CHAPTER 16

LEAKSTOPPING AND SHORING

CONTENTS

SECTION 1 - LEAKSTOPPING

SECTION 2 - SHORING

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SECTION 1 - LEAKSTOPPING

1601. General Considerations

a. The work falls naturally into two stages:

(1) First aid leakstopping, to stop the inflow of water or reduce it to a rate which portable or fixed pumps can contain.

(2) Post damage, semi-permanent repairs, to make the ship sufficiently seaworthy to continue operations or to proceed to a repair facility.

b. Very large holes or serious damage to the hull cannot generally be repaired at either of these stages. Such damage is in the Primary Zone and is dealt with by establishing a flooding boundary. Less extensive damage, such as smaller holes and splits in the hull, bulkheads and decks, damage to pipe systems and strained or damaged doors and hatches can and must be dealt with. There are several ways to deal with these different kinds of damage; usually the simplest is not only the quickest but also the best. In deciding the most suitable type of repair the following must be considered:

(1) The rate of flooding and the size of the compartment.

(2) The kind of hole (eg puncture or split), its size and whether the plating around it is distorted.

(3) The accessibility of the damage and its position relative to the waterline.

(4) The manpower, equipment and pumping capacity available.

(5) The importance of the compartment, as determined by the Command Aim.

1602. Underwater Damage

Holes that are completely underwater obviously constitute the greatest danger and must be tackled immediately to slow the rate of flooding to within the scope of pump capacities. A small compartment will fill more rapidly than a large one with similar damage and leakstopping devices must be applied swiftly to all leaks, starting at the bottom of the compartment, to prevent its total loss due to free flooding. A large compartment will fill slower than a smaller one with the same damage, allowing more time for leakstopping. This, however, should not distract from the urgency of the situation. Some damage will be so severe and flooding so rapid that leakstopping cannot be carried out and pumps will not reduce the level of water. In these cases the compartment must be shut and allowed to free flood, and the boundary structure made watertight. This may require the use of shoring to support weakened or straining structure or fittings.

1603. Waterline Damage

Holes at or just above the waterline should be dealt with as quickly as conditions permit, since they are a great potential danger. The rolling, heeling or trim of the ship, or increase of flooding elsewhere, may bring them underwater, thus increasing the flooding at the waterline. This will cause free-surface flooding, which will impair stability and may hazard the ship.

1604. Leakstopping Devices and Methods

The main difficulty in leakstopping is making a watertight joint between the stopper and the edges of the damaged plate. Around an 'entry hole' the inboard surface is usually very ragged and petalled but an 'exit hole' may present a fair inboard surface. The principle in both cases is to choke the flow of water by compressing soft material into the hole and against the edges of the plating. Mattresses and bedding material are especially suitable for fairly large holes. Other materials can, of course, be used and some methods of leakstopping are described in the following paragraphs.

1605. Softwood Wedges and Plugs

a. Small splinter or bullet holes, and small splits can normally be plugged by hammering in softwood wedges (or bungs for round holes). These have the advantage of swelling when wet, making them grip and seal more firmly. Wedges can be used singly or in bunches, and small gaps can be filled by pieces of wedge (which can be split easily from a whole wedge along the straight grain). Wedges have a tendency to spring back when used on thin plating or in oily conditions. A recommended remedy is to cover the wedge with wet cloth before driving it in. The cloth fills the gaps between the wedges as well as providing a better grip.

b. When using wedges in a vertical split, multiple splits or splinter holes, the lowest ones must be tackled first; work proceeding upwards. This will ease the problem of obscuring low splits by the wedges already driven in and will, in general, make the task of wedging up easier and more complete. Where splits and holes are obscured by water they can be felt for with the fingers and the wedges guided in accordingly. Wedging up is the only method of leakstopping against seawater pressure that can be carried out single-handed. All other methods will require two or more people.

1606. Large Holes

If holes or splits are too large to be filled by softwood wedges, the following alternative methods of leakstopping are available:

a. GRP Domes.

b. Patchpack.

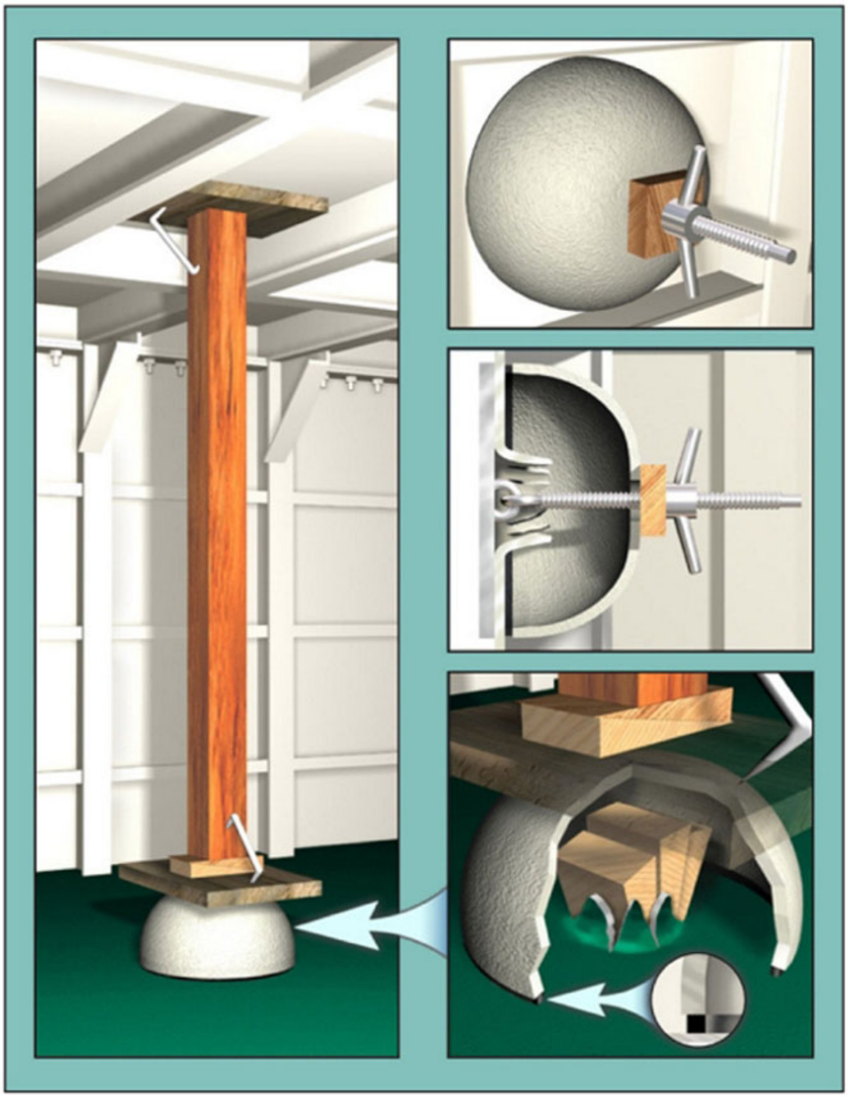
c. Improvised leakstopper.

d. Steel stopper plate.

1607. Glass Reinforced Polymer (GRP) Dome

These are used for patching holes with ragged edges. They are shallow GRP boxes that are available in three sizes, 300 mm diameter x 175 mm deep, 450 mm diameter x 200 mm deep and 600 mm diameter x 225 mm deep. One face is open and has a rubber seal around its edge, the opposite face being closed and with a 15 mm hole in its centre which is blanked off with a bolt, butterfly nut and washers. When used on a tiled deck, tiles and deck cement should be removed to allow a better seal. The box can be held in place by a shore (see Fig 16-1), when the hole is sealed by the foot of the shore or by the wooden wedge. Alternatively it can be secured by removing the bolt, etc. and using a 50 x 50 x 6 mm steel angle strongback fitted with an eyebolt and a 600 x 12 mm ringbolt and butterfly nut with a wooden washer. Allowances are scaled to one set of GRP domes, (one of each size), per FRPP and one per Main Machinery Space. If needed, and the necessary equipment is available, a heavier strongback can be made by bolting or welding an eye (approximately 12 mm) into the throat of a short length of channel bar. In order to maintain a low magnetic signature, GRP structured vessels are to locally manufacture eyebolts and strongbacks from aluminium, as detailed in BRd 2170(3).

Fig 16-1. GRP Dome and Shore



1608. Patch Packs

These consist of six 5 mm thick mild steel plates ranging in size from 300 x 200 mm to 900 x 600 mm with a number of eyes welded to one side of each plate. All six plates, complete with strongbacks, hookbolts and wingnuts, are tack-welded together to form one pack for ease of stowage. The plates are intended to be applied to the outside of the damaged shell plating with the 50 mm x 15 mm flat bar strongbacks inboard, held in place by the 12 mm dia. hookbolts and wingnuts, with sheet rubber or other joining material inserted between the patch and the shell plating. Allowances are scaled to one patch pack per FRPP. The 76 x 38 mm steel channel, provided at FRPP lockers can be used if the strongbacks need to be more robust.

1609. Improvised Leakstoppers

a. The shape and extent of holes in the hull may preclude the use of GRP domes or patchpacks, but adequate leakstoppers can be improvised using materials readily to hand. Tabletops or similar flat boards may be considered as emergency stopper plates. Sealing between the stopper and the hull can be achieved using bedding, a shot mat or soft furnishings. If entry holes are severely petalled, a 'sausage' of rolled material (eg blankets or carpet) should be wrapped around the jagged plating until the pad stands well clear of the edges (see Fig 16-4). This type of leakstopper will normally be held in place by shoring, but an improvised strongback may be appropriate. For holes well above the waterline, where less urgency is needed, it is advisable to cut off the worst of the hull petalling to make the seal more effective.

b. In addition to the allowance of patchpacks, strongbacks and hookbolts in BRd 2170(3), additional devices may be fabricated onboard, as illustrated Fig 16-2 and Fig 16-3.

1610. Steel Stopper Plates

Large ships carry an allowance of steel plate for damage repair and in smaller ships engineers' workshops will, generally, have ready-use plate available. Handling of large steel plates is difficult, so they should be cut to the required size before moving, and their use will only be practicable when the ship is no longer under attack. The plate may be secured to the hull (after insertion of packing, where required) by welding or by use of the Ramset tool.

1611. GRP Emergency Repair Pack

Ships with glass reinforced plastic (GRP) hulls carry an Emergency Repair Pack for making repairs to minor hull damage. The pack includes all materials, personal protective equipment and instructions. The 2-part epoxide based repair material produces best results on clean, dry and well prepared surfaces, but in an emergency it will tolerate slight oil contamination and may be applied underwater. The pack can also be used for making temporary repairs to ruptured pipes, etc. Clamping it to the damaged surface until the epoxy resin cures can enhance the effectiveness of the repair. The minimum temperature for curing is 5°C, but the gel time will reduce considerably at higher temperatures.

Fig 16-2. Leakstopping - Large Hole - Using Strongback

Fig 16-3. Strongback and 'U', 'T' and 'L' Bolts

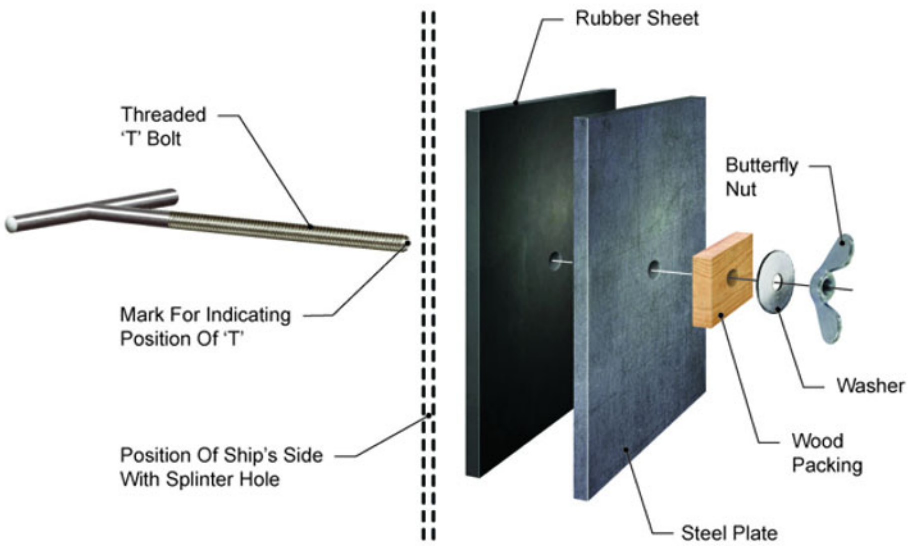
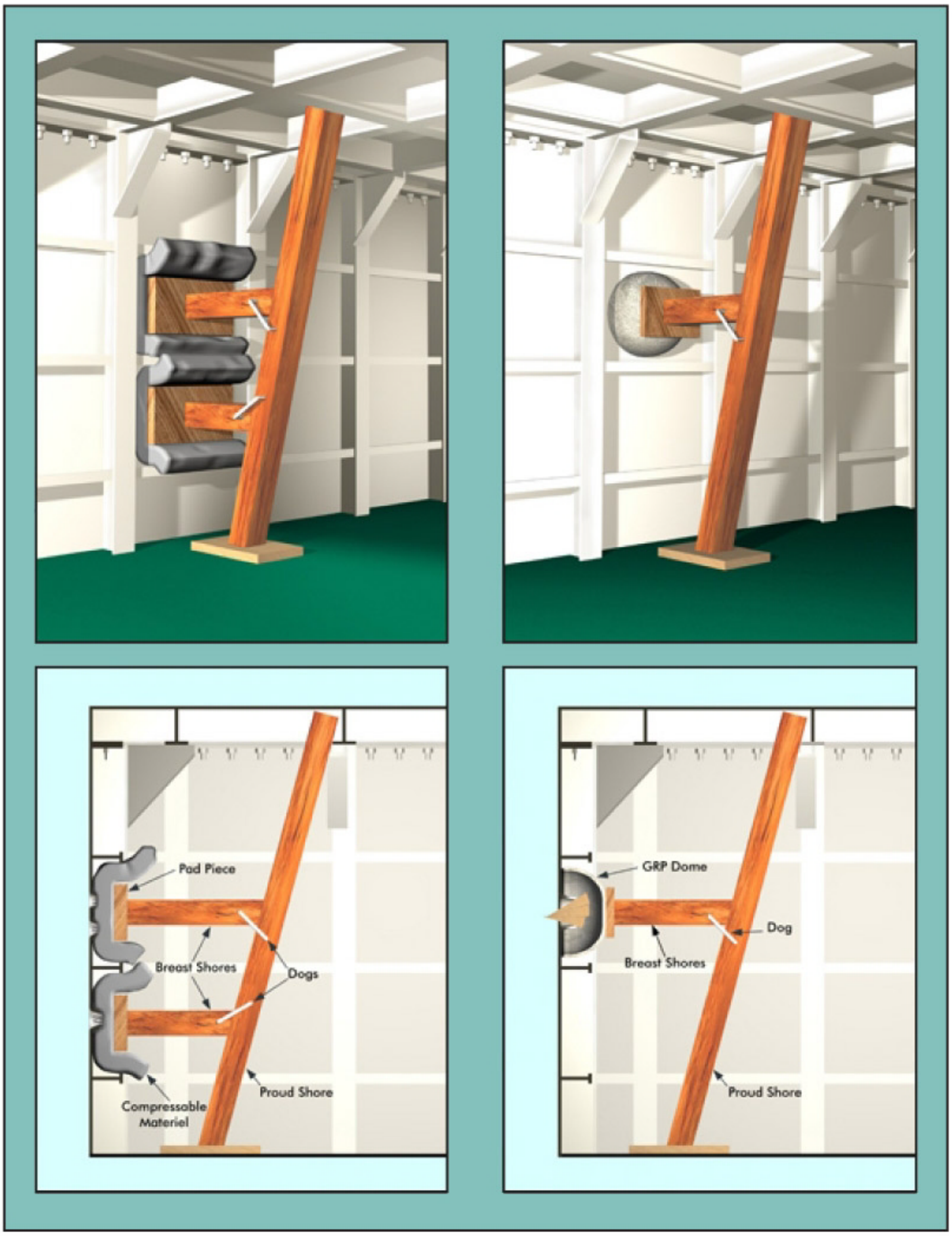


Fig 16-4. Leakstopping - Large Hole - Using Shore



1612. Cement Boxes

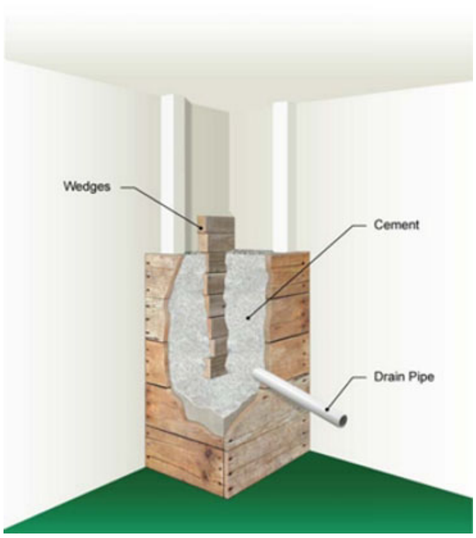
WARNINGS

1. CONTACT WITH THE CEMENT POWDER OR WET MIX CAN CAUSE IRRITATION, DERMATITIS OR BURNS.

2. EYE AND SKIN PROTECTION IS TO BE WORN.

Small holes near boundaries, and in difficult corners, can be dealt with by using a small cement box. The material used as the leakstopper is rapid hardening cement (Ciment Fondu, sometimes called damage control cement), which is a semi-permanent repair material. Unlike ordinary commercial (Portland) cement, which takes some time to harden, the rapid hardening cement sets in five hours, hardens in eight hours and achieves maximum strength in 24 hours. It will also set, providing it is well contained, under static water. The leak must be stopped as much as possible using softwood wedges (or some other form of leakstopping) and the surrounding plating, which is to be covered by cement, must be cleaned of oil, grease, loose paint, etc. (GP detergent is recommended for this purpose, care being taken with its application). The cleaned steel can then be roughened with a cold chisel or similar tool to aid the grip of the cement. A cofferdam or cement box should be built around the leak using, for preference, tongued and grooved timber or heavy plywood boarding. The cement can be mixed with either salt or fresh water to provide a stiff mix. It is sometimes useful (especially if water from the leak is still coming in, or present, to fill sand bags, one third full, with mixed cement before moulding to suit the damaged area. This will reduce washing-away of the cement. The cement placed in the box must always be well tamped down, care being taken to avoid trapping air. If small amounts of running water are present it is recommended that sheet rubber or PVC be placed over the leak and taken to the bottom of the box. This will give the cement a better chance of setting and also greatly reduce the chances of any of it being washed away. A drainpipe should be set into the box at a low level in order that any water that may become trapped inside may 'bleed off'. When the cement has set this pipe can then be plugged. It should be remembered that 0.1 m3 of mixed cement weighs approximately 40.5 kg and that sufficient should be made to fill the box. Fig 16-5 shows the construction of a cement box.

Fig 16-5. Cement Box

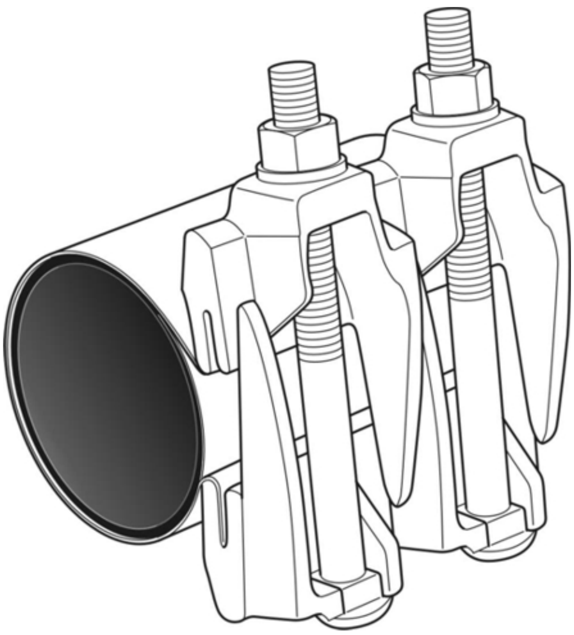


1613. Damaged Pipes

a. Softwood plugs, wrapped with cloth, can be hammered into a severed pipe if the open end is in reasonable shape. Plugs are not to be used in pressurised systems and must be secured into position, to reduce the hazard to personnel in the event of a blowout. If the pipe is distorted, the use of blank flanges is more effective, but takes longer due to the need to isolate the system and remove bolts. Small bore pipes can be repaired by use of rubber hose and 'Jubilee' clips.

b. Splits and small splinter holes in pipes can be repaired by isolating the system and applying the suitable size of pipe repair clamp (see Fig 16-6).

Fig 16-6. Pipe Repair Clamp



c. **Rubber Pad and Whipping Repair Method.** This repair is carried out using a rubber patch secured by cord whipping (see Fig 16-7).

(1) Whipping repairs will significantly reduce the amount of fluid leaking from pipe depending on the quality of workmanship however it is unlikely that fluid leakage will be fully stopped.

> ***Note.*** *If whipping repairs are to be undertaken on systems containing pressurised POL products the risk of atomised POL products leaking on the completion of the repair must be assessed.*

(2) To construct a whipping repair the following procedure is to be followed:

(a) Isolate the system.

(b) Place rubber sheeting over the damaged pipework ensuring that the sheeting is at least 25 mm longer than the split at both ends and is covering ¾ of the pipe work circumference. Secure with tape.

(c) Lay a loop of whipping cord on the opposite side of the pipe work to the split (if practicable) so that at least 15 mm is overhanging the rubber sheeting.

(d) Start to whip the pipe work by starting the coils at the opposite end of the cordage to the loop.

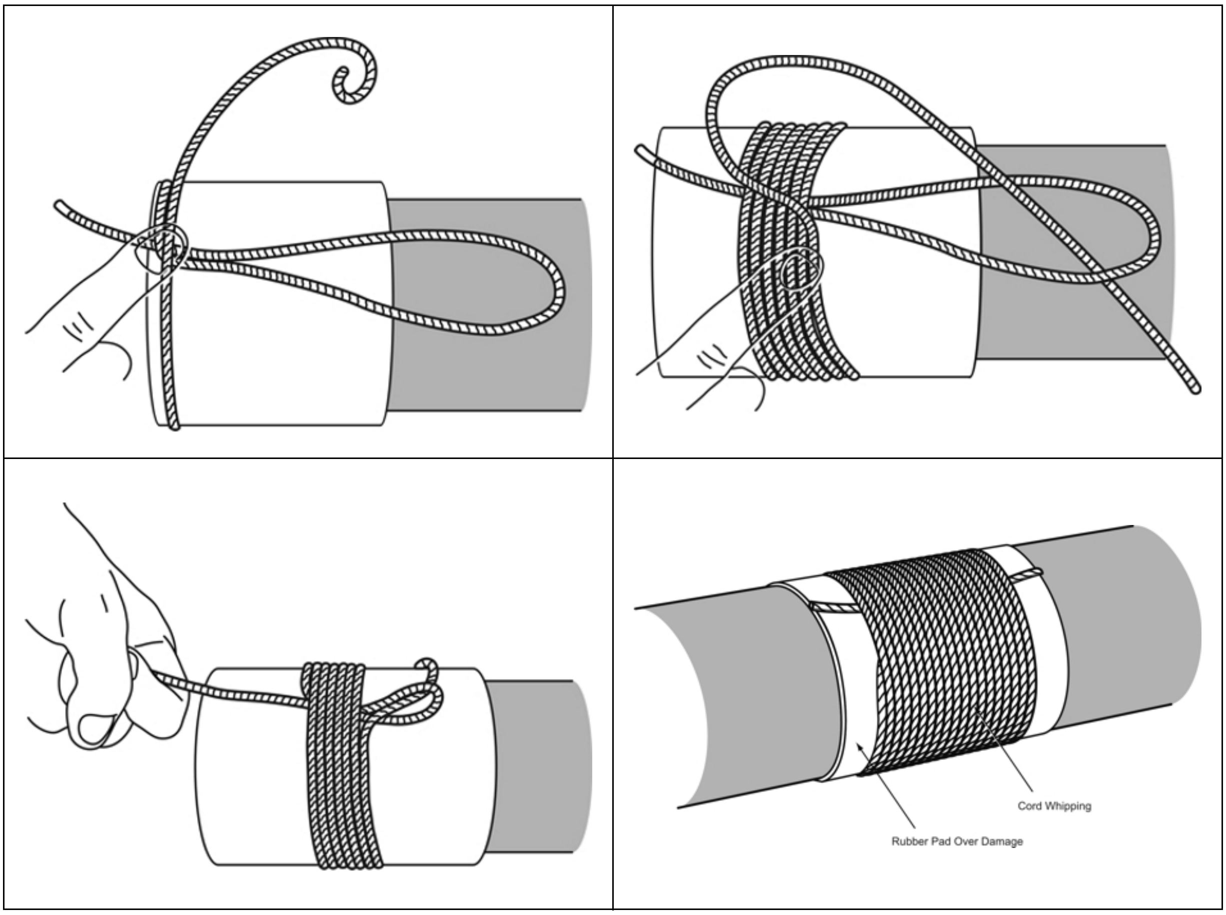
(e) Pull the turns as tight as possible (the integrity of the seal may be increased by use of a bar to pull the whipping tight) and lay each turn directly adjacent to the previous turn.

(f) When all of the rubber sheeting has been covered with whipping pass the end of the cordage through the loop and pull to secure the whipping.

(g) Slowly open the fluid system isolations and check for leaks.

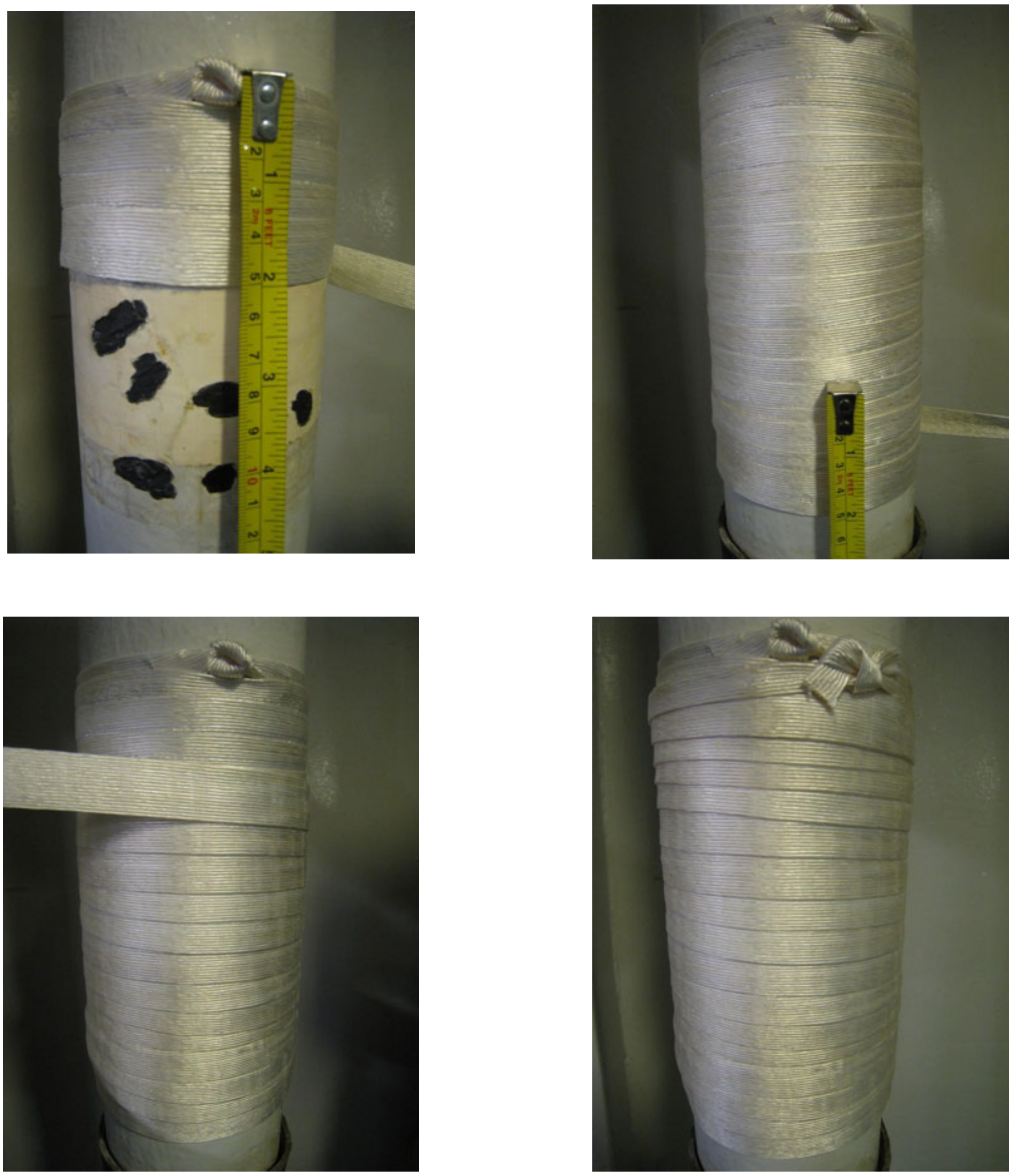
d. Pipe repair tape kits are carried onboard, under the control of the Hull section (Engineers' workshop in RFAs). Each kit includes two-part epoxy putty, repair tape, protective gloves and instructions. The resin in the repair tape is activated by contact with water and cures in approximately 30 mins, depending on the temperature.

Fig 16-7. 4 Stages of Rubber Pad and Whipping Repair



e. **Strapping Tape Method.** The strapping tape is split at the end and tied in position at about 50 mm above the damage and applied to the repair as dry as possible. It is then wrapped tightly around the pipe overlapping the tape on each turn, to a point 50 mm beyond the damage. The tape is then passed back up the pipe overlapping again. A small bore pipe requires two full overlapped passes and a large bore pipe will need 3-4 passes. Once the wrapping is complete, the tape is secured again by splitting the end and securing with a knot (see Fig 16-8). Water is then applied over the repair to allow the shrinking/tightening process of the tape to begin (the tape will shrink by approximately 5%); the tape does not need further wetting after this initial application. The repair should achieve maximum strength 30 mins after the wetting phase. All vessels are to ensure a roll (see BRd 2170(3) for allowances) is stowed in each FRPP/ZCP/Section Base and 1 roll made available to the mobile repair parties.

Fig 16-8. 4 Stages of Strapping Tape Repair



f. Damaged HP air or hydraulic systems can be repaired, in emergency situations, using hose repair kits. The allowance of these kits, specified in BRd 2170(3), varies between ships. Each kit contains stainless steel braided, PTFE lined hoses in 5 m lengths and various Keelaring reducing couplings. These repairs can be applied to systems operating at pressures up to 276 bar, but should only be considered as temporary, pending permanent repairs.

SECTION 2 - SHORING

1614. Shoring

a. Many of the leakstopping devices described depend on shoring for their efficiency. Shores also have other very important functions in a damaged ship:

(1) Support of straining bulkheads, decks, doors and hatches against abnormal pressures.

(2) Support for damaged and weakened structure and fittings.

b. In both, the shoring is used to distribute the stress loading of straining or weakened members to sound parts of the structure. The principal watertight bulkheads are built to withstand the stresses that occur when compartments are flooded statically, and compartments are tested during building to ensure that this is so. To conserve timber, therefore, and to avoid wasting valuable time and labour, sound structure should not be shored merely because the compartment on the other side is flooded. However, extensive damage in the vicinity may have weakened the structure and made it incapable of standing up to its designed stresses; it must then be supported. Support is also needed for a bulkhead thrown open to the sea, to prevent its collapse under wave action or under pressure from movement through the water. In this case, if no strain is apparent, only a little support is needed; if strain is apparent, much more shoring is needed.

1615. Symptoms of Strain

a. Straining of structure is usually readily apparent and can be recognised by:

(1) **Panting.** This is the alternate bulging and contraction of plating (often accompanied by a groaning or pinging noise) caused by uneven pressure or locked up stresses. It is difficult to shore panting structure efficiently and a much better job can be done if the ships speed is reduced, or the ships head turned away from the sea, until shoring is completed. If conditions will not permit this, the shores should be fitted to the extreme of the outward movement. Alternatively, if there is a convenient securing point (eg eye plate) or one can be welded on, the plating can be held in by wires or chains and lifting appliances.

(2) **Buckling.** Deck beams or bulkhead stiffeners may buckle; bulkheads or deck plating may bulge when under strain.

(3) **Fracture or Splitting of Plating.** This may occur alongside stiffeners or where bulkheads or decks abut on hull plating. It is often difficult to detect cracks that may be hidden under paint, oil or fittings.

b. Great care is necessary when examining the structure and if strain is apparent shoring must be carried out immediately. It should not be postponed, because flooding may spread, causing an increase in draught with the consequent greater pressure on the structure and a further loss of compartments.

1616. Supporting Weakened Structure

When structure has been weakened by damage, or has lost its normal means of support, shoring provides the best method of giving temporary support until more permanent measures are possible. If structure has been distorted, shoring should be used only to hold it to its new position. No attempt should be made to force if back to its original shape because this would probably induce further stresses and may cause complete rupture.

1617. Timber Shoring

The main and best material for shores is softwood, ie pine or fir. It can be easily handled, cut, fastened and, compared to hardwood, has a higher strength/weight factor. The sizes most used for shores are 100 x 100 mm and 150 x 150 mm. Deal planking of sizes 50 mm and 75 x 225 mm are usual for pad pieces and packing, and the usual size of tongued and grooved planking is 32 x 150 mm. Batten timber, used for tying a system of shores together, is 25 x 75 mm. Softwood wedges are used for setting up shores. Mild steel dogs (staples), and nails are used for securing shores, pad pieces and battens together. When stowed onboard, the shores, planks and battens should be cut to the greatest length that can be moved through the ship.

1618. Acro Props

a. The Acro Prop consists of two telescopic, tubular steel sections, supplied in two sizes, 1.75 m extending to 3.1 m and 1 m extending to 1.68 m. It is fitted with head and base plates and provided with a screw jack, with drop handle, for fine adjustments. The Acro Prop can only take loading along their lengths. Any lateral loading will distort them, so they should only be used as vertical or breast shores, never as proud shores. They must not be hit with hammers or dented, as any distortion to the outer case may prevent the inner part from sliding freely, thus making adjustments difficult or impossible.

b. When Acro Prop are stowed (either vertically or horizontally), the pin should be located through a hole in the inner tube, below the screwed collar, which should be near to the bottom of the thread to allow for maximum adjustment.

c. It is essential that an Acro Prop be carried correctly to avoid hazards to personnel. It must be carried vertically, with the threaded portion uppermost. The pin must be fully inserted just below the rotating collar. To prevent the pin from moving it must be held in place, as shown in Fig 16-19. The other hand should grasp the Acro Prop at a point one third of its length up from the base.

d. Acro Props may be used for permanent shoring during peacetime damage situations, when ship motion is unlikely to displace them, but they must be regularly inspected. They are always to be used in conjunction with wooden pad pieces to:

(1) Reduce the danger of slipping.

(2) Spread loading on the structure.

(3) Prevent damage to GRP domes.

e. After use all moving parts of the Acro Prop should be lightly oiled before stowage, to prevent seizure.

1619. Tools for Shoring

The following tools, required for shoring, are stowed at FRPP lockers:

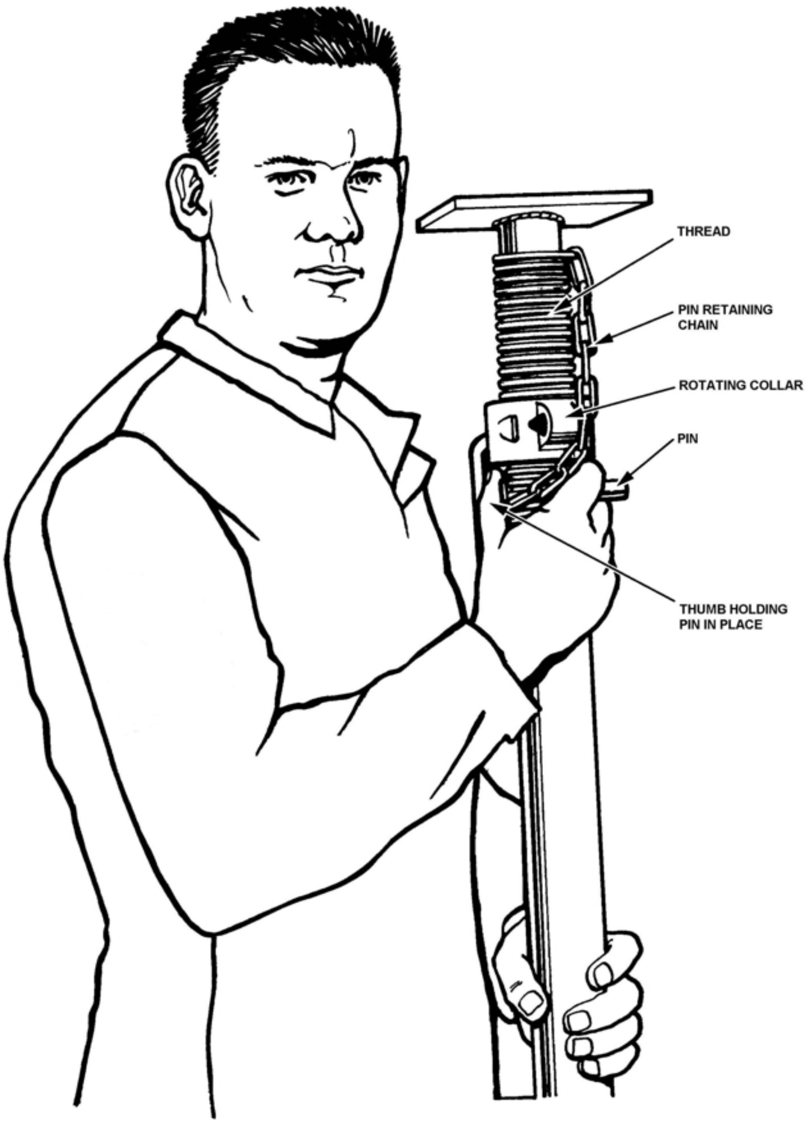
a. 7lb (3.15kg) hammer.

b. 2lb (910g) hammer.

c. Cross cut wood saw.

d. Gunter batten.

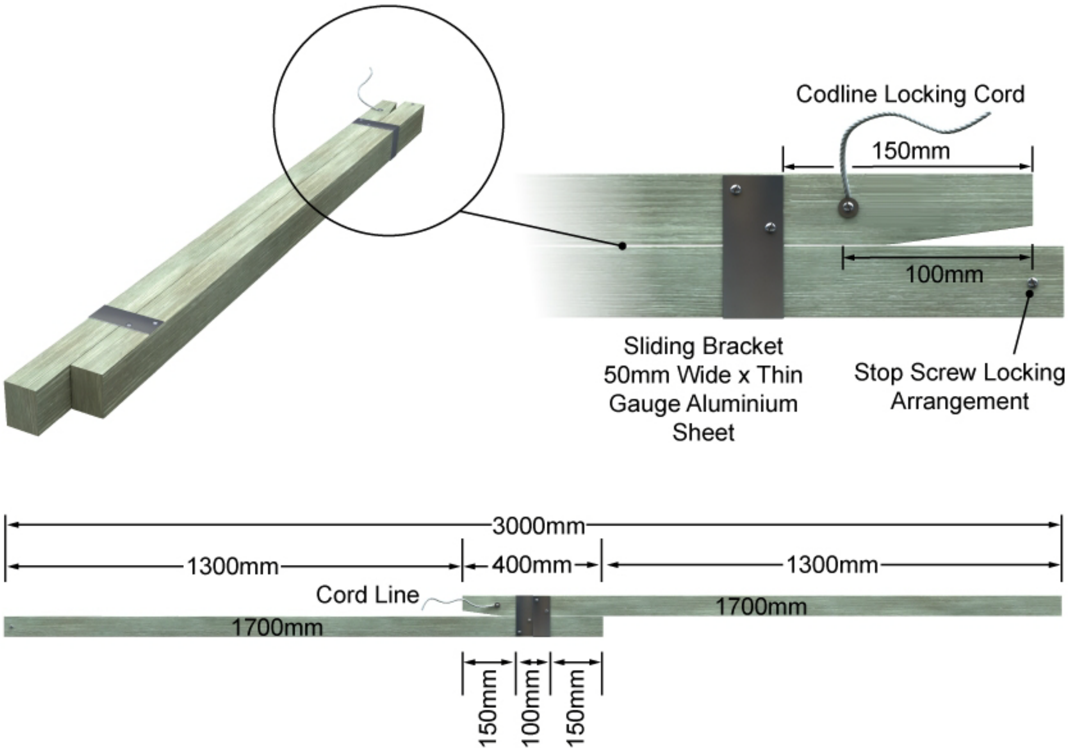
Fig 16-9. Carrying an Acro Prop



1620. Gunter Battens

Gunter battens are used for measuring the length to which shores are to be cut. Guidance for their manufacture and use is given in Fig 16-10 and Fig 16-11. Two sizes are to be made, one 1700 mm long and the other 850 mm.

Fig 16-10. Gunter Batten - Manufacturing Details



Note. *The Gunter Batten is to be manufactured from 38 x 25 mm straight grained softwood.*

1621. Principles of Shoring

a. The essentials for shoring to be effective are:

(1) Strong and rigid anchorage for the shores.

(2) A reasonably complete network of reinforcement.

(3) Distribution of the load over as large an area as possible.

b. The method of shoring to be adopted depends on the extent of damage and the character of the structure in the vicinity. The aim should be to shore to the nearest strong point. If the nearest structure is not strong enough, the shoring must be continued back, through other compartments if necessary, to end at members of the necessary strength. The shoring assembly must always be kept under observation because if it becomes strained it will itself need support.

1622. General Rules for Shoring

There are certain rules generally applicable to all types of shoring, whether for bulkheads, decks, doors or hatches. They are:

a. A timber shore should never be longer than 30 times its minimum width or thickness.

b. Ideally, the head and heel of a shore should abut on stiffened plating (by a deck beam or bulkhead stiffener). This is not always possible, in which case wooden pad pieces should be used to spread the load.

c. Shores should never be cut in anticipation, for any distortion of structure would make them useless.

d. Shores must never be placed in position before damage occurs; they would transmit shock and make the damage greater.

e. Wedges should be used in opposing pairs. The two wedges should be driven in simultaneously or a heavy weight held against one while the other is driven in.

f. A system of shores should be tied together with battens and dogs or nails.

g. Careful watch must always be kept on shoring and any loosening attended to immediately.

1623. Methods of Shoring

There are 4 methods of shoring:

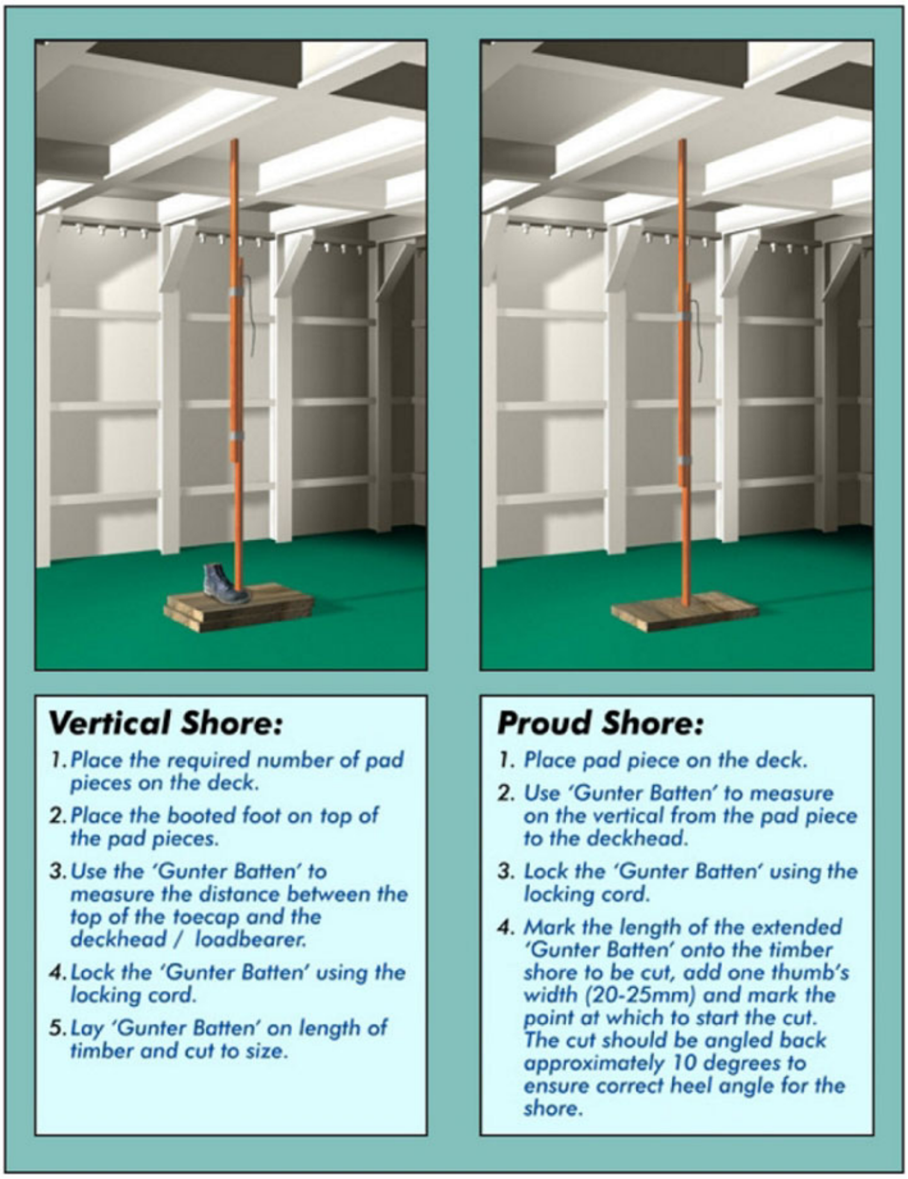
a. **Vertical Shoring**. For hatches and decks and for leakstopping devices on them. (see Fig 16-12, Fig 16-13 and Fig 16-14). A vertical shore must be cut approximately 50 mm shorter than the measurement between the deck pad piece and the deckhead, to allow for the wedges used to 'harden' it into position.

b. **V Shoring**. For vertical structures. This is not as simple as square shoring. (see Fig 16-16 and Fig 16-17).

c. **Square Shoring**. For bulkheads, ships side plating, watertight doors and for leakstopping devices on them. A proud shore is sometimes needed to achieve square shoring. A proud shore is a shore cut longer than the height between decks (add 20 mm), the head placed against a girder or a welded-on lug, and the heel jammed on the deck below. A breast shore is then carefully cut to jam down as nearly horizontal as possible between the proud shore and the structure to be supported. With accurate cutting of the shores, wedges are unnecessary. However, should wedges be necessary, they are best used at the heel of the breast shore where it butts against the proud shore. Fig 16-15 illustrates this arrangement.

d. **Cantilever Shoring.** Can be used in lieu of any build type for leak stopping where there is restricted access to the area of damage. This type of shore uses an EMMS clamp as a fulcrum and is **NOT** to be used for reinforcing or shoring up of bulkheads or hatches (see Para 1629).

Fig 16-11. Use of Gunter Batten to Measure Length of Vertical/Proud Shore



1624. Basic Instructions for Shoring

a. Details of more elaborate systems of shoring are given in later paragraphs, but the basic rules are:

(1) **Bulkheads.** The first and most effective shore on an intact but straining bulkhead should be at the centre of the bulge or, if the strain is due to water pressure on the other side, at one-third of the height and at the centre of width of the bulkhead. Full advantage must be taken of beams, pillars and heavy, fixed fittings to anchor the shores.

(2) **Decks.** Pad pieces will always be needed at both ends of a vertical shore. For vertical shores to abut under a beam, pad pieces or shoring material must be laid across under the beams.

If a deck is bulging because of pressure underneath, the foot of the shore should be over the distortion if possible. If a number of vertical shores are to be fitted in line, a length of 100 H 100 mm timber should be used as a continuous pad piece.

(3) **Watertight Doors and Hatches.** The first shore should be set up on a pad piece on the door or hatch just clear of the clips along the side remote from the hinges. If needed, a second shore can be similarly set up along the side nearer the hinges. On a very big hatch, it may be necessary to set up four shores (see Fig 16-14) but two will generally be enough. Shores to doors and hatches must not be set up harder than necessary, because undue pressure will only tend to increase the leaking.

b. If a vertical shore is being set up on an oily deck, efforts should first be made to clear the oil away using GP detergents and/or suitable absorbing agents before using rough abrasive cloth/paper (doubled up to present the rough side to the surfaces in contact) or rags, under the pad piece and the heel of the shore, to improve its grip. Wedges should be set under the heel unless floodwater makes it impossible, when they should be set under the head.

Fig 16-12. Vertical Shoring - Decks

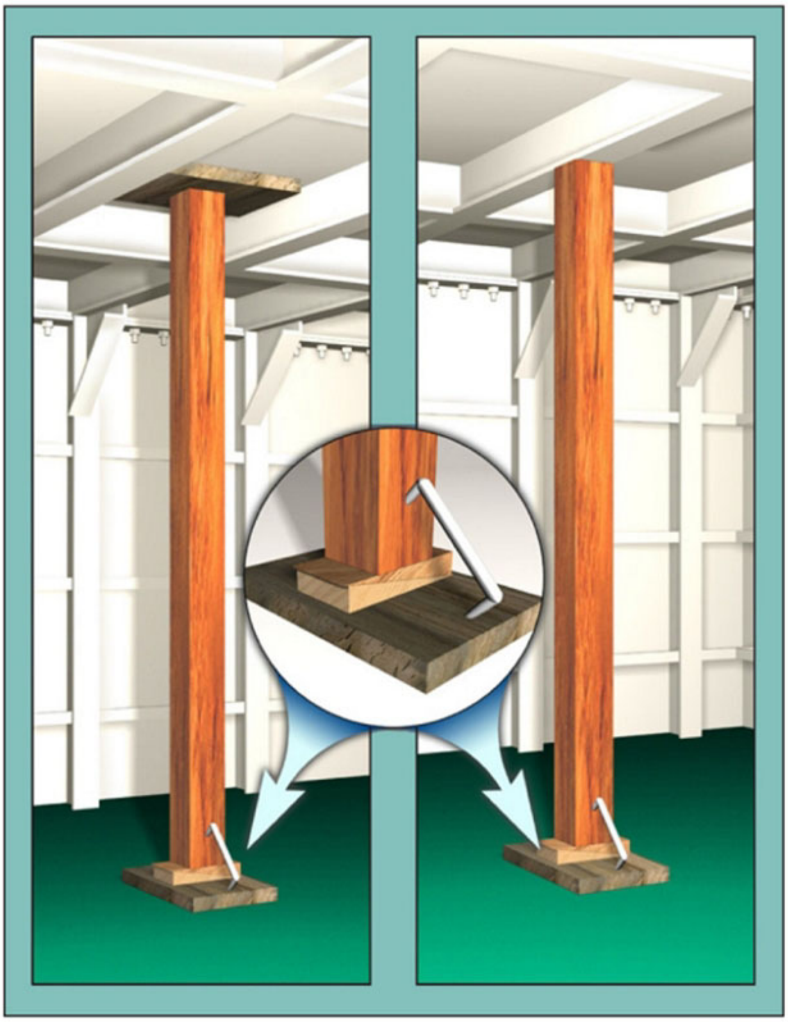


Fig 16-13. Vertical Shoring - Using an Acro Prop

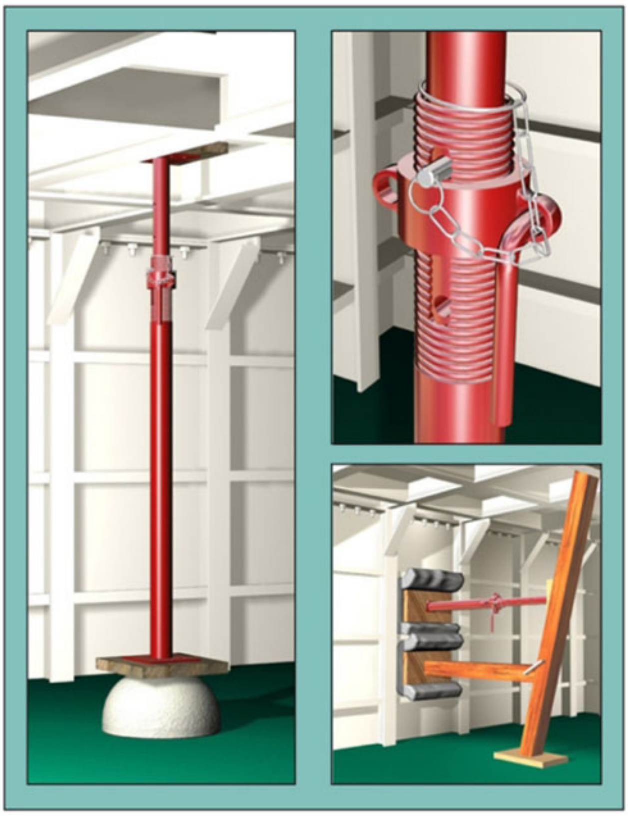


Fig 16-14. Vertical Shoring - Hatch

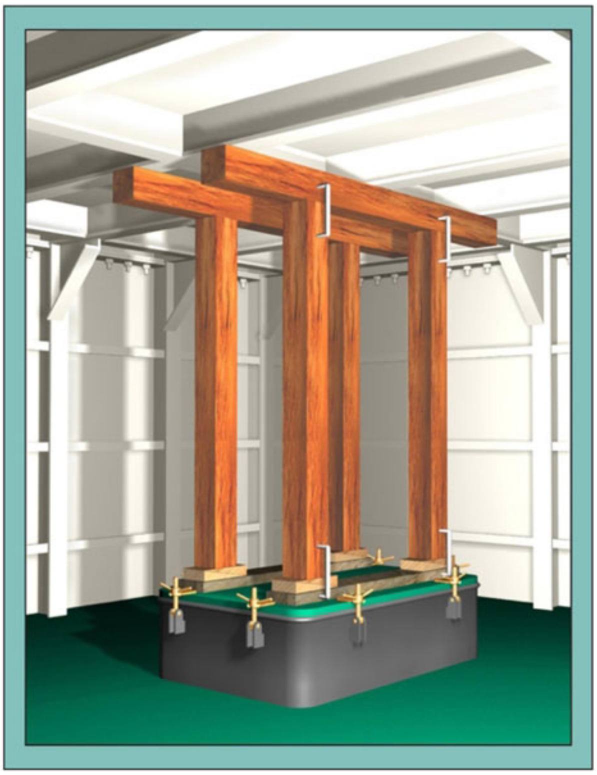
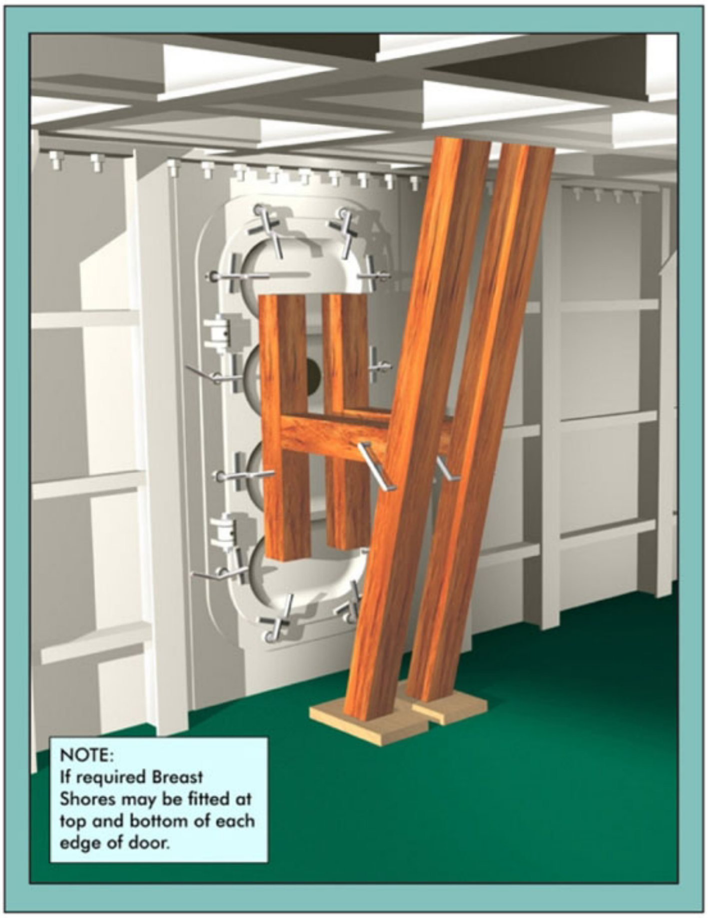


Fig 16-15. Square Shoring - Door



1625. Multiple Shoring of Bulkheads

a. Where no solid structure is available to take the thrust of shoring in the immediate vicinity, a system of multiple shoring must be adopted to take the thrust back to the nearest strength structure. Examples of this shoring are illustrated in Fig 16-18, Fig 16-19, Fig 16-20 and Fig 16-21.

b. Long lengths of shoring timber are unwieldy, difficult to set up and, in addition, may be too long to get through the door or hatch of the compartment in which they are required. With the types of multiple shoring illustrated, comparatively short lengths of timber can fulfil the purpose.

c. Breast shores should be set up to pad pieces against the bulkhead with their heels to a proud shore and be continued back (and up and down if necessary) through other proud and breast shores, or through V shoring, to the nearest strength structure. The whole system must be cross-tied by battens, with shores, pad pieces, cross-ties, packing and wedges secured by dogs and nails. Supporting chocks under the heads and heels of breast shores give additional security against falling. Distance pieces between the heel of the proud shore and the nearest strength structure help prevent the possibility of slide back.

d. If slackening is observed, wedges and breast shores should be hardened up and re-secured with dogs or nails.

Fig 16-16. V Shoring - Bulkhead (Elevation)

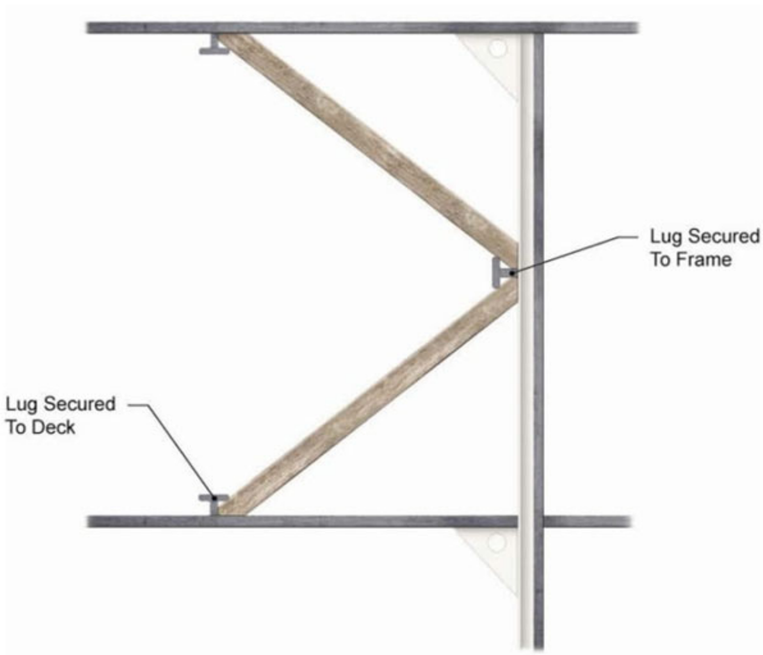


Fig 16-17. V Shoring - Bulkhead (Plan)

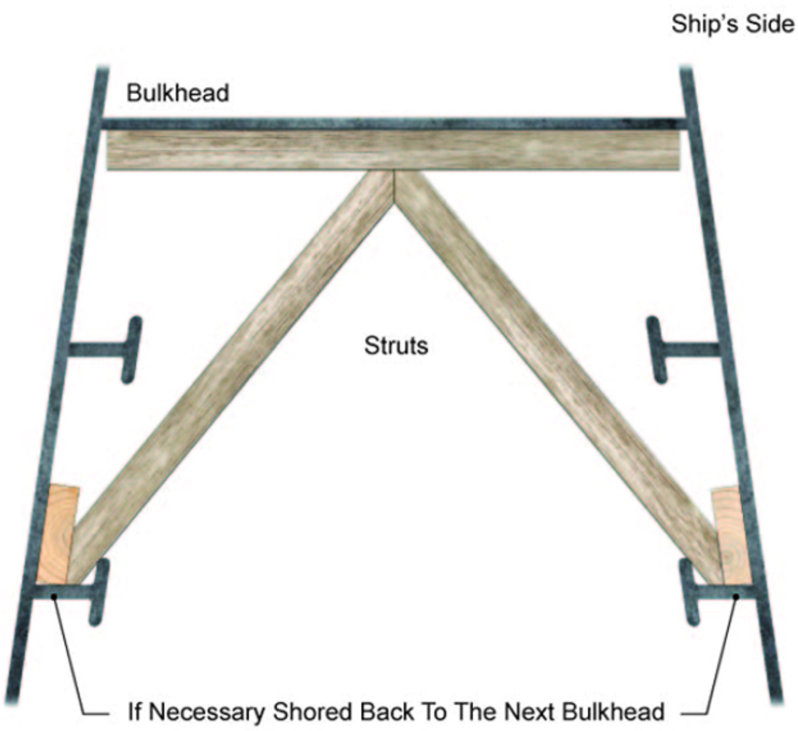


Fig 16-18. Multiple Square Shoring

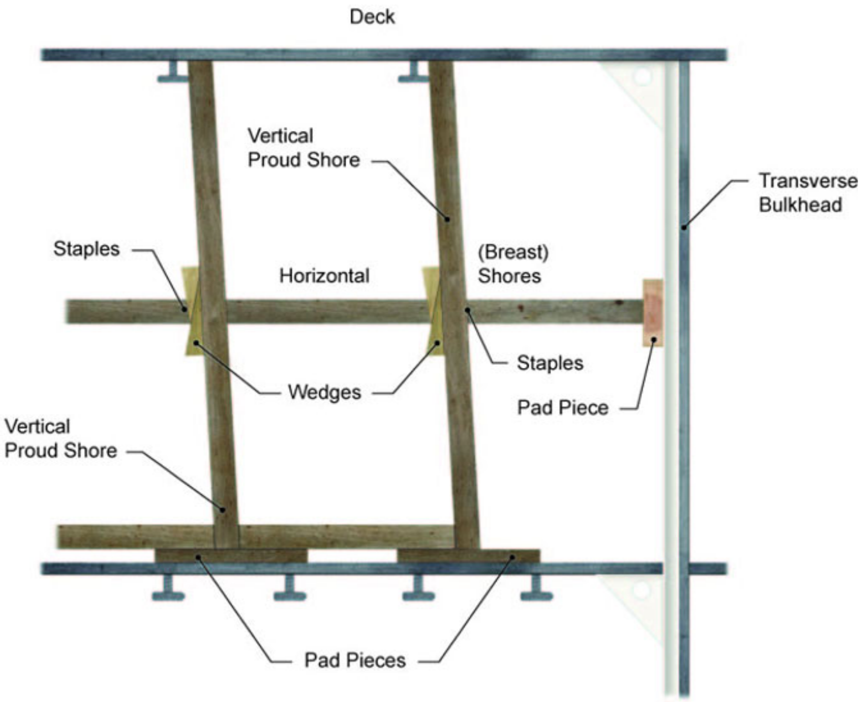


Fig 16-19. Multiple Square and V Shoring

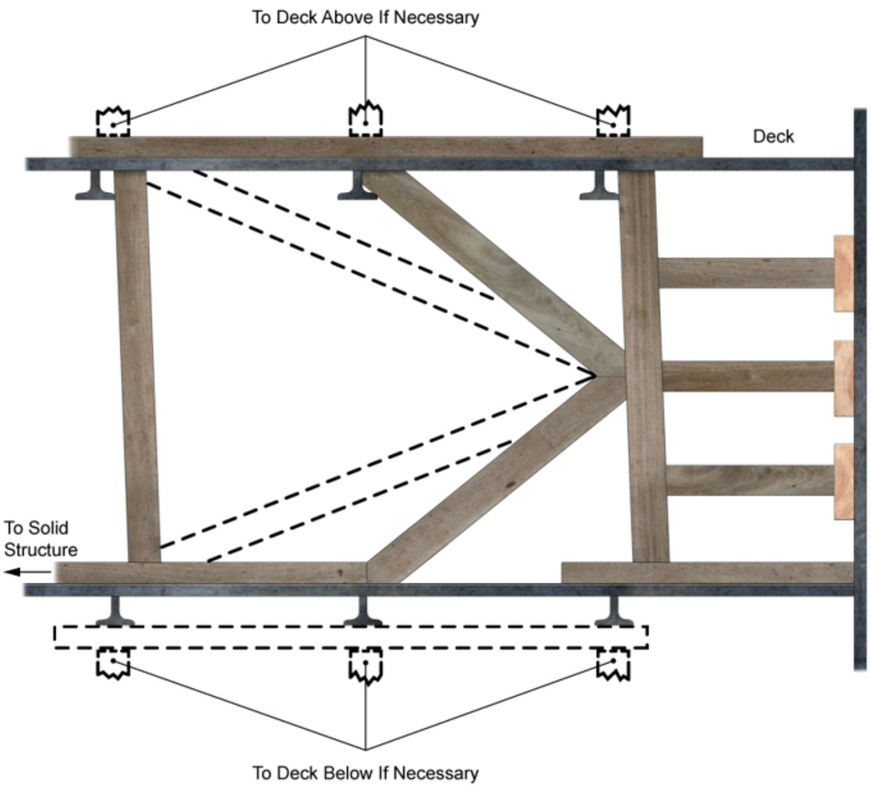


Fig 16-20. Multiple Square and V Shoring

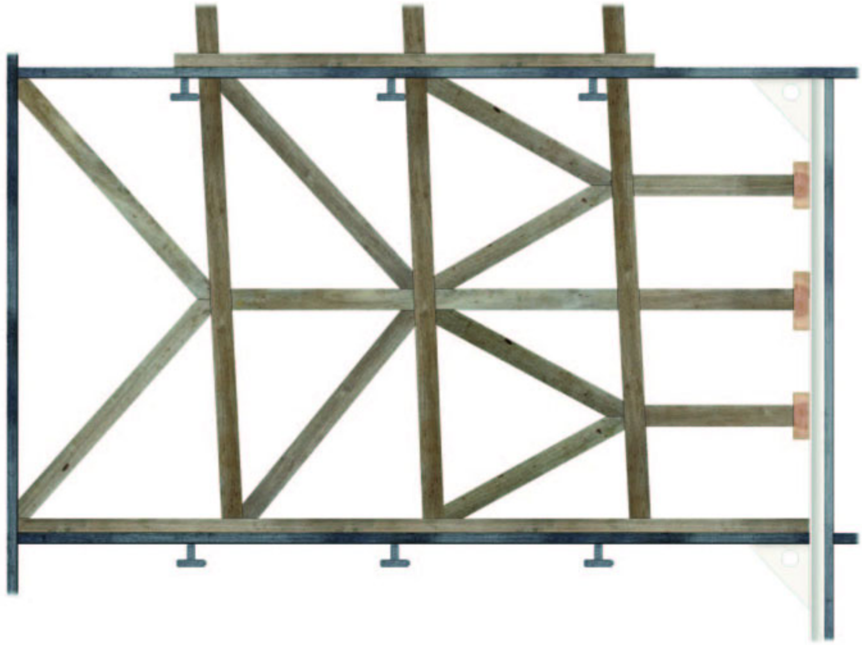
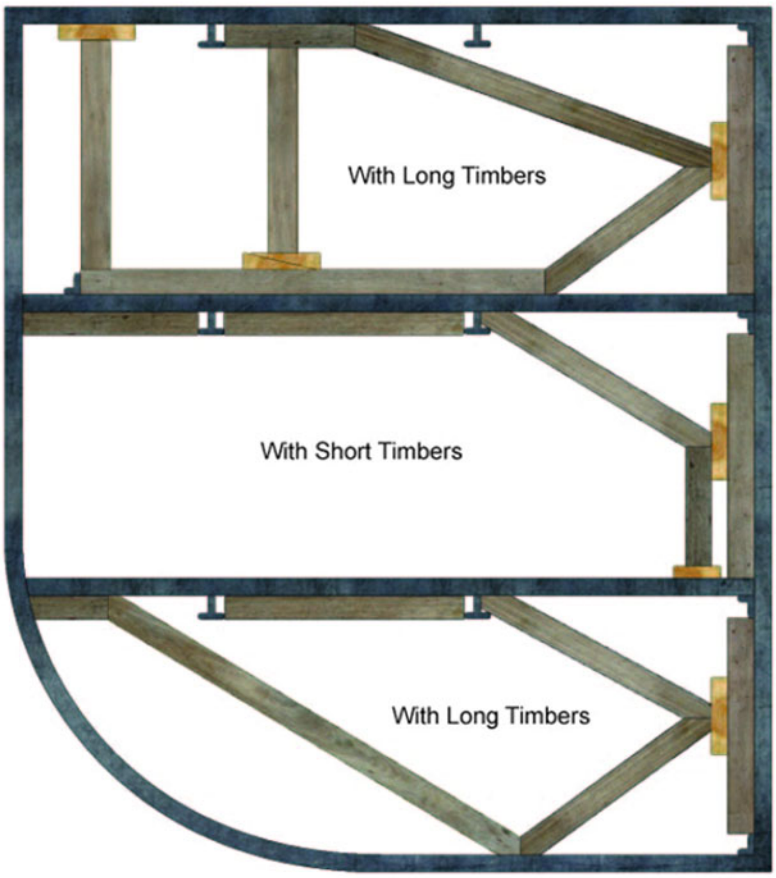


Fig 16-21. Shoring a Longitudinal Bulkhead (Various Methods)



1626. Fabricated Shore

Should it be necessary to use a long single shore in a compartment that has only a small access opening because machinery and fittings make the erection of multiple shoring impossible, a shore can be fabricated from short lengths of timber bolted together as illustrated in Fig 16-22. Each length used should be the longest length that can be passed through the access opening and the fabrication of the shore must be carried out in the compartment. Understandably, the use of a fabricated shore cannot be a first aid measure as the cutting, drilling and bolting together of the pieces will take time. A fabricated shore is not as strong as solid timber of the same dimensions.

Fig 16-22. Fabricated Shore

1627. Shoring Training Allowance

The allowance of 100 x 100 mm shoring timber held at FRP Posts includes a 20% enhancement for training purposes.

1628. Machinery Spaces

The erection of shoring in machinery spaces is difficult, and is almost impossible to achieve quickly, due to the large deck heights, and machinery and pipe systems that impede such work. Structures which require to be supported need to be shored from nearby, sound structures, while patches to the ships side, and some bulkheads, can be supported by using Emms clamps.

1629. Emms Damage Repair Clamp

a. This item is designed to be used in pairs and can replace proud shoring systems when supporting patching or other leakstopping devices. Its use alleviates the problems of access and stowage associated with providing long lengths of shoring timber in such spaces, and allows shoring to be cut to shorter lengths as required.

b. Three types of Emms clamp are provided:

(1) **Standard Small.** For use with 100 x 100 mm shoring.

(2) **Standard Large.** For use with 150 x 150 mm shoring or double 100 x 100 mm shoring, (in large ships only).

(3) **Universal.** For use with 100 x 100 mm shoring in ships with offset bulb (‘P’ section) frames.

c. The damage repair clamps for main machinery spaces (MMS) form part of the contents of the damage repair tool box, which is held in these spaces, or they may be secured to ships' frames high up in the MMS, near to the access hatch or air lock. The damage repair clamps for the FRPP form part of the contents of the damage control locker. Full details of allowances for RN and RFA ships are in BRd 2170(3).

d. The standard Emms clamp is made in two parts, each with an end shaped to fit over the flanges of either 'T' bar or bulb frames. One part is welded to a box section, and the other free section is secured to it by means of a captive, double start threaded bolt and wingnut. The two parts of the clamp can be secured to 'T' bars by fitting the shaped ends over the flange and then tightening up on the wingnut. For fitting over bulb angle the free part should be reversed and the wingnut tightened. The box section is designed to hold standard damage repair shores that are held in position with opposed wedges and, if necessary, nails.

e. The clamps are secured to ships' frames or longitudinals either side of the damaged area. Once in position and secured, a suitable length of shoring timber can be passed through the box sections welded to each clamp, thus providing a strongback close to the damaged area against which a GRP dome or patch can be shored, wedged, dogged and nailed, using a pad piece if necessary (see Fig 16-24). Two clamps can be used in tandem to extend the distance of the strongback from the damaged area.

f. These repair clamps are not proof tested and therefore must not be used as beam clamps for lifting purposes. Consequently a tally marked **'FOR DAMAGE CONTROL PURPOSES ONLY'** is fitted to each clamp.

g. The standard Emms Clamp was designed to fit on 'T' section frames. It will not fit offset bulb frames (eg in Type 23, LPH, HMS SCOTT and RFAs). The Universal Emms Clamp (see Fig 16-23) is used in these ships. It is attached to the frame by a screwed clamp and the box section swivels to give versatility in the orientation of the shoring.

h. The small standard clamp may be clamped onto the universal clamp, in tandem. The universal clamp cannot be clamped onto either of the standard clamps.

Fig 16-23. Universal Emms Clamp

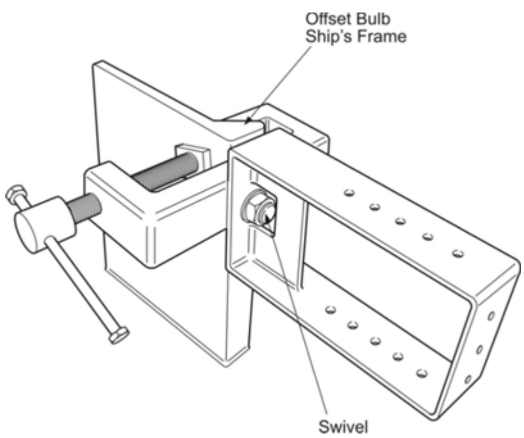
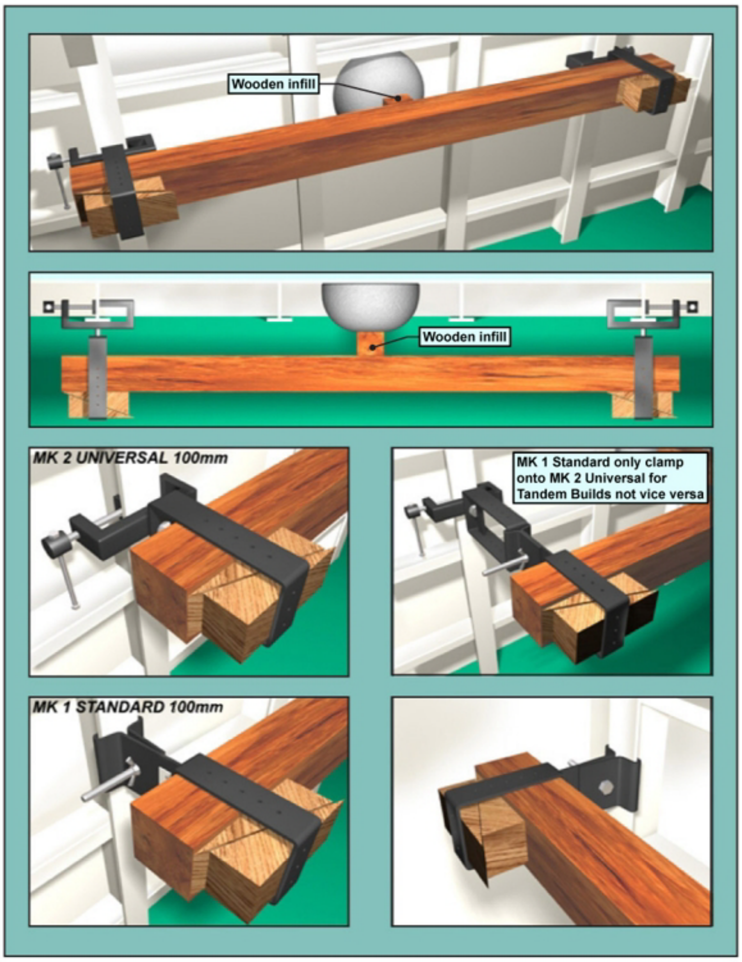


Fig 16-24. Emms Clamp Shoring



1630. Confined Access Shoring

a. The traditional shoring builds outlined in this chapter and BR 4008 are widely understood and accepted as best practice for general DC incidents requiring secondary shoring to provide both flood protection and in some cases bulkhead strengthening. However, primarily horizontally fitted, EMMS clamp builds are not suitable where the damage sustained is in the first section of plating adjacent to transverse bulkheads, where there are stiffeners of differing sizes, machinery bedplates restricting access or with cable runs or pipe systems fouling the stiffeners.

b. Enclosed are examples of alternative Emms Clamp shoring builds that can be adapted in many areas where traditional builds cannot be achieved.

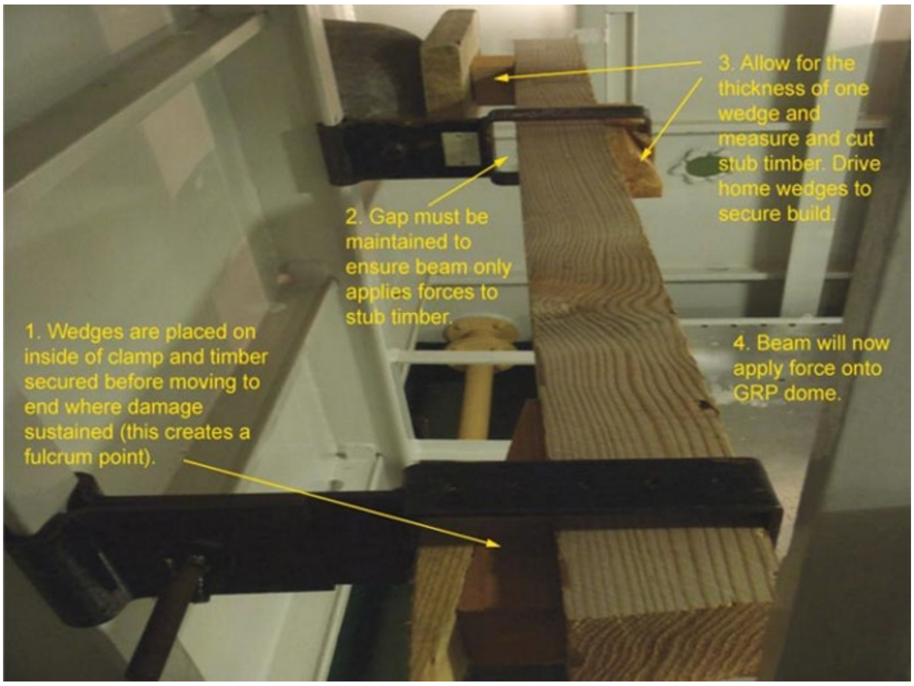
c. **Method**

(1) Fig 16-25a and Fig 16-25b illustrates 2 modified EMMS clamp builds where access to or the ship's hull construction prevents the clamps being fitted either side of the area of damage. The two EMMS clamps are fitted as normal and careful consideration made to ensure the adjustment butterfly nut is situated correctly as this may compromise access to the area of damage.

In this build the ‘free-end’ (ie the clamp furthest away from damage) is secured with wedges on the inside face of the DC timber thus creating a datum pivot point to facilitate a bending moment acting on the GRP dome/repair. The rest of the build is fitted as normal ensuring that the stub piece of wood acting on the pad piece is measured to provide a gap on the inside of the EMMS clamp allowing the external wedges to act; the action of these wedges creates the moment that is required to secure the repair.

Fig 16-25a. EMMS Clamp Shoring Methods

Fig 16-25b. EMMS Clamp Shoring Methods



(2) Fig 16-26a and Fig 16-26b shows 3 examples of the cantilever build. This is utilised where there is very limited access to the hull stiffeners to construct the conventional EMMS clamp build; all that is required is one accessible stiffener. In this build, 2 EMMS clamps are connected together that enable the DC timber build to be projected from the hull plating. The floating 'proud' shore locates through the EMMS clamp and is not secured in place with any wedges therefore allowing the timber to pivot when load is applied. The most effective measurement of the breast shores is to have the one acting on the damage to be half of the length of the one used at the non-damage end. Following the steps illustrated in Fig 16-26a will create a very rigid secondary build equally as capable as the standard proud and breast method. The advantage of this build is that the proud shore is totally 'free standing' and therefore can be utilised where there is no supporting deck of deckhead structure present.

(3) As in all cases with secondary builds the most effective repair is achieved with careful measurement and cutting of accurate angles on the breast shores.

Fig 16-26a. Emms Clamp Shoring - Cantilever Method

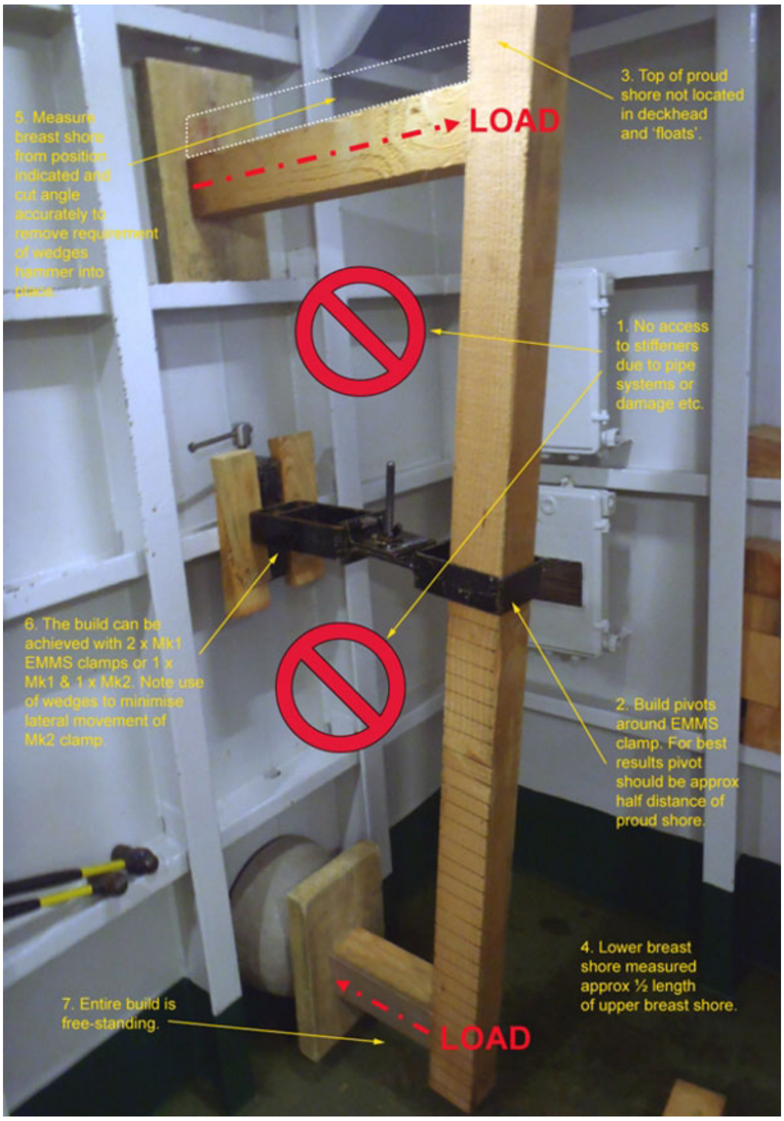


Fig 16-26b. Emms Clamp Shoring - Cantilever Methods