Bends generally straighten out slightly when released from restraint so they should be slightly over-bent (Fig. 1). Bent pieces should not be wetted again as they will tend to open out and, if restrained, may fracture. They should be sealed with a suitable coating to prevent an increase in moisture content, once the necessary drying has taken place.

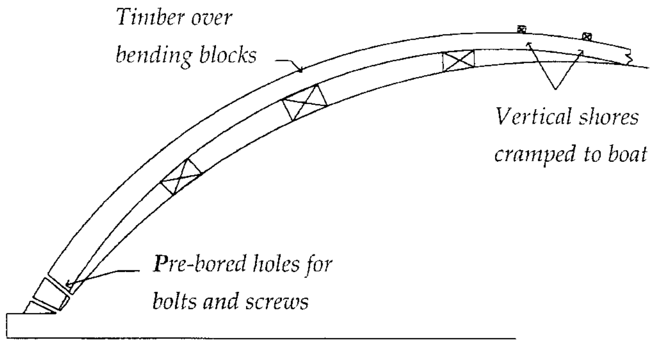

Figure 1. Typical method of bending timber sponsons around boats. Initial over-bending will be corrected when sponson is fastened to boat.

Laminated construction may be necessary where a tight bend is required in a thick member, the laminations being up to about 3 mm in thickness.

Bending equipment

Heated timber will accept a lot of compression but will not stretch very much. To overcome this, strapping is applied to the outside of the bend to prevent the timber from stretching and to force the inner face to compress.

The end blocks, to which the strapping is fixed must be firm and strong and must not allow any 'give' during the bending process. The reversed lever system (Fig. 2) is considered to be the most efficient and the lever should be approximately the same length as the stock being bent.

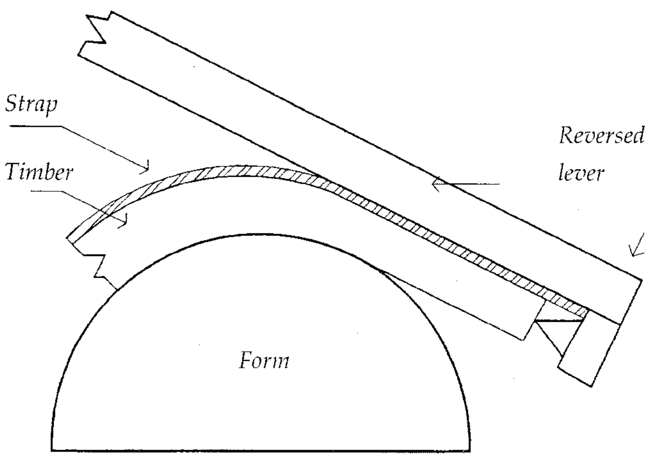

Figure 2. Reversed lever system for bending timber.

Bends, in which the ratio of the thickness of the piece to the radius of curvature is less than one-thirtieth, can often be made without taking any special precautions but tighter curves will require strapping.

The form around which the bend is to be made should be as strong as possible and must be firmly fixed to prevent any rotational movement. Screw presses, hydraulic presses and steam heated presses are often used for mass production of bent pieces when the bends are not severe. For further information, see State Forests of New South Wales Technical Publication No. 7 *Bending of Timber*.

SHEATHING

Four types of sheathing material are discussed: plywood, timber, copper and plastic.

Plywood sheathing

Plywood, preferably rot-proofed, may be used to sheath the hull of a light craft. The adhesive is usually a rubber-based solution with good drying properties and should not deteriorate when in contact with salt water. The edges of the plywood sheets must be properly sealed to prevent the plywood absorbing moisture. Hull construction and the thickness of the sheathing will determine the spacing of edge nailing or screwing but spacing should not exceed about 150 mm because greater spacing will permit the plywood to lift between fixings. Plywood sheathing may be used to repair an old hull or to strengthen a light hull which is to be used in severe operational situations.

Timber sheathing

The timber used should be of species known to have a high natural resistance to marine borer attack or timber which has been pressure-impregnated with an approved preservative.

The timber should be straight, sawn to the dimensions ordered and free of knot clusters, splits, shakes and fractures. Moisture content of the timber sheathing should be in the range of 20% to 30% at the time of fixing.

Planks should be 19 to 25 mm thick. The adhesive is usually a rubber based solution with good drying properties and should not deteriorate when in contact with salt water. Metal sheathing may be used over the keel, stem and stern. Copper should not be less than 0.8 mm thick.

Copper or galvanised iron fastenings may be used but it is advisable to use the same type of metal throughout so that no electrolytic corrosive action takes place due to different metals being used in close proximity.

Wherever practicable, the heads of major hull fastenings should be sunk about 3 mm below the surface of the hull and covered with a paste made of white lead and zinc oxide in oil. All seams should be properly caulked, payed and filled. Where metal sheathing is to be applied, all sharp edges of timber must be rounded off.

The metal sheathing should be so laid that a tuck of at least 20 mm is covered by the timber sheathing and any galvanised fixings should be at least 50 mm away from the metal sheathing. A coat, 1.5 mm thick, of the adhesive should be applied between the wood and metal sheathing.

The hull is generally sheathed to about 150 mm above the loaded waterline of the vessel. The distance between fastenings should not exceed 450 mm in any one plank and end fastenings should be within 150 mm from the butt of the plank.

Butt blocks should be fastened over hull-plank butt-joints to give access to the joints for caulking purposes. Kraft paper or felt should be placed over the adhesive before fixing the butt block.

Where the keel has been sheathed with metal, a false keel at least 30 mm thick of solid timber may be fixed.

Copper sheathing

Generally, the same requirements apply to metal sheathing as were noted for timber sheathing.

Sheathing should be hot or cold rolled annealed sheets 1200 mm x 356 mm x 4.3 kg/m^2. Nails should be copper and not less than 3.75 mm diameter.

The sheathing underlay should be a suitable adhesive and the hull sheathed so that all timbers including planking, keel, stem and stern posts and rudder (if timber) are covered to about 150 mm above the loaded water line. All sheets should lap those adjacent by at least 25 mm.

Edge nailing should be done on a centre line 12 mm from the edge with nails spaced at not more than 25 mm centres. All sheets should be nailed, in addition to edge nailing, in a diagonal pattern at 75 to 100 mm centres.

All sheets should be centre punched before nailing and the nails dipped in the adhesive. The length of the nail should be sufficient so that when driven home the total penetration is 20 mm. Where the hull is less than 25 mm thick the penetration should be 6 mm less than the thickness.

Plastic sheathing

Plastic sheathing (ie acrylic or fibreglass) has the advantage over metal that no electrolytic action can take place.

Acrylic

A specially woven acrylic cloth which can be stretched over two-way curves is bonded to the wooden hull with an epoxy-type adhesive. Adhesives are used to impregnate the acrylic cloth and thus complete the water proofing process; colouring agents can be incorporated in the adhesive to give the desired appearance.

Knowledge of how to stretch and form the acrylic is very important and the manufacturer's advice should be sought before commencing work. In the event of damage, the acrylic sheathing can be easily repaired. The same material can be used for deck and roof covering.

Fibreglass

Two general methods of application are used:

- a pre-formed sheet of polyester reinforced with glass fibre is bonded to the hull, or
- liquid resin and glass fibre reinforcement are applied to the hull.

The basic resin components must be accurately measured before mixing as incorrect proportions will upset the curing process. Materials such as bitumen, which contain phenol, will seriously interfere with the setting or curing of polyester resins.

Polyester/fibreglass is stiffer than acrylic and therefore is more likely to crack or delaminate from the hull. Repairs to polyester/fibreglass are made with an epoxy resin repair kit.

New plastic materials and improved application techniques are being developed all the time so thorough enquiries should be made prior to selecting a material for use as sheathing.

MASTS AND SPARS

Masts and spars are usually designed specially to suit the boat. Masts of solid or built up sections should be made from a relatively light timber that will glue readily, is straight grained, and strong in relation to its density.

The built up section may be a full section or hollow and will usually have all grooves machined prior to assembly.

All the timbers recommended for masts and spars in Table 1 are suitable for use in glued or laminated sections. The timbers to be used must be completely free of faults which would adversely affect the utility of the piece and be straight and true. Knots, sloping grain, shakes and compression wood must be regarded as 'not acceptable,' though where large sections in solid masts are to be used, some knots may be allowed. Mast steps should be shaped using patterns made from the plans or loft drawings to shape and notch them correctly. The tenon socket for the heel of the mast should have drain holes, arranged so that the socket will drain completely when in position. The mast steps are usually made of durable hardwood.

The socket should be cut so that the rake of the mast can be adjusted.

Driven wedges in the socket are used to adjust the rake of the mast. The wedges should be tacked with a nail, after being driven, to hold them in place. The tenon on the mast must be long enough to cope with all possible adjustments of rake.

Sapwood is permissible only if it has been treated to a suitable loading with an approved non-leachable preservative.

ADHESIVES

Adhesives are used in a wide variety of applications and require careful preparation and mixing.

When using any adhesive the emphasis must be on cleanliness and, if possible, freshness of the surfaces to be joined i.e. freshly machined surfaces are generally more reactive than old surfaces.

Adhesives should be mixed in clean containers and kept covered to exclude all contaminants.

Those containing formaldehyde or amine hardeners can cause dermatitis, making special precautions necessary such as the removal of the adhesive from the skin before setting takes place. 'Barrier creams' may be used as a protective measure, however, gloves are recommended. Tables 5 to 11 give the general properties of the main adhesive types. However, when using a specific adhesive, the manufacturer's instructions should always be followed.

Bonding preservative-treated timber

Types of preservatives

- Tar oil types such as creosote
- Organic solvent preservatives containing copper or zinc naphthenates
- Water borne types such as copper/chrome/arsenic (CCA) salts.

To bond tar oil preservative treated timber

(Tar oils are mainly used in applications which do not call for bonded sections.)

Wipe the joint surfaces clean with a solvent, such as acetone, using rags.

Timbers having a tendency to bleed may be steam cleaned. Use a resorcinol resin glue which, in this case, will require elevated temperature curing.

In general, bonding of this type of treated material is best avoided.

To bond timber treated with an organic solvent preservative

Casein glue is satisfactory; however, the alkaline properties of the adhesive may cause the preservative to be deleteriously affected.

Urea resin adhesives set as the result of the introduction of an acid hardener. Small changes in acidity will alter the setting time. Acid will accelerate, alkali will retard. This is particularly noticeable with gap filling urea resins.

Conversely, resorcinol resins set best under neutral conditions. In this case acid will retard and alkali will accelerate.

The physical compatibility of the adhesive and preservative will depend on the nature of the vehicle. A light volatile solvent will present no difficulties provided sufficient time is allowed for evaporation of the solvent.

Degreasing treatment will be required where heavy oils have been used and crystalline blooming should be removed by brushing, sanding or planing.

Copper naphthenate can be applied using a variety of solvents of which naphtha and light mineral spirits give good results. Fuel oil solvents are unsatisfactory.

It is often beneficial to spread the adhesive two or three times to obtain uniform coverage.

Waxes or water repellents will interfere with adhesion.

To bond water-borne preservative-treated timber

Timbers treated with a water borne preservatives are often put into service at a high moisture content, as this is the nature of their end-use position. However, the moisture content of the timber must be reduced to a level indicated by the adhesive manufacturer if it is to be glued satisfactorily.

Satisfactory bonds may generally be achieved with most adhesives, however, high loadings of CCA preservatives can cause adhesion problems with phenolic resins. Treatment of timber with boron compounds also inhibits adhesion with phenolic resins.

In all cases, when bonding preservative treated timber, it is advisable to obtain the adhesive manufacturer's recommendations and to carry out some trial gluings on spare material to ensure the compatibility of the systems used.

Preservative treatment of already bonded timbers

Casein adhesives will not withstand this treatment. If urea resin adhesives have been used, consult the manufacturer to ensure that the particular grade of adhesive will withstand treatment in the pressure chamber and subsequent drying. Urea resins may fail during kiln drying.

Resorcinol resin adhesive is satisfactory when preservative treatment is to be carried out after gluing and subsequent drying, but the adhesive must be allowed to cure for at least five to seven days at 15-20°C.

Dipping or other surface treatments will probably not affect any of the more waterproof adhesives if the treatment and the adhesives are chemically and physically compatible.

Table 5. Resorcinol formaldehyde and resorcinol phenol-formaldehyde.

Form:	Viscous reddish-brown liquid with liquid or powder hardener
Preparation:	Mixing of resin and hardener
Shelf life at 20°C in closed container:	Resin - three months or more Hardener - six months or more
Setting mechanism:	Polycondensation
Weather resistance:	Excellent
Assembly time at 20°C:	Up to 60 minutes
Pressing time and temperature:	24 hours at temperature above 20°C Several minutes at 90°C
Time to develop ultimate strength:	One week at 20°C
Gap-filling properties:	Good
Applications:	Laminating, assembly, radio frequency gluing
Remarks:	Setting temperature should be above 20°C and for maximum wet strength with some hardwoods, above 60°C Probably the most commonly used weather resistant adhesive type Excess can be cleaned up with wet rag

Table 6. Urea formaldehyde.

	A	B	C	D
Form:	White viscous liquid with liquid or powder hardener	As for A together with wheaten flour extender	White powder sometimes with liquid or powder hardener	As for C together with wheaten flour extender
Preparation:	Mixing of resin and hardener, or separate application*	Mixing of resin, hardener, flour and water or separate application*	Mixing with water and sometimes hardener or separate application*	Mixing of resin, hardener, flour and water or separate application*
Shelf life at 20°C in suitable closed container:	Resin 3-6 months Hardener no limit	As for A	Hardener no limit	As for C
Setting mechanism:	Polycondensation	Polycondensation and loss of water	Polycondensation	Polycondensation and loss of water
Weather resistance:	Unprotected glue line withstands weathering for at least one year	Weather resistance lowered by extension	Unprotected glue line withstands weathering for at least one year	Weather resistance lowered by extension
Time to develop ultimate strength:	One week for cold setting. Stacked after hot setting		48 hours if block	
Assembly time at 20°C:	Cold-set glues up to half an hour, hot-set glues up to 12 hours or more.			
Pressing time and temperature:	2 to 24 hours at room temperature. Several minutes at 90° - 125°C			
Gap-filling properties:	Poor, but may be improved by use of gap-filling resin or hardener			
Applications:	Plywood, particleboard, assembly gluing, radio frequency gluing			
Remarks:	Setting temperature for cold-setting formulations should be above 12°C. Weather resistance of liquid mixes may be improved by addition of melamine or resorcinol. Flour extensions of more than 50 parts by weight of flour to 100 parts of liquid resin may cause the glue to weaken and possibly fail after several years. Excess can be cleaned up with wet rag			

* With separate application the resin is spread on one face to be glued and the hardener on the other. Hardening then takes place when the two faces are brought together.

Table 7. Epoxy resin.

Form:	Honey-like or coloured paste with liquid hardener	Solid sticks, powder
Preparation:	Careful mixing with hardener	No preparation: resin melted onto surface to be glued
Shelf life at 20°C in suitable closed container:	Resin at least six months, hardener at least one year	At least two years
Setting mechanism:	Polymerization	
Weather resistance:	Moderate to good	
Assembly time at 20°C:	Several minutes to one hour	Equal to shelf life
Pressing time and temperature:	Up to 48 hours at 20°C; approx. one hour at 90°C	48 hours at 110°C; 30 minutes at 200°C
Time to develop ultimate strength:	Up to several weeks	
Gap filling properties:	Excellent	
Applications:	Wood-to-metal, metal-to-metal, reinforcement of fibres, i.e. glass, kevlar and carbon. High quality sheathing resin. Universal glue. High chemical resistance glue	
Remarks:	Adhesive not soluble in water, hardeners may be severe on unprotected skin Shrinkage during setting negligible Excess can be cleaned up with solvent Good quality but expensive	

Table 8. P.V.A. (polyvinyl/acetate emulsions).

Form:	White to cream viscous liquid	White to cream viscous liquid with liquid hardener
Preparation:	No preparation required	Mixing of resin with hardener
Shelf life at 20°C in a suitable closed container:	Usually no limit.	Longer than one year
Setting mechanism:	Loss of water	Polymerization and loss of water
Weather resistance:	Low	Good
Assembly time at 20°C:	Up to 10 minutes. Longer with special formulations	Five minutes. Will vary with substrate
Pressing time and temperature:	Up to two hours at room temperature	Approximately 30 minutes 24-29°C is preferred
Time to develop ultimate strength:	Approximately one week	
Gap-filling properties:	Good	
Applications:	Assembly glue, veneering, parquetry, non-structural finger jointing	
Remarks:	Very strong adhesive, but strength under permanent load is lower Preferred glue for end grain gluing Formulations incorporating hardener may be hot pressed	

Table 9. Melamine formaldehyde.

Form:	Solid thin film	White power - usually with powder hardener
Preparation:	No preparation required	Mixing with water and hardener
Shelf life at 20°C in closed container:	Up to three months	At least two years
Assembly time at 20°C:	Equal to shelf life	Up to 24 hours
Gap-filling properties:	Poor	Good
Setting mechanism:	Polycondensation (cross linking and splitting-off of water)	
Weather resistance:	Unprotected glue line will withstand weathering for several years	
Pressing time and temperature:	Several minutes at 90°C	
Time to develop ultimate strength:	After block stacking for 48 hours	
Applications:	Veneering using light and permeable veneers	
Remarks:	Melamine is often mixed with urea to improve the weathering durability of the latter	

Table 10. Contact.

Form:	Viscous cream or coloured liquid
Preparation:	No preparation required
Shelf life at 20°C in suitable closed container:	Longer than one year
Setting mechanism:	Loss of solvent
Weather resistance:	Fair
Assembly time at 20°C:	10-20 minutes (longer with special formulations)
Pressing time and temperature:	Several seconds to several minutes at room temperature
Time to develop ultimate strength:	Several weeks
Gap-filling properties:	Good
Applications:	Universal adhesive, but copper and its alloys unsatisfactory with many formulations
Remarks:	Bond can be achieved by hammer blow without pressure, but orthodox pressure application gives higher strength. At best, strength lower than other wood glues, still lower under permanent load. Adhesive will deteriorate after prolonged period. Inflammable

Table 11. Casein.

Form:	Ready-mixed cream powder	Granules of lactic casein
Preparation:	Mix with water	Mix with water and alkaline materials
Shelf life at 20°C in closed container:	9-12 months	Up to two years
Setting mechanism:	Chemical action combined with loss of water	
Weather resistance:	Moderate	
Assembly time at 20°C:	Up to 40 minutes	
Pressing time and temperature:	Two to four hours at room temperature. Several minutes above 100°C	
Time to develop ultimate strength:	One week	
Gap-filling properties:	Good	
Applications:	Assembly gluing, plywood production, laminating.	
Remarks:	Now rarely used.	

PLANS AND SPECIFICATIONS

Plans: The design drawings of the vessel, usually to scale, showing layout, shapes, sizes and dimensions.

Specifications: The written matter setting out further information and requirements to be read in conjunction with the plans. They usually cover such items as types of materials, fittings, standards of finish and workmanship required, amounts of material, any special methods involved, types of adhesives, caulking materials, paints and other finishes necessary for the job.

Some designers provide full size drawings or templates of parts for smaller craft being made by amateur boat-builders. These templates should be glued to plywood or hardboard if they are to be retained. Otherwise, they can be glued to one of the member pieces and then all similar members can be shaped to the original piece.

Where scale drawings or plans are provided, the plans must be 'lofted'. That is, set out on the floor, full size. **The markings must be heavy enough to last until the job is completed.**

All templates should be checked and double checked for size, shape, and for either left or right-hand set-out. It is cheaper to check than to waste a piece of select timber.

When marking out, the template should be tacked in position with two or more panel pins or nails, as necessary. It is suggested that templates, plans and specifications be carefully stored so future repairs can be more easily made.

There is often a tendency to draw thick lines in the belief that this is necessary to be able to see the set-out under all working conditions. Fine dark lines will be seen just as easily and permit a far greater degree of accuracy. Where a template has been traced, the member should be dressed down to the template side of the pencil line, as the thickness of the pencil line may increase the size of the member too much.

Jigs and forms must be accurately made and strong enough to stand up to all necessary hammering. Any inaccuracies in the jig will be transferred to the part to be formed. It should not be assumed that the floor is flat, and the jig must be carefully squared, plumbed and braced.

Fittings

Lockers, fasteners, machinery, linings, safety equipment, electrical installations and other fittings should be fixed so that they can be removed readily without causing any damage to enable regular and thorough inspection and maintenance of the interior of the craft.

REPAIRS

Tingles are patches used to repair the hull of the boat. Patches may be used to repair defects on timber or plywood hulls. The patches can be screwed or nailed and may be applied on the inside or the outside of the hull. Small repairs on plywood craft may be made by fitting a 'doubling' piece to the inside skin and then letting a plywood section in from the outside.

Correct scarfing methods should be used. The patch should be bedded in with a suitable compound and sufficient overlap should be provided for fixing. Large areas of damage may be repaired using sheets of marine grade plywood, which may be screwed, nailed or bolted in place. Diagonal planking may be used to make temporary repairs where the hull is curved two ways. Where possible, the tingle should be fixed through to the frame. All edges should be 'faired in' to aid the flow of water over the surface.

Resin repair kits

Epoxy resin repair kits were developed to allow quick repairs of wooden craft and, if correctly applied, can continue to cure in the water. The repairs may be made on either the inside or the outside of the hull.

This type of repair work is applicable only where limited damage has occurred.

Carrying out repairs

The damaged inner skin of timber should be built up approximately to its original thickness by filling the fracture or indentation. The following are some of the methods that may be used:

- fitting a piece of wood or plywood and bedding it in with resin mix;
- filling with epoxy resin putty;
- fitting a piece of wire gauze over the fracture;
- filling with an expanded foam material;
- filling with a dough of shredded glass fibre reinforcement and resin mix.

Unless excessively large, holes produced by clenches need not be filled. Wooden plugs or putty can be used if filling is considered necessary.

Following the flushing or filling of the inner skin and without waiting for resin or putty utilized for this purpose to set, the full repair can be effected.

The outer skin of the hull should be cut away to expose some 30 mm of sound inner skin, leaving the damaged inner skin alone. All edges should be well bevelled to allow adhesion of the reinforcement. Any oiled calico used between skins should be removed and the area exposed should be thoroughly dried before applying the resin and reinforcement.

A thick layer of resin mix is then to be applied over the whole of the inner skin which has been exposed by the cutting back of the damaged outer wooden skin. The first piece of reinforcement, which has been cut to size, is placed in position on top of the wet resin and the resin mix, if of glass fibre, worked through the reinforcement, by rolling. This operation is normally carried out with serrated washer rollers that are easily cleaned. Mohair paint rollers may be preferred as they minimize the possibility of damage to the glass fibre.

Application of the resin and reinforcement should continue until the repair has been built up flush or just proud of the original hull form. A polythene sheet can be laid over the final application of resin and skin and rolled with a non-serrated roller to produce a smooth external finish. After gelation and cure of the repaired surfaces, an application of a standard marine primer followed by the final hull finish will complete the repair.

The resin must be mixed in strict accordance with the manufacturer's instructions.

WOOD DECAY

Causes of decay

Troubles arising from wood decay are usually due to faulty design, the use of unsuitable or infected timber or the lack of adequate preservative treatment.

Wood decay is caused by fungi and will only occur when air is present and there is sufficient water to raise the moisture content of the wood above 20 per cent and maintain it there for lengthy periods. Wetting does not harm timber provided it can dry out quickly. For this reason, the incidence of decay in open boats is slight when compared to decked boats.

Moisture can find its way into the timbers of decked boats by:

- **Use of unseasoned timber.** Large size members such as stern and stem posts are often inadequately seasoned; or
- **Leakage of water**. It is the leakage of fresh water that encourages most decay. Direct wetting by sea water does not appear to encourage decay. However, moisture evaporating from sea water in the bilges can condense as fresh water on the timbers above.

Leakage is most serious when it occurs at the edge of the deck and finds its way into the ends of beams and frames.

If there is a lining to the hull, such leakage could go on for a long time before being detected. It is an advantage if parts of the lining are screwed so that portions can be removed for regular inspection.

Leakage and decay often occur at the junction between coamings and decks and where bulwark stanchions pass through covering boards. When surveying or refitting a vessel, a careful inspection should be made of these areas.

Faulty plumbing around lavatories and sinks can be a source of fresh water leakage and regular inspections should be made of these areas.

The absence of adequate ventilation, leading to condensation of moisture from the air, is a very common cause of timber decay in cabin boats which lie at moorings for long periods. The ventilation provided for little used places such as the forepeak, lockers, etc., is often totally inadequate and generally blocked by the goods stored in them.

Recognition of decay

It is sometimes difficult to detect incipient decay in boats as the decayed wood may hold its shape as long as it is in a damp condition. Often the only indication is a wrinkling of the paint on the surface. Usually, distortion of the timber only occurs when decay is at an advanced stage.

The most satisfactory method of detecting decay is to prod suspect timbers with a sharp pointed tool. On testing an area of incipient decay, it will usually be found that the texture of the wood has been softened and it is impossible to prise up a long splinter. The fibres break off short owing to the loss of toughness. Obviously you cannot prod every piece of timber in the boat; but you should examine those parts where leakage of water may have occurred and around ends and joints.

Treatment of decay

1. Eliminate the source of moisture that caused the decay.

2. Completely remove the decayed wood, cutting back to sound clean timber some 70 mm beyond the furthest sign of attack.

3. Liberally apply a suitable wood preservative to bare timber exposed during the work and to new timber used for replacement.

Common preservatives

Copper naphthenate

Copper naphthenate is sold as a green coloured solution and should contain at least 3% copper. Any recommendations by the manufacturer to reduce the copper content below 3% should be disregarded. Copper naphthenate usually takes two to three days to dry, after which it can be painted over.

Fixed preservatives

These may be applied by dip diffusion of the green veneers or by vacuum pressure treatment of dry veneers or plywood or timber. The chemicals used are based on copper-chrome-arsenic salts which become fixed in the wood. Not all timbers may be treated by these processes and you are advised to seek further information in this regard.

MARINE BORERS

Wooden boats, like any wood exposed to sea water, are liable to attack by many kinds of marine borer. The type of borer, the timber species, the location, the time of the year and the methods used for protecting the planking are all factors that will determine the extent of any damage.

Types of borer

Teredo and Bankia

In the coastal waters of New South Wales, the most destructive borer is the 'shipworm' ('cobra' or 'teredo') which, in favourable circumstances, can hole timber planking in less than two months. Certain timbers, such as turpentine, are resistant to this type of borer.

Martesia

This type, also known as 'shell-borer' (it resembles a small sand pippy), occurs in some coastal areas of high salinity, usually in partially enclosed warm shallow water. No timber has natural resistance to it because this borer uses the timber for accommodation and does not devour it.

Nausitora

Nausitora occurs in the upper tidal reaches of coastal rivers. In appearance it is a similar type of borer to teredo. No timber has natural resistance to it.