 105 | 45 |
| 12 | 7150 | 65 | 110 | 14850 | 110 | 45 |
| 13 | 8050 | 70 | 115 | 18000 | 120 | 50 |
| 14 | 9375 | 75 | 125 | 18750 | 125 | 50 |
| 15 | 10800 | 80 | 135 | 22275 | 135 | 55 |
| 16 | 12325 | 85 | 145 | 23100 | 140 | 55 |
| 17 | 13950 | 90 | 155 | 27000 | 150 | 60 |
| 18 | 15675 | 95 | 165 | 31200 | 160 | 65 |
| 19 | 17000 | 100 | 170 | 32175 | 165 | 65 |
| 20 | 18375 | 105 | 175 | 36750 | 175 | 70 |
| 21 | 19800 | 110 | 180 | 37800 | 180 | 70 |
| 22 | 21 275 | 115 | 185 | 42750 | 190 | 75 |
| 23 | 22800 | 120 | 190 | 45000 | 200 | 75 |
| 24 | 24375 | 125 | 195 | 49200 | 205 | 80 |

NOTES:

1. At least 3 stringers shall be fitted on each side of a round bilge hull and in the bottom of chine hulls. Where more than 3 stringers are fitted their scantlings shall be subject to special consideration by the Authority.
2. Stringers may be laminated. Each lamination should be not less than 12mm in thickness
3. Scantlings of chines and stringers may be reduced from those shown in the table by a uniform taper of both siding and moulding by up to 20% of the cross-sectional area beyond 0.6L amidships.

**5.3.10** Beam Shelf/Sheer Clamp

**5.3.10.1** A suitable beam shelf and/or sheer clamp shall be fined and the minimum section area shown in Table 28 is to be maintained.

Table 28: Hard Chine Vessels - Beam Shelf/ Sheer Clamp

| Measured length m | Section area $mm^2$ |
|---|---|
| 5 | 2300 |
| 6 | 2500 |
| 7 | 3250 |
| 8 | 4050 |
| 9 | 4900 |
| 10 | 6000 |
| 11 | 6970 |
| 12 | 7420 |



| Measured length m | Section area $mm^2$ |
|---|---|
| 13 | 8500 |
| 14 | 9620 |
| 15 | 10800 |
| 16 | 12350 |
| 17 | 13650 |
| 18 | 15370 |
| 19 | 15750 |
| 20 | 17200 |
| 21 | 19120 |
| 22 | 20700 |
| 23 | 22320 |
| 24 | 24500 |

NOTE:

Vessels over 24 metres measured length will be specially considered by the Authority.

**5.3.10.2** The siding of the sheer clamp shall be sufficient to maintain faying surfaces equal to twice the deck planking thickness.

**5.3.11** Fitting of Longitudinal Members

**5.3.11.1** Beyond 0.6L amidships the scantlings of stringers, chines, sheer clamps and beam shelves may be reduced by a uniform taper of both moulding and siding by up to 20% of the cross-sectional area shown in the Tables.

**5.3.11.2** Scarphs in stringers, sheer clamps, beam shelf etc. may not be closer than the web frame spacing, measured between the closest extremities of the scarphs considered. Scarphs are not permitted in way of bulkheads, web frames or in line with keel scarphs. The scarph in a sheer clamp shall not be closer to the butt in a sheer strake than one web frame spacing.

**5.3.11.3** Breasthooks of grown timber or chocks of straight grain or brackets are to be fitted at the forward end of the hull between the stem and: .

(i) Sheer clamp
(ii) Chines in vessels of 12.5 metres in length and over.

**5.3.11.4** Grown knees, solid chocks or brackets are required to be fitted between the transom and:

(i) Sheer clamp
(ii) Chines in vessels of 12.5 metres in length and over
(iii) Every second stringer in vessels of 12.5 metres in length and over.

**5.3.12** Watertight Bulkheads

Watertight Bulkheads are to have scantlings determined from 3.2.8 and associated notes.

**5.3.13** Hull Planking

**5.3.13.1** The hull planking thickness shall be determined in accordance with Table 29 and associated notes.

**5.3.13.2** Where in double planked fully glued diagonal construction the planking layers are laid parallel to each other, then the overlap between alternate layers shall be not less than 4 times the plank thickness and not more than half the plank width.

Table 29: Hard Chine Vessels - Hull Planking Thickness

| Measured length m | Bottom | | Topside | |
|---|---|---|---|---|
| | Plywood mm | Double diagonal mm | Plywood mm | Double diagonal mm |
| 5 | 9 | 15 | 9 | 15 |
| 6 | 11 | 17 | 9 | 15 |
| 7 | 12 | 19 | 9 | 15 |
| 8 | 14 | 21 | 11 | 16· |

| Measured length m | Bottom | | Topside | |
|---|---|---|---|---|
| | Plywood mm | Double diagonal mm | Plywood mm | Double diagonal mm |
| 9 | 15 | 23 | 11 | 18 |
| 10 | 16 | 25 | 12 | 19 |
| 11 | 18 | 26 | 14 | 20 |
| 12 | 20 | 28 | 15 | 21 |
| 13 | 21 | 30 | 16 | 23 |
| 14 | 22 | 32 | 17 | 24 |
| 15 | 24 | 34 | 18 | 26 |
| 16 | 25 | 36 | 19 | 27 |
| 17 | 27 | 38 | 20 | 29 |
| 18 | 28 | 40 | 21 | 30 |
| 19 | 30 | 42 | 22 | 32 |
| 20 | 31 | 44 | 23 | 33 |
| 21 | 33 | 45 | 25 | 34 |
| 22 | 34 | 47 | 26 | 36 |
| 23 | 36 | 49 | 27 | 37 |
| 24 | 37 | 51 | 28 | 39 |

NOTES:

1. Where stringer spacing differs from the basic stringer spacing's shown in Table 25 planking thickness shall be increased and may be decreased for every increase or decrease respectively in the resulting span between stringers as follows:
   (i). Plywood-3 mm per 50 mm difference
   (ii). Diagonal planking-3 mm per 30 mm difference.
2. Plywood may be in multiple thicknesses to obtain the total thickness shown in the table.
3. The table scantlings are for hardwood of 960 kg/m$^3$ density and marine grade water-proof plywood to Australian Standard AS 2272-Plywood for Marine Craft.
4. Table thicknesses for double diagonal planking are applicable only to hulls where planking layers are glued together.
5. Vessels over 24metres measured length will be specially considered by the Authority.

**5.3.14** Deck Beams

Scantlings of ordinary deck beams are not to be less than those determined from 5.2.10 and associated notes.

**5.3.15** Deck Planking

Deck planking thickness shall be determined in accordance with 5.2.11 and associated notes.

**5.3.16** Pillars

The scantlings of pillars shall be determined in accordance with 5.2.12 and associated notes.

**5.3.17** Engine Seating

The installation of engine seating shall be in accordance with 5.2.13 and associated notes.

**5.3.18** Deckhouses

Deckhouses are to have scantlings determined from 5.2.14 and associated notes.

**5.4 Supplementary Provisions**

**5.4.1** Additional requirements for passenger boats

Sufficient handrails shall be securely installed on the outside of wheelhouse, deckhouse and in the interior of wheelhouse/deckhouse to the satisfaction of the Surveyor.

**5.4.2** Additional requirements for fishing boats

**5.4.2.1** In every decked vessel, sufficient bulwarks, guard rails or guard wires shall be provided at the exposed parts of the freeboard and superstructure decks and the tops of any deckhouses or companionways used in the operation of the vessel.

**5.4.2.2** In every decked vessel, adequate guard rails, lifelines, gangways or passages shall be provided



for the passage of the crew between their quarters, machinery spaces and working spaces. Storm rails shall be fitted on the outside of all deckhouses and casings.

**5.4.2.3** Controls of winches, line and net hauling shall be placed in a manner that the operators have ample room for their unimpeded operation and that they have a clear view on the working area. The winches and equipment shall be fitted with safety devices that are designed to prevent accidents.

**5.4.2.4** Flooring in fish rooms may be of either cement or timber. Where of cement, drain channels are to be fitted, draining to the bilge or slushwell.

**5.4.2.5** All grounds and hull structure not easily accessible after completion of construction are to be treated with at least three coats of a non-toxic wood preservative.

## 6 Manufacturing Facilities and Workmanship

### 6.1 Manufacturing Facilities

**6.1.1** Workshop conditions, material storage, and handling must be such that materials shall be free from contamination, readily accessible, and appropriate for the vessel to be built.

**6.1.2** Materials that would deteriorate with exposure to the weather shall be stored under cover.

**6.1.3** The Boatbuilder shall have processes to effectively monitor, verify and document the quality of construction and compliance with design documentation throughout the build program and at its completion.

NOTES:

1. This would include ongoing inspections and/or tests at critical stages of construction.
2. A quality management system provides a widely recognized framework to facilitate the compliance of a vessel with quality and compliance standards.

**6.1.4** All boatbuilding manufacturing facilities shall be identified, recognized and registered by the overseeing authority.

### 6.2 Workmanship

**6.2.1** General

The workmanship applied to the construction of vessels shall be of sufficient quality to achieve the outcomes of structural strength and watertight integrity required by the provisions of this standard.

All boatyard workers shall be registered by the overseeing authority with identification numbers that categorise areas of specialization and expertism.

**6.2.2** Construction procedure

**6.2.2.1** Workshop requirements

All boatyard workshops shall be inspected by surveyor(s) and on successful inspection, workshop safety certificate shall be issued.

The craft is to be suitably protected during the building period from adverse weather and climatic conditions. The minimum protection to be provided is normally a substantial and efficient roof projecting beyond the length and breadth of the craft. Where laminated glued construction is being extensively used, a building shed with controlled temperature and humidity levels may be required.

**6.2.2.2** Workmanship is to be well executed and carried out under adequate supervision throughout the preparation and building of the craft. The various parts of the structure are to be properly faired and fitted.

**6.2.2.3** When a hull is to be transported for fitting out and completion elsewhere, the construction should be progressed to a stage commensurate with the method of transport to be used. When a partially completed vessel is to be towed or propelled afloat, the Boatbuilders are to ensure that its stability and weathertightness is adequate prior to its removal from the Boatbuilders yard.

**6.2.3** Preservative treatment

The preservatives are preferably to be applied by dipping and soaking or by pneumatic spray but where these methods are not practicable a liberal application by brush can be used. The timber is to be treated when all work on the member is complete, but where cut or bored after treatment a liberal brush application is to be applied to the exposed timber.

**6.2.4** Plywood

All edges and cut-out areas are to be thoroughly sealed by glues, varnishes, paints or other suitable compositions to prevent moisture penetrating along the end-grain.

**6.2.5** Gluing process

**6.2.5.1** The timber is to be clean and dry, and the joining surfaces are to be properly prepared and free from dust and grease. The adhesive is to be evenly applied and the joint closed within the manufacturer's recommended closing time in order to obtain a thin and uniform glue line. Sufficient clamps and other pressure devices are to be used and the pressure is not to be released until the joint has set.

**6.2.5.2** Modified urea-formaldehydes may be used in parts of the structure which will not be commonly subjected to continuously wet conditions and will be well ventilated. These parts include the coach roof and superstructures in both wood and plywood craft and internal structural assemblies which are clear of the bilges in plywood craft only. The glue lines in these structures are to be protected by several applications of varnish or paint.

**6.2.5.3** The glues are to be mixed and applied in accordance with the manufacturer's instructions and with due regard to the shop temperature and humidity requirements. Due attention is to be paid to the application techniques for the species of timber being glued and the manufacturer's advice should be sought in the working of difficult timbers and the effect of preservatives on the materials.

**6.2.6** Laminated timbers

**6.2.6.1** The layers forming the lamination are generally to be of the same timber species and are to be of even moisture content. The grain of the layers is to be approximately parallel to the length of the member, and special attention is to be paid to grain in the selection and assembly of the timber.

**6.2.6.2** Where practicable the layers are to be continuous, and if this is not possible, the layers are to be scarph jointed, the slope of the scarph being not greater than 1 in 10.

**6.2.6.3** Where the layers are bent to produce members of curved form, the thickness of each layer is to be such that the layer will not be unduly stressed in forming, and that a satisfactory inter laminar bond can be achieved.

**6.2.7** Fastening practice

**6.2.7.1** Attention is to be paid to the fastenings throughout, particularly the size and disposition. The boring of the timber to receive the fastenings is to be properly executed, according to the density of the timber and the type and material of the fastening.

**6.2.7.2** All hull and deck through-fastenings are to be of a composition similar to that of any metal members they secure. Where this cannot be arranged, suitable insulation is to be fitted to prevent contact between dissimilar metals.

**6.2.7.3** Where craft are sheathed with copper or other non-ferrous metals, iron or steel fastenings are not to be used in way.

**6.2.7.4** Through bolts are to be clenched on rings or washers or are to be fitted with nuts. Nuts, rings or washers are to be of the same material as the bolts.

**6.2.7.5** Where bolt fastenings pass through the outside planking or centreline structure, cotton or other suitable grommets are to be fitted under the heads. Keel bolt and centreline fastening holes are to be treated with a suitable composition.

**6.2.7.6** Where screw fastenings are used, the thread of the screw must enter the frame or beam a minimum distance equal to the thickness of the hull or deck planking.

# 7 Compliance and Boats Identification

## 7.1 General

It is the responsibility of the Boatbuilder/Owner of the new vessel to be constructed to this guideline to inform the Overseeing Authority on the intention to build and register the vessel.

**7.1.1** Prior to commencement of construction the Boatbuilder/Owner is to provide the following information:

-

(a) Dimensions and power;
(b) Intended use of the vessel
(c) Construction material with attached certificate of material assessment by a competent forest authority;
(d) Place of build (hull)
(e) Place of outfit (where differing from build location)
(f) Proposed date of commencement of construction
(g) Proposed date of completion of vessel
(h) Area of operation
(i) Boatyard certificate issued by the Overseeing Authority

**7.2 Safety Compliance Notice**

**7.2.1** Every Boat constructed according to these Guidelines shall have fitted to it, in a conspicuous position, plainly visible from the helm (unless exempt by regulation), a Safety Compliance Notice issued by the Overseeing Authority

A Compliance Notice is defined as either:

(a) Conformity Label,
(b) Capacity Label,

Example of Marked Information

The Conformity Label shall include the following:

(a) name of manufacturer;
(b) manufacturers or constructor's identification code, MIC;
(c) model type or number, or both;
(d) label number; and
(e) statement of compliance.

| Tanzania Shipping Agencies Corporation (TASAC) | | |
|---|---|---|
| BOATBUILDER: ABC IMAGINARY CO (AAAA) ie MIC | | |
| The manufacturer certifies that this Boat complies with the requirement of the construction Standards for wooden Boats | | |
| MAXIMUM LOAD | MAXIMUM OCCUPANTS | MAXIMUM POWER |
| ---------- kg | ---------- Persons | ----------KW (HP) |
| No._ XXXX0016 | | |

Figure 21: Conformity Label Example

**7.3 Hull Identification Number (HIN)**

The identification code consists of 12 consecutive characters displayed as capital letters of the alphabet or Arabic numerals with no spaces, slashes (oblique's), or hyphens between them. The code comprises:

(a) a three-digit Manufacturer's Identification Code (MIC); followed by
(b) a five-character Manufacturer's Hull Serial Number; and
(c) four figures giving the date of manufacture.

**7.3.1** Manufacturer's Identification Code (MIC)

The MIC consists of three characters displayed as block capitals or numbers, forming the first three characters of the HIN, as issued by the Overseeing Authority.

**7.3.2** Manufacturer's Hull Number

**7.3.2.1** The fourth through eighth characters of the HIN are the individual Manufacturer's Hull Number, which is defined by the manufacturer.

**7.3.2.2** No two Boats shall be assigned the same Manufacturer's Hull Number.

**7.3.2.3** The Manufacturer's Hull Number shall consist of capital letters of the alphabet or Arabic numerals, or both, except that the letters "I," "O," and "Q" shall not be used.

**7.3.3** Date of Manufacture



**7.3.3.1** The ninth through twelfth characters of the HIN indicate the date of manufacture. The ninth character is a capital letter of the alphabet indicating the month from when the craft is considered to have commenced construction and is defined as follows:

A=January, B=February, C=March, D=April, E=May, F=June, G=July, H=August, I=September, J=October, K=November, L=December

**7.3.3.2** The tenth is an Arabic numeral designating the last digit of the year of manufacture.

**7.3.3.3** Characters eleven and twelve are Arabic numerals marking the model year of the Boat.

| ABC2AB41G091 | | | |
|---|---|---|---|
| Manufacturer's Identification Code (MIC) | Manufacturer's Hull Number | Commencement of Construction | Model year |
| ABC | 2AB41 | G0 | 91 |

Figure 22: Example of Twelve-Digit Hull Identification Number (HIN)

Figure 22 is a typical example of a complete twelve-digit HIN for a Boat where construction commenced in July 1990 for the 1991 model year



## Annex A
## (informative)

### Mean Strength Properties of Tanzania Timbers

| SN. | Botanical name | Trade name | Density | Static bending Centre loading | | Compression | Hard (Resistance to indentation) | Shear |
|---|---|---|---|---|---|---|---|---|
| | | | At 12% m.c. Air dried | Max bending strength MOR | Stiffness MOE | Max. compression strength parrallel to grain | On side grain | Max. Shear strength parrallel to grain |
| | | | Kg/ $m^3$ | $N/mm^2$ | $N/mm^2$ | $N/mm^2$ | N | $N/mm^2$ |
| | *1* | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
| 1. | *Acacia mearnsii* | Black wattle | 722 | 121 | 14372 | 60.8 | 7778 | 15.6 |
| 2. | *Acacia melanoxvlon* | Australian black wood | 689 | 101 | 15269 | 60.44 | 4640 | 19.2 |
| 3. | *Acacia nigrescens* | Mkambala | 1122 | 132 | 13793 | 76.2 | 19067 | 21.8 |
| 4. | *Afzelia quanzensis* | E.A. afzelia | 833 | 114 | 10441 | 69.2 | 8222 | 19.0 |
| 5. | *Albizia amara* | Mkengehovu | 677 | 114.7 | 9753 | 50.8 | - | 20.5 |
| 6. | *Albizia gummifera* | Mfuranji | 465 | 79 | 8379 | 42.2 | 2844 | 15.3 |
| 7. | *Albizia versicolor* | Mtanga | 657 | 60 | 7227 | 43.0 | 4627 | 14.7 |
| 8. | *Albizia zygia* | Nongo | 577 | 89 | 10570 | 44.1 | 5155 | 15.4 |
| 9. | *Allanblackia stuhlmannii* | Allanblackia (msambu) | - | 76 | 19359 | 39.9 | 3849 | 10,2 |
| 10. | *Brachystegia spiciformis* | Mtundu | 817 (G) | 126 | 13406 | 68.7 | 8133 | 18.0 |
| 11. | *Brachystegia microphylla* | Mseni | 769 | 93 | 9797 | 68.7 | 84444 | 19.1 |
| 12. | *Breonadia salicina* | Mgwina | 962 | 85 | 12504 | 61.6 | 9778 | 14.6 |
| 13. | *Callitris robusta* | Cypress pine | 561 | 78 | 6639 | 45.2 | 4400 | - |
| 14. | *Casearia battiscombei* | White matua | 625 | 85 | 9683 | 47.5 | 3209 | 14.3 |
| 15. | *Cassipourea malosana* | Pillar wood | 737 (G) | 112 | 11602 | 67.7 | 5555 | 19.0 |
| 16. | *Cedrela odorata* | Central American cedar | 433 | 58 | 7538 | 36.0 | 2027 | 9.5 |
| 17. | *Cephalosphaera usambarensis* | Mtambara | 561 | 98 | 15791 | 46.2 | 3289 | 15.4 |
| 18. | *Chrysophyllum albidum* | Mululu | 721 | 133 | 13148 | 71.4 | 6933 | - |
| 19. | *Cinnamomum camphora 29 yrs* | Japanese camphor | 493 (G) | 71 | 7814 | 38.8 | 2875 | 12.0 |
| 20. | *Cocoa nucifera* | Mnazi | 601 | 67 | 77938 | 45.4 | 4813 | 8.1 |
| 21. | *Cordyla africana* | Mroma | 833 | 84 | 11248 | 59.8 | 7022 | - |
| 22. | *Croton megalocarpus* | Musine | 705 | 102 | - | 53.9 | 6000 | - |
| 23. | *Cupressus lusitanica (18yrs)* | E.A. cypress | 481 | 73 | 8172 | 42.3 | 2698 | 14.2 |
| 24. | *Diospyros abyssinica* | Msambu | | | | | | 17.3 |
| 25. | *Diospyros mespiliformis* | African ebony | 753 | 98 | 11145 | 53.0 | 6769 | 18.6 |
| 26. | *Ekebergia capensis* | Ol mokuma | 497 | 58 | - | 28.7 | 4000 | - |

| SN. | Botanical name | Trade name | Density | Static bending Centre loading | | Compression | Hard (Resistance to indentation) | Shear |
|---|---|---|---|---|---|---|---|---|
| | | | At 12% m.c. Air dried | Max bending strength MOR | Stiffness MOE | Max. compression strength parrallel to grain | On side grain | Max. Shear strength parrallel to grain |
| | | | Kg/ $m^3$ | $N/mm^2$ | $N/mm^2$ | $N/mm^2$ | N | $N/mm^2$ |
| | *1* | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
| 27. | *Entandrophragma exceisum* | Mrie | 465 | 52 | 7154 | 33.7 | 2044 | 10.9 |
| 28. | *Erithrophieum africanum* | Mkarati | - | 162 | 15404 | 97.1 | 12978 | 26.4 |
| 29. | *Erithrophieum suaveolens* | Mwavi | 978 | 145 | 14180 | 91.7 | 8222 | 16.6 |
| 30. | *Eucalyptus botryoides (20 yrs)* | Southern mahogany | 779 | 124 | 14676 | 66.0 | 5693 | 16.9 |
| 31. | *Eucalyptus globulus (14 yrs)* | Tasmanian blue gum | 784 | 108 | 14041 | 62.6 | 5867 | 17.2 |
| 32. | *Eucalyptus globulus (19 yrs)* | Tasmanian blue gum | 662 | 97 | 11572 | 49.7 | 3435 | 13.8 |
| 33. | *Eucalyptus maideni (14yrs)* | Maiden's gum | 807 | 131 | 16000 | 66.7 | 7164 | 18.3 |
| 34. | *Eucalyptus maideni (20 yrs)* | Maiden's gum | 843 | 121 | 12558 | 60.7 | 6253 | 17.0 |
| 35. | *Eucalyptus microcorys (15yrs)* | Tallow-wood | 849 | 117 | 14055 | 66.9 | 5867 | 19.6 |
| 36. | *Eucalyptus paniculata (14 yrs)* | Paniculata gum | 626 | 88 | 10283 | 51.6 | 3747 | 13.6 |
| 37. | *Eucalyptus paniculata (47 yrs)* | Paniculata gum | 1010 | 182 | 24879 | 96.3 | 13778 | 20.2 |
| 38. | *Eucalyptus regnans (14 yrs)* | Australian ash | 570 | 75 | 9600 | 45.4 | 3373 | 14.4 |
| 39. | *Eucalyptus salgina (35 yrs)* | Blue gum | 753 | 123 | 16887 | 67.6 | 6133 | 12.2 |
| 40. | *Eucalyptus saligna (14 yrs)* | Blue gum | 527 | 81 | 9924 | 44.9 | 2533 | 11.6 |
| 41. | *Fagaropsis angolensis* | Mafu | 673 | 110 | 13565 | 61.7 | 6080 | 19.6 |
| 42. | *Ficalhoa laurifoloia* | Mkuka | 675 | 94 | 10634 | 52.5 | 4978 | 13.4 |
| 43. | *Grevillea robusta* | Grevillea | 609 | 62 | 7154 | 36.3 | 3733 | 8.8 |
| 44. | *Hagenia abyssinica* | Ol kijabe | 657 | 90 | 9138 | 50.4 | 5218 | 18.4 |
| 45. | *Hallea rubrostipulata* | Mromberombe | 625 | 84 | 10055 | 47.6 | 3689 | 12.8 |
| 46. | *Hymenaea verrucosa* | Mtandarus | 817 | 111 | 11227 | 61.4 | 9244 | 22.9 |
| 47. | *Ilex mitis* | Msaira | 597 | 66 | 7890 | 35.3 | 5107 | 12.5 |
| 48. | *Isoberlinia scheffieri* | Mbarika | 801 | 108 | 13676 | 58.8 | 6293 | 13.3 |
| 49. | *Julbernardia globiflora* | Muwa | 946 | 142 | 14566 | 81.1 | 12267 | 23.8 |
| 50. | *Juniperus procera* | African pencil cedar | 513 | 91 | 8379 | 39.3 | 1911 | 12.8 |
| 51. | *Khaya anthotheca* | Mkangazi | 657 | 66 | 9604 | 48.3 | 5111 | 10.1 |
| 52. | *Macaranga conglomerata* | Muhaa | 465 | 62 | 8014 | 36.9 | 2267 | 11.7 |
| 53. | *Macaranga kilimandscharica* | Muhaa | 497 | 71 | - | 43.1 | 3111 | - |
| 54. | *Manilkara obovata* | Nkunya | 1026 | 158 | 19143 | 82.0 | 15244 | 19.7 |
| 55. | *Maranthes goetzeniana* | Nganga | 929 | 101 | 11988 | 52.8 | 8444 | 15.0 |
| 56. | *Markhamia platycalyx* | Msambia | 561 | 110 | - | 56.3 | - | - |

| SN. | Botanical name | Trade name | Density | Static bending Centre loading | | Compression | Hard (Resistance to indentation) | Shear |
|---|---|---|---|---|---|---|---|---|
| | | | At 12% m.c. Air dried | Max bending strength MOR | Stiffness MOE | Max. compression strength parrallel to grain | On side grain | Max. Shear strength parrallel to grain |
| | | | Kg/ $m^3$ | $N/mm^2$ | $N/mm^2$ | $N/mm^2$ | N | $N/mm^2$ |
| | *1* | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
| 57. | *Pseudolachnostylis maprouneifolia* | Mtunguru | 876 | 106 | 12400 | 54.4 | 7809 | 17.6 |
| 58. | *Milicia excelsa* | Mvule | 657 | 90 | 9345 | 54.7 | 5600 | 15.6 |
| 59. | *Millettia stuhlmannii* | Pangapanga | 849 | 118 | 12697 | 71.5 | 7227 | 20.2 |
| 60. | *Neoboutonia macrocalyx* | Mfurufuru | 390 | 50 | 8034 | 27.4 | 1662 | 9.1 |
| 61. | *Newtonia buchananii* | Mkufi | 561 | 97 | 9926 | 50.1 | 4622 | 15.4 |
| 62. | *Newtonia paucijuga* | Mdadalike | 721 | 98 | 11393 | 56.5 | 6120 | 19.5 |
| 63. | *Ocotea usambarensis* | E.A. camphor | 593 | 91 | 9926 | 52.5 | 4133 | 16.5 |
| 64. | *Ocotea usambarensis (second growth 40 yrs)* | E.A. camphor wood | 529 | 79 | 9281 | 48.8 | 2844 | 13.4 |
| 65. | *Olea capensis* | Loliondo | 737 | 91 | 10828 | 59.2 | 6267 | 18.9 |
| 66. | *O. capensis var. macrocarpa* | Musharagi | 913 | 174 | 17467 | 84.0 | 12178 | 28.1 |
| 67. | *Parinari exelsa* | Mula | 753 | 123 | 13406 | 65.8 | 7644 | 20.1 |
| 68. | *Pericopsis angolensis* | E.A. percopsis | 946 | 111 | 12317 | 76.0 | 10018 | 20.1 |
| 69. | *Pinus caribaea (13yrs)* | Caribbean pine | 421 | 51 | 6076 | 31.9 | 1760 | 9.2 |
| 70. | *Pinus montezumae (18yrs)* | Mexican pine | 447 | 58 | 7896 | 33.2 | 2204 | 11.6 |
| 71. | *Pinus patula (17yrs)* | Patula pine | 417 | 61 | 6445 | 34.5 | 1467 | 11.2 |
| 72. | *Pinus patula (22yrs)* | Patula pine | 449 | 71 | 7605 | 39.5 | 1867 | 12.9 |
| 73. | *Pinus patula (30yrs)* | Patula pine | - | 83 | 9023 | 46.7 | 2578 | 14.6 |
| 74. | *Pinus patula (15yrs)* | Patula pine | 505 | 56 | 8228 | 31.6 | 2044 | 8.8 |
| 75. | *Pinus patula (25yrs)* | Patula pine | 518 | 52 | 8317 | 33.2 | 2342 | 10.3 |
| 76. | *Pinus radiata (18yrs)* | Radiata pine | 465 | 51 | 7759 | 33.7 | 2138 | 10.7 |
| 77. | *Pinus radiata (33yrs)* | Radiata pine | 611 | 87 | 11945 | 52.4 | - | - |
| 78. | *Podocarpus spp* | Podo | 513 | 82 | 8057 | 43.1 | 3689 | 15.1 |
| 79. | *Polyscias fulva* | Mfumbati | 368 | 38 | 5834 | 26.2 | 1196 | 8.0 |
| 80. | *Populus canescens* | Grey poplar | 616 | 75 | 9663 | 45.9 | 3209 | 13.3 |
| 81. | *Pouteria adolfi-friedericii* | Manu | 535 | 63 | 7331 | 25.8 | 2933 | 12.7 |
| 82. | *Pseudolachnostylis maprouneifolia* | Mtunguru | 876 | 106 | 12400 | 54.4 | 7809 | 17.6 |
| 83. | *Pterocarpus angolensis* | Muninga | 657 | 94 | 8443 | 57.0 | 6578 | 17.2 |
| 84. | *Pterocarpus tinctorius* | Muninga maji | 765 | 88 | 9842 | 58.1 | 8500 | 17.9 |
| 85. | *Prunus* | Mueri | 785 | 122 | 11279 | 63.2 | 8267 | 19.9 |
| 86. | *Sclerocarya birrea* | Mng'ong'o | 561 | 53 | 3931 | 35.2 | 4222 | 14.2 |

| SN. | Botanical name | Trade name | Density | Static bending Centre loading | | Compression | Hard (Resistance to indentation) | Shear |
|---|---|---|---|---|---|---|---|---|
| | | | At 12% m.c. Air dried | Max bending strength MOR | Stiffness MOE | Max. compression strength parrallel to grain | On side grain | Max. Shear strength parrallel to grain |
| | | | Kg/ $m^3$ | $N/mm^2$ | $N/mm^2$ | $N/mm^2$ | N | $N/mm^2$ |
| | *1* | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
| 87. | *Sclerocarya caffra* | Mng'ong'o | 545 | 51 | 5607 | 29.3 | 3689 | 11.0 |
| 88. | *Spirostachyys africana* | Msaraka | 962 | 107 | 8637 | 59.9 | 8933 | 19.6 |
| 89. | *Sterculia appendiculata* | Mgude | 430 | 67 | 9098 | 40.0 | -- | 10,3 |
| 90. | *Sterculia quinqueloba* | Mbalamwezi | 753 | 75 | 9539 | 41.5 | 5955 | 11.5 |
| 91. | *Strombosia scheffieri* | Msangana | 881 | 123 | 14159 | 68.4 | 7507 | - |
| 92. | *Bobgunnia madagascariensis* | Kasanda | 1080 | 158 | 18700 | 81.3 | - | 18.7 |
| 93. | *Tectona grandis (20yrs)* | Teak | 625 | 85 | 10930 | 52.5 | 3969 | 15.0 |
| 94. | *Terminalia ivorensis* | Idigbo | 540 | 79 | 10686 | 46.0 | - | 11.8 |
| 95. | *Terminalia sambesiaca* | Mkurungu | 753 | 98 | 11903 | 62.1 | 6351 | 18.3 |
| 96. | *Terminalia superba* | Afara | 383 | 32 | 5103 | 25.5 | 1369 | 7.6 |
| 97. | *Vitex doniana* | Mfuru | 481 | 43 | 4676 | 28.0 | 3044 | 8.9 |
| 98. | *Warburgia stuhlmannii* | E.A. greenheart | 873 | 111 | 11703 | 61.9 | 8169 | 19.7 |
| 99. | *Xeroderris stuhlmannii* | Xeroderris | 817 | 114 | 14200 | 62.0 | - | 15.0 |
| 100. | *Xymalos monospora* | Mburano | 577 | 74 | 8731 | 45.6 | 3542 | 15.0 |
| 101. | *Zanha africana* | Mkalya | 801 | 80 | 8731 | 48.3 | 6689 | 17.1 |

Source: The commercial Timbers of Tanzania by J.M. Bryce and Revised by A.W. Chihongo.

Third edition 2003, published by Tanzania Forestry Research Institute.

**Annex B**
**(informative)**

**Swahili Terms in Wooden Boat Building**

| SN | English Name | Swahili Name |
|---|---|---|
| 1. | A beam | Tanga kati |
| 2. | Abaft | Tezi |
| 3. | Aboard | Chomboni |
| 4. | Amidships | omo |
| 5. | Aperture | Kidirisha |
| 6. | Armature | Amecha |
| 7. | Ballast | Farumi, weka Farumi au changarawe |
| 8. | Bilge Stringer | Tamkisi |
| 9. | Boom | Foromali |
| 10. | Bulk Head | Ukuta wa ndani/kiambaza |
| 11. | Bulwark | Kinga |
| 12. | Clamp | Darumeti |
| 13. | Clinker | Mavi chuma |
| 14. | Clinker Bilt | Jengo mweleko |
| 15. | Corrosion | Mbabuo anga hewa |
| 16. | Covering Board | Flali |
| 17. | Deck | Staha |
| 18. | Deck Beam | Fundo |
| 19. | Engine Bed | kitanda cha injini |
| 20. | Engine Bed Bolts | Bolti za kitanda cha injini |
| 21. | Engine Box | Sanduku la injini |
| 22. | Engine Floor | Sakafu ya injini |
| 23. | Fender | Kofi |
| 24. | Floor Beams | Mbao za kufungia mlingoti |
| 25. | Floor Boards | Mbao za sakafu |
| 26. | Floors | Aligama |
| 27. | Foundation Bolts | Misumari ya ghabu |
| 28. | Frame | Taluma |
| 29. | Free hand sketch | Mkakato |
| 30. | Garboard | Mbao za matiki |
| 31. | Hatch | Falika |
| 32. | Hog/Keelson | Bitana |
| 33. | Keel | Mtako/Mkuku |
| 34. | Keel Bolts | Misumari yam kuku |
| 35. | Keel Scarph | Skafu ya Mkuku/Mtako |
| 36. | Knee | Betana |
| 37. | Longitudinal Beam | Darumet |
| 38. | Mast | Mlingoti |
| 39. | Mast Partner | Kifundo |
| 40. | Mast Step | Mastem |
| 41. | Outrigger Boom | Mkingiko |
| 42. | Outrigger Clamp | Kiwango |
| 43. | Planking | Mbao za mbavuni |
| 44. | Plug | Hasho |
| 45. | Railing | Mahilenyi |
| 46. | Rudder | Usukani |
| 47. | Samson Post | Mangili |
| 48. | Seam | Jongo |

| SN | English Name | Swahili Name |
|---|---|---|
| 49. | Seat or After Deck | Staha |
| 50. | Sheer Clamp | Kofi |
| 51. | Stem | Fashini ya mbele |
| 52. | Stem Knee | Betana ya mbele |
| 53. | Stern | Shetri |
| 54. | Stern Knee | Betana ya nyuma |
| 55. | Stern Post | Fashini ya nyuma |
| 56. | Stiffener | Kiyabisishi |
| 57. | Stop Water | Gurunzi |
| 58. | Thwart | Kiti |
| 59. | Tiller | Kana |
| 60. | Transom | Chanda |
| 61. | Transom Knee | Betana ya chanda |
| 62. | Ventilation Hole | Tundu la hewa |
| 63. | Vessel/Craft | Chombo |
| 64. | Water Proof | Jarabati maji |
| 65. | Worm Shoe/Keel shoe | Kiatu cha mkuku |

**Annex C**
**(informative)**

**Sample scantling for round bilge hull**

Main dimensions: Loa= 20m, Breath = 6.2m and Depth = 2.4m

Table C.1: Keel, hog, stem, stern post and fastenings for motor, sailing and auxiliary craft

| Length, L, m | Moulding and siding of keel | | | | Siding and moulding of stem at heel, mm | | Siding and moulding of stem at head and sternpost mm | | Diameter of bolts, mm, | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Sailing and auxiliary | | Motor | | | | | | | |
| | Moulding. mm | Siding, mm | Minimum siding of keel, mm | Sectional area of keel or keel and hog, $cm^2$ | Sailing and auxiliary | Motor | Sailing and auxiliary | Motor | Centreline structure | Keel scarph |
| 20 | 195 | 385 | 150 | 520 | 205 | 195 | 165 | 150 | 20 | 14 |

See associated notes

Table C.2: Frames for Motor, Sailing and Auxiliary Craft

| Depth, D, m | | Type 2 Grown frame only | | | |
|---|---|---|---|---|---|
| | | | Moulding, mm | | |
| Motor | Sailing and auxiliary | Siding, mm | At heel | At head | Frame Spacing, , mm |
| - | 2.4 | 42 | 50 | 37 | 255 |
| 2.4 | - | 52 | 61 | 46 | 280 |

Table C.3: Floors for motor, sailing and auxiliary craft

| Depth, D. m | | Floors on grown or laminated frames | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Motor | Sailing and auxiliary | Length of arms. mm | | Strap floors. mm | | Wood floors at middle line | | Steel angle bar mm |
| | | For 3/5L amid-ship | Beyond 3/5L amid-ship | At throat | At point | Moulding mm | Siding mm | |
| - | 2.4 | 480 | 350 | 45 x 16 | 40 x10 | 95 | 45 | 45 x.45 x5 |
| 2.4 | - | 530 | 390 | 50 x 19 | 45 x 10 | 115 | 55 | 50 x.50 x5 |

See associated notes

Table C.4: Floor fastenings for motor, sailing and auxiliary craft

| Depth, D, mm | | Diameter of bolts in throat, mm | | Diameter of bolts at arms, mm | |
|---|---|---|---|---|---|
| Motor | Sailing and auxiliary | Grown laminated or steel frame | Bent frame | Grown laminated or steel frame | Bent frame |
| - | 2.4 | 12 | 8 | 8 | 6 |
| 2.4 | - | 12 | 10 | 10 | 8 |

See associated notes

Table C.5: Beam shelf and bilge stringer scantlings and fastenings for motor, sailing and auxiliary craft

| Length, L, m | Cross-sectional area of beam-shelf, $cm^2$ | | Cross-sectional area of bilge stringer, $cm^2$ | | Diameter of bolts, mm, | | | Steel side keelson and bilge stringer angles, mm |
|---|---|---|---|---|---|---|---|---|
| | Sailing and auxiliary | Motor | Sailing and auxiliary | Motor | Arms of breast-hook | Beam shelf stringers | Hanging knees | |
| 20 | 150 | 130 | 105 | 100 | 14 | 12 | 12 | 75 x65 x 5.5 |

NOTE

The Table scantlings for the beams shelf and bilge stringer are based on a timber having a standard density of 560 $kg/m^3$ and where timber of a different density is to be used the scantlings are to be modified in accordance with 5.1.4.

Table C.6: Timber bulkheads

| Height of bulkhead m | Planking | | Stiffener | | |
|---|---|---|---|---|---|
| | Double planked mm | Ply-wood mm | Stiffener spacing mm | Moulding mm | Siding mm |
| 2.5 | 50 | 25 | 450 | 115 | 65 |

See associated notes

Table C.7: Bulkhead plating and stiffeners for motor, sailing and auxiliary craft

| Bulkhead plating and spacing of stiffeners | | | Stiffeners with free ends | | | | | |
|---|---|---|---|---|---|---|---|---|
| Depth of bulkhead at middle line | Thickness of plating, mm | Spacing of stiffener, mm | Overall length of stiffener, m | Height of upper deck above top of stiffener, m | | | | |
| | | | | 0 | 0.6 | 1.2 | 1.8 | 2.4 |
| | | | | Modulus, $cm^3$ | | | | |
| 2.4 | 4.0 | 375 | 2.4 | 13.0 | 20.0 | 26.0 | 33.0 | 39.0 |

See associated notes

Table C.8: Outside and deck planking for motor. Sailing and auxiliary craft

| Length, L, m | Basic thickness, mm |
|---|---|
| 20 | 41.5 |

See associated notes

Table C.9: Fastenings for outside end deck planking in motor, sailing end auxiliary craft

| Planking thickness, mm | Size of fastenings | | | | | | | | | | Number of fastenings per plank | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Outside planking | | | | | | | Deck planking | | | Width of plank | | | | |
| | Grown, laminated or steel frames | | | | | Bent frames | | Wood screws diameter | | Bolt, mm | Under 100 mm | 100 mm and under 150mm | 150 mm and under 180mm | 180 mm and under 205mm | 205mm and under 225mm |
| | Bolt, mm | Wood screws diameter | | Cooper bolt nails*size | | Cooper bolt nails size | | | | | | | | | |
| | | mm | gauge | mm | gauge | mm | gauge | mm | gauge | | | | | | |
| 41.5 | 10 | 8 | 18 | 9.5 | 3.0 | 6 | 4 | 7 | 16 | 8 | 1 | 2 | 2 | 2 | 3 |

See associated notes

Table C.10: Beams and hanging knees for motor, sailing and auxiliary craft

| Length of beam, m | Spacing of ordinary beams centre to centre, mm | Ordinary beams 3/5L amidship | | | | Ordinary beams beyond 3/5L amidship, half beam throughout | | | | Beams in way of masts and at ends of deck openings | | | | Strap hanging knees to deck beams | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | At middle | | At ends | | At middle | | At ends | | At middle | | At ends | | | Length of arm, mm | | At throat, mm | At point, mm |
| | | Siding, mm | Moulding, mm | Siding, mm | Moulding, mm | Siding, mm | Moulding, mm | Siding, mm | Moulding, mm | Siding, mm | Moulding, mm | Siding, mm | Moulding, mm | Number on each side | For 3/5L amidship | Beyond 3/5L amidship | | |
| 6.3 | 625 | 88 | 125 | 88 | 88 | 70 | 100 | 70 | 70 | 112 | 156 | 112 | 112 | 11 | 675 | 540 | 70x33 | 54x14 |

See associated notes

Table C.11: Longitudinal steel items for motor. sailing and auxiliary craft

| Length, m | Upper deck sheerstrake and stringer plate 3/5L amidship, mm | Upper deck sheerstrake and stringer plate at ends and cabin deck stringer plate, mm | Upper deck tie plates, mm | Upper deck stringer angle, mm | cabin deck tie plates, mm | cabin deck stringer angle, mm |
|---|---|---|---|---|---|---|
| 20 | 410 x4,5 | 280 x4 | 140 x4.5 | 50 x50 x 5 | 90 x4 | 55 x55 x4 |

Table C.12: Steel angle beams at upper and cabin decks for motor, sailing and auxiliary craft

| Length of beam, m | Spacing of beams, mm | Upper deck beams, mm | | | | Upper deck beams, mm | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Without pillars | Thickness of knee | With one row of pillars | Thickness of knee | Without pillars | Thickness of knee | With one row of pillars | Thickness of knee |
| 6.3 | 545 | 140 x 75 x12 | 7.5 | 90 x 75 x6.5 | 6.5 | 135 x75 x7.5 | 7 | 75 x65 x6 | 6 |

**Annex D**
**(informative)**

**Sample scantling for hard chine hull**

Main dimensions: Loa= 20m, Breath = 6.2m and Depth = 2.4m

Table D.1: Hard Chine vessels – Keel and Hog

| | Keel | | | Hog | | |
|---|---|---|---|---|---|---|
| Measured | Section | | | Section | | |
| length | area | Siding | Moulding | area | Siding | Moulding |
| m | $mm^2$ | mm | mm | $mm^2$ | mm | mm |
| 20 | 48600 | 180 | 270 | 35000 | 350 | 100 |

Table D.2: Hard Chine Vessels Transom

| | | *Stiffeners | | Margin | |
|---|---|---|---|---|---|
| Measured | Thickness | | | | |
| length | plywood | | Moulding | Siding | Moulding |
| m | mm | mm | mm | mm | mm |
| 20 | 24 | 110 | 55 | 165 | 80 |

Table D.3: Transom

| | | *Stiffeners | | Margin | |
|---|---|---|---|---|---|
| Measured | | | | | |
| length | Thickness | Siding | Moulding | Siding | Moulding |
| m | mm | mm | mm | mm | mm |
| 20 | 58 | 110 | 55 | 165 | 80 |

Table D.4: Transverse web frames

| Transverse Web Frames | | | |
|---|---|---|---|
| Measured | Web frames | | |
| length | *Spacing | Siding | Moulding |
| m | mm | mm | mm |
| 20 | 1250 | 65 | 170 |

Table D.5: Hard Chine Vessels Floor

| | *Floors | |
|---|---|---|
| Measured | | Moulding at |
| length | Siding | centre line |
| m | mm | mm |
| 20 | 80 | 260 |

Table D.6: Hard Chine vessels bottom stringers

| Measured length | Bottom stringers | | | |
|---|---|---|---|---|
| | Spacing | Total section area per side | Moulding | Siding |
| m | mm | $mm^2$ | mm | mm |
| 20 | 355 | 24192 | 42 | 96 |

Table D.7: Hard Chine vessels Chines

| Vessels Chines | | | |
|---|---|---|---|
| Measured length | Sectional area | Siding | Moulding |
| m | $mm^2$ | mm | mm |
| 20 | 12168 | 78 | 156 |

Table D.8: Chines and Stringers (Single planked hulls)

| | Chines | | | Stringers | | |
|---|---|---|---|---|---|---|
| Measured | Section | siding | moulding | Section area | siding | Moulding |

| length | area | | | per side | | |
|---|---|---|---|---|---|---|
| m | $mm^2$ | mm | mm | $mm^2$ | mm | mm |
| 20 | 18375 | 105 | 175 | 36750 | 175 | 70 |

Table D.9: Hard Chine Vessels - Beam Shelf/ Sheer Clamp

| Measured length | Section area |
|---|---|
| m | $mm^2$ |
| 20 | 17200 |

Table D.10: Hard Chine Vessels - Hull Planking Thickness

| Measured length | Bottom | | Topside | |
|---|---|---|---|---|
| | Plywood | Double diagonal | Plywood | Double diagonal |
| m | mm | mm | mm | mm |
| 20 | 31 | 44 | 23 | 33 |



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