

## **Study of sewn plank built boats of Goa, India**

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### **Abstract**

Study of traditional boats has enhanced our knowledge on maritime past. Traditional boats are both river and sea-worthy. These boats have been used in rivers for transporting cargo to inland ports from ships anchored in the sea and have often been used in naval warfare. In this paper an attempt has been made to study the sewn plank boats of Goa, their building techniques and other features in order to understand their quality and engaged them in the past for inland river transport system.

**Keywords:** Traditional boats, Plank boats, Boatbuilding, Trade, Goa.

## **Introduction**

Goa lies on the central part of the west coast of India looking the Arabian Sea. Its geographic position is marked by 15<sup>0</sup>48'00" N and 14<sup>0</sup>53'54" N Latitude and 74<sup>0</sup>20'13" E and 73<sup>0</sup>40'33" E Longitude. The coastal tract of Goa extends from the Terekhol River in the North to the Kalinadi Creek in the South. Major rivers of Goa namely Terekhol (Tiracol), Chapora, Mandovi, Zuari, Sal and Talpona originate in the Sahyadri ranges and flow into the Arabian Sea. Goa had many ports and trade centres which flourished in different periods of history. During the early centuries of the Christian era trade took place even in the inland ports which were connected by river routes. Since seagoing ships could not sail in the narrow rivers for the purpose traditional boats such as plank boats or extended dugouts might have been used in order to carryout inland trade.

The author of *Periplus Maris Erithrei* (AD 60–100) has mentioned the role of traditional boats in hinterland and maritime trade, however, he did not provide the detail description of techniques and characteristics of such boats (Hutchinson, 1980; and Schoff, 1974). It has been observed that traditional boatbuilding techniques have been passed on from generation to generation mainly from fathers to son of the boatbuilding communities in spite of advancement in technologies. Similarly the traditional boatbuilders of Goa have retained their inherited knowledge probably from the medieval period onwards as evident from the iconographic evidences (Gaur and Kerkar, 2007). This is one of the reasons that the regional level study has provided good evidence on traditional boats in terms of their technology and construction (Shaikh, 2009).

Various types of traditional boats such as dugout, extended dugouts and sewn plank boats have existed in Goa. Of these, dugouts and sewn plank boats are mainly noticed in rivers whereas other types are used along coastal waters for fishing. Dugouts are used in river fishing and sometimes used for ferrying whereas sewn plank boats are used for transporting sand and used in estuaries as well as in interior rivers (Fig. 1). Sewn plank boats, thus, forms an important living tradition need to be studied to understand the role of hinterland transport, their characteristics and engagement for carrying cargo to interior ports during ancient times.

## **Early evidence**

The archaeological evidence regarding boats is very patchy in India. Recently, an iron fasten wooden boat was found in the excavations at Taikkal – Kadakkarapally (Tomalin et al., 2004) and a dugout made of single log of wood from Pattanam (Cherian et al., 2007) moreover boats have also been depicted on various paintings, coins, seals, potsherds, etc. which are irregular in terms of their size.

The earliest evidence of boat in the Indian subcontinent goes back to the Indus Civilization wherein depiction of boats was found on seals, baked clay tablets and potsherds. Lothal excavations has yielded a terracotta boat model, similarly a seal of Harappan and Mohenjo-Daro graffito on Indus potsherd represents planked vessels (Rao, 1979). Plank built boats are also evident from Bharhut (2nd century BC) and on the southern pillar of the east gate of Sanchi Stupa I (1st century BC) (Mookerji, 1912; and Cunningham, 1879). Coins of Chandraketurgarh (2nd and 1st century BC) in the Ganges delta bear the outline of vessels with masts. Ship motif coins were also recovered from Andhra coast issued by the Satavahana rulers (2nd century BC to 3rd century AD) (Mookerji, 1912). Sailing boats (13th-14th centuries AD) have been depicted on rock paintings found at Chamardi near Bhavnagar in Gujarat (Sonawane, 1996). Ships are also depicted in Aurangabad (6th century AD) and Ellora caves as well on the wall paintings of Ajanta caves (Mookerji, 1912; and Schlingloff, 1988). In addition to this, boats are also portrayed on hero stones of Goa (950–1300 AD) which are displayed in the Archaeological Museum (ASI), Old Goa (Rajagopalan, 1987; and Sila Tripathi, 2006). Recently, stone panels depicting boats) 10th–13th centuries AD) have been discovered in various parts of Goa, among them the boat panel of Nagve evidences plank built boat (Fig. 2) (Gaur and Kerkar, 2007; and Kamat, 2008).

### **Types of plank built boats**

Plank built boats have a broad classification (McGrail, 2004; and Rajamanickam, 2004) and they are built in two ways namely: (i) skeleton first; (ii) shell first. Further, these boats have been classified into two major categories as i) Sewn plank-built, and ii) Nailed plank-built. Sewn plank-built boats are further sub divided into two categories a) sewn plank-built without keel, b) sewn plank-built with keel. Similarly nailed plank-built boats are classified into three categories i.e. a) nailed plank-built without keel, b) nailed plank-built without keel but attached with outrigger, and c) nailed plank-built with keel (Rajamanickam, 2004). Among all these types of plank boats, sewn plank with keel is very common in Goa, moreover nailed plank boats are also noticed at few places along the Goa coast.

### **Features of Sewn Plank Boats of Goa**

Sewn plank boats of Goa are locally known as '*Revenchem Vodem*'. These boats are constructed by laying the keel first, followed by joining of strakes of planks and then ribs or frames these boats fall under the shell built category by reduction, transformation and construction (McGrail, 2004). These boats are decked at bow and stern and the empty space in the middle is intended to carry shipment

(Fig. 3). These boats are propelled by pole or paddle and steered with rudder (Fig. 4). Total length of a sewn plank built boat is approximately 11-12 m; width at centre is 3.60 m and 2.70 m at bow and stern.

## Construction

Traditional boatbuilding industry of Goa is strongly backed by the basic knowledge of craftsmanship of local carpenters and this knowledge has been passed from father to son. Most of the traditional boats are built in temporary boatbuilding yards and sheds erected by the carpenters wherever they found suitable place for construction of a boat mostly close to the bank of a river.

## Selection of timber and laying of keel

Boatbuilders of Goa use a variety of timber for building sewn plank built boats. Mostly *malat* (*Aganosma caryophyllata*) and *Jambal* (*Sizyginm cumini*) timber is preferred which is either procured from local saw mills or brought from neighbouring states. After cutting and trimming the timber in the saw mills, they are brought to the yard.

The construction of a sewn plank built boat starts by laying the keel (Fig. 5). The keel defines the size of the vessel. Keel is made of three pieces of timber which are used at the stem or bow, stern and main keel. The size of bow keel is longer than the stern keel. The diameter of the bow and stern keel is 0.61 m; however it varies depending upon the size of the vessel. The bow keel is of 3.60 m and stern keel is of 2.55 m in length, then keel would be almost '∇' in section. In some cases the uppermost portion of stern and stem keel is larger in diameter than the lower most. The diameter of main keel is 0.22 m and 9.72 m in length which appears to be rectangular in shape. While laying the keel, the main middle keel is laid first and then bow and stern keels are added with the support of other timbers, holding both the stern and stem. Depending upon the size of the vessel angular alignment of bow and stern posts are decided. The stem and stern posts keel are fastened to the main keel by making a 'Π'. It is not because stem and stern posts are fastened to the main keel and not the main keel fastened to the stem and stern post, scarf which fixes the stem or stern post to the main middle keel. It is noticed that a scarf is made at the end of the main keel, lower portion of bow and stern posts are fixed in this scarf thus interlocking the bow and stern post with the main keel (Fig. 6). This interlocking keeps bow and stern posts entangled with the main keel in such a way that it never dislodges.

## Planking and Bending

Planking of boat starts first by joining the lower most strake to the keel. Then other strakes are joined to the keel by making a '∩' scarf cut and sewed with coir rope. In this manner planking is carried out with the first strake and moves upwards on both sides simultaneously. Planks are joined edge to edge with '∩' scarf (Fig. 7). Such scarf's interlock the planks which easily not dislodged (Fig. 8). Both ends of all the strakes are joined directly to the stern and stem post with 'V' scarf. Uniform thickness of all the planks is maintained. Mostly single long planks are used with 0.2 and 0.3 m thickness. Small planks are joined together in case of non-availability of single plank. Eight or ten rows of strakes run on either side of the boat. The row of strakes are added in such a way that the section in the middle becomes 'U' shaped whereas bow and stern becomes almost 'V' shaped. In order to get the required shape of the hull initially temporary frames or small ribs are added.

Planks are made bend to get the exact shape and mostly they are used at the middle portion of the gunwale and keel where strakes end. Planks are curved with great care and caution hence this process takes longer duration in construction of a boat. Bottom four strakes are made inward bent at both the ends then joined to the keel. At the middle the planks are made outward bend. The upper four strakes are made outward bend starting from bow to stern. Planks are cut with exact dimension to get the required bend. Planks are placed on a temporary stand; '*kadu*' oil is applied on them then both sides are heated with minimum temperature till the required bend is attained. In order to avoid burning of plank minimum distance is maintained between plank and fire. Afterwards planks are directly placed at appropriate locations of the boat and required bend is given to them.

## Caulking and Sewing

Caulking is carried out during planking and after planking of plank built boats. Locally prepared glue called *cari* is applied on the edges of the planks then cotton is placed on *cari* finally the planks are joined. Sometimes gaps are found after joining the strakes which allow seepage of water into the boat therefore caulking is also carried out after planking. In this type of caulking *dambar* (coal tar) is also applied over cotton then coir husk and coir rope is placed finally they are sewed together with coir rope (Figs. 9 and 10). Such type of caulking joints also serve as shock resistance when the boat hits against waves, rocks and river bank.

The majority of plank built boats of Goa are sewn plank built boats. The sewing practice has been followed worldwide from prehistory to the present day (Greenhill, 1995). Two persons undertake the

sewing process sitting one inside and the other outside of the boat. The sewing process starts after caulking and holes are drilled at the edge of the planks, the distance between two holes is 8 cm. The person sitting inside the boat passes the rope through the holes with the help of needle to the person outside, who pulls the rope very tightly with the help of wooden stick and again passes it to the inside person. This process continues until the entire strake is fastened, then the same method is followed for the remaining planks. The stitch appears 'X' shaped from the inner side (Fig. 11) and 'I I I I' pattern from outer side (Fig. 12). This method of sewing is similar to fastening of *Masula* boats. Most of the *Masula* boats have two types of sewing namely double web and single web (Kentley, 2003). But sewn plank boats of Goa fall under latter category i.e. the web is formed only from inside of the boat [what do you mean?]. After sewing the holes are packed with treenails. Recently it has been observed that copper nails have been used joining the planks in a newly built plank boat.

### **Fastening frames and thwarts**

Joining of strakes followed by fastening of frames provide additional strength to the entire boat (Fig. 13). To fasten ribs various types of scarf's are used (Fig. 14) and altogether 14 frames are tied inside the boat with coir rope at 0.60 m apart. This distance varies on the basis of the size of the boat. Mostly frames of 0.10 m thick and 0.7 m wide are used because they are found suitable. Frames are made of three timbers, two are on both the sides of the gunwale and other one is in the middle. The 2nd, 3rd, 12th and 13th frames at the gunwale have large timber which serves as pivot for paddles. Thwarts are then added at every distance of 1.20 m. Apart from frame and thwart an iron rod of 0.10 m in diameter is fixed right below the 6th, 8th and middle thwart of the boat which provides additional strength to the boat. A small deck is made both at bow and stern for placing planks over the thwarts where crew can sit. The deck is prepared by placing planks horizontally and vertically. The space available in the middle portion of the boat is used for carrying cargo.

### **Propulsion and Maintenance**

Since these boats are used in shallow waters they are propelled by poles, peddle and steered with the help of rudder. Rudder is fixed to the stern groove. Sometimes a sail is used in order to harness wind energy which provides instant propulsion. In case of damage or decay of timber of the bow or stern post they are replaced with 'Z' scarf (Fig. 15), if larger portion is damaged or disintegrated then the entire keel is replaced. Similarly, re-caulking and re-sewing is carried out if they are required. A coat of cashew oil is applied to the entire boat at every six months or whenever required.

## **Distribution and Utility of Sewn plank built boats**

Sewn plank built boats are widely distributed across the Indian sub-continent. These boats have been recorded along the Malabar Coast, Coromandel Coast, Orissa, lower Ganges and Sri Lanka (Deloche, 1994; Greenhill, 1971; Hornell, 1946; Kentley, 1985 and 1996; Kentley and Gunaratne, 1987; and McGrail, 2003). In Goa sewn plank boats are found along Terekhol, Chapora, and Amona rivers and their tributaries (Fig. 16) which flow in the district of North Goa. These boats are engaged for transporting sand from rivers to main land for various uses. Sewn plank built boats are not found in the district of South Goa.. These boats do not vary in terms of construction from place to place but they differ in propulsion e.g. in Terekhol most of these boats are propelled with long poles, whereas at Chapora and Tonca these are paddled and some use outboard motors. These boats are capable of carrying 12 to 13 tons of sand, 6 to 8 crew members are required and 5 to 7 hours take to complete a trip. They are propelled up to the middle of the river to excavate sand and load the sand. A round net attached to a wooden pole is used to retrieve sand from river.

## **Comparison of sewn plank boats of Goa with neighbouring regions**

Plank boats are one of the main types of traditional crafts largely distributed along the Indian Coast. Their utility and building techniques differ from region to region. The plank boats of Goa are called as '*Revenchem Vodem*' which share similarities with the crafts *Machugas*, *Manji*, and *Phatemara* which ply along the Konkan and Karnataka Coast (Hornell, 1920). The keel of these boats is made of three pieces of timber. The bow is more inclined outward than the stern and designed specially to sheer the water easily. The planks are fastened edge to edge and mostly sewed. Such types of smaller crafts are used in inland waters and rivers whereas bigger crafts are used for long distance voyages (Rajamanickam, 2004). Plank built boats of Goa are comparatively smaller in size because they navigate through narrow rivers. The construction method, technical terms and names of different parts of plank built boats of Goa and Karnataka are almost identical but differ in method of joining planks. Boat builders of Karnataka use fish-cut joints for joining planks (Swamy, 1999) whereas 'V' scarf (Fig. 17) plank joining method is being adopted mostly in Goa.

The plank boats of the east coast of India are known as *Masula*. In terms of their construction they vary from Goa. The *Masula* have a circular bow and stern keel whereas plank boats of Goa have an angular bow and stern keel. These boats are mostly engaged in beach seining whereas boats of Goa are used in excavating sand from rivers. But the sewn plank boats of Goa share similarities with the Southern-sector *Masulas* of the east coast (Kentley, 2003).

## **Discussion and Conclusion**

The plank built boats of Goa is evident of their prevalence since the medieval period onwards if not earlier. The study of plank boats has thus, provided insight into the technical, logical and most complex technology adopted by the boatbuilders while building boats, for instance, the interlocking of bow and stern keel with the main keel and edge to edge sewing of planks is foremost. Edge to edge method of sewing is believed to have the advantage of making boats stronger, chances of damage and breaking is very minimal after hitting hard substratum and maintenance is less. Ibn Batuta (1304-1368 AD) has mentioned that the ships of India and Yemen being sewn together with coir thread, never breaks easily after striking against rocks, because the thread will yield a little, contrary to what happens when put together with iron nails (Hornell, 1920). The use of coir rope for stitching of traditional boats is a common practice in the Indian Ocean region (Chittick, 1980). Another advantage of these boats is that their damaged parts are easily replaceable and sewing can be reseeded whenever necessary.

In these boats decks are noticed at bow and stern, in the middle the enough empty space is used to carry 10-12 tonne of cargo to the mother ship from inland ports and vice-versa, even during rough weather. Nine strakes of planks are provided at bow and stern to get required height; 7 or 8 rows of strakes are added at the centre of hull which makes loading and unloading easier (Fig. 18).

These boats are so designed in order to use in shallow water with greater stability and increase carrying capacity (Gould, 2000). The bow and stern of plank boats are narrow and pointed which enhance their speed. The endurance of these boats enhances if they are maintained properly. Their design, edge to edge method of sewing, broad hull, carrying capacity and durability led us to the hypothesis that such boats were undoubtedly used for hinterland trade. In the absence of docks in earlier times these boats were proved to be beneficial for big sailing ships for loading and unloading cargo in the sea. Since these boats acted as a mediator between mother ship and hinterland port, they formed the foundation of trading activities in the Indian Ocean (Ray, 2006). Plank built boatbuilding centres have reduced to minimal, mostly repairs and maintenance of boats are undertaken at these centres. However, occasionally boats are constructed by the craftsmen of Goa.

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1. General view of plank boats at Tiracol River, Goa.



2. Stone panel depicting plank boat, Nagve, Goa.



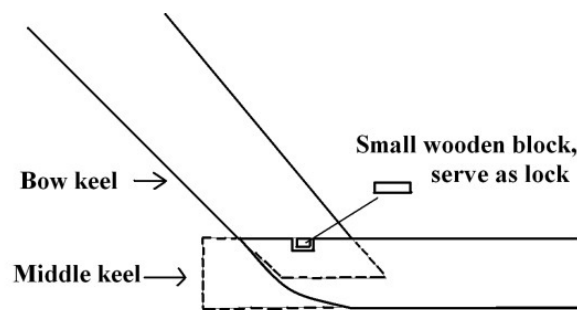
3. Top view of Sewn plank built boats with keel.



4. Use of rudder in plank built boat.



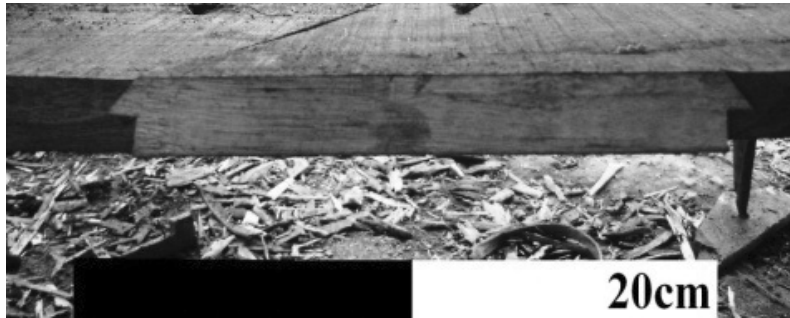
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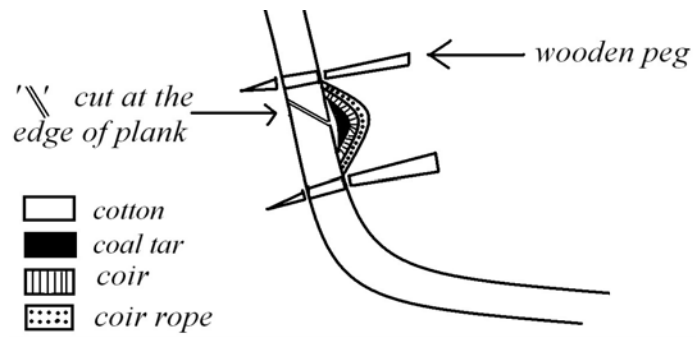
6. Sketch showing interlocking of bow keel to the middle keel.



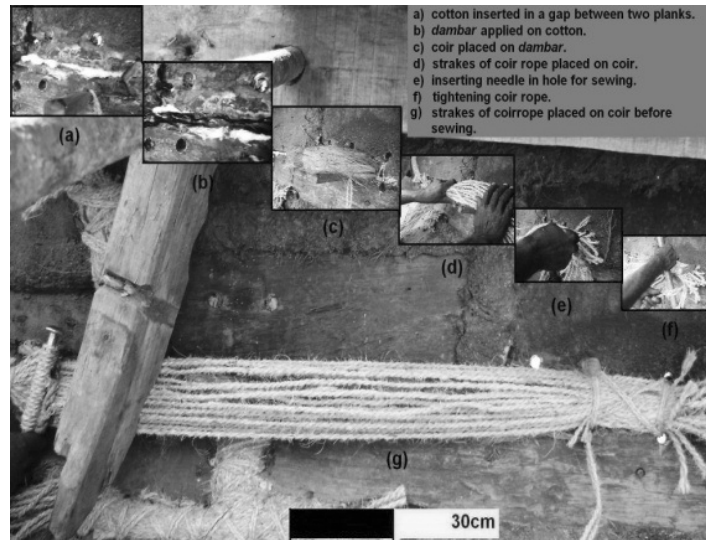
7. Planks joined edge to edge with 'Z' groove.



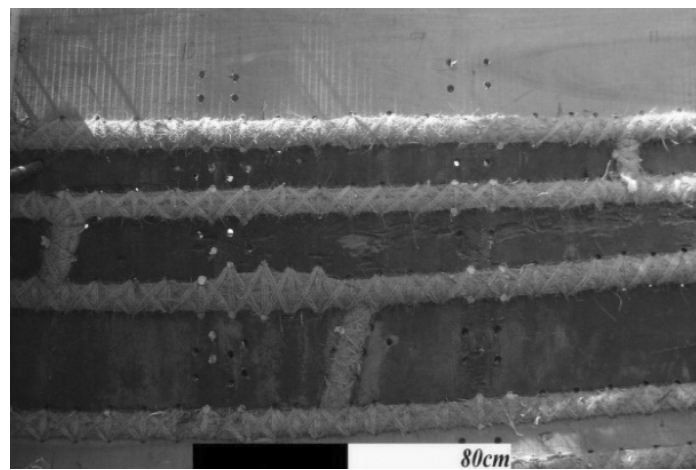
8. Planks after interlocking with 'Z' groove.



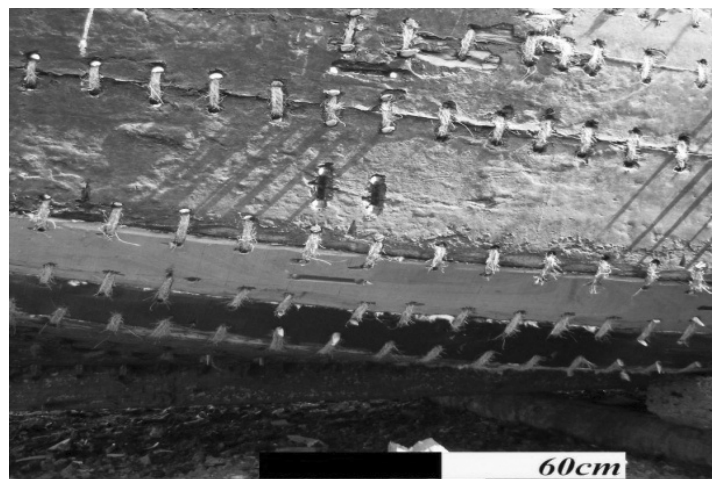
9. Cross section after caulking.



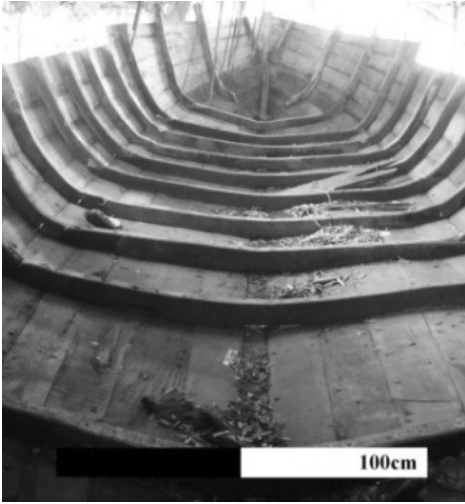
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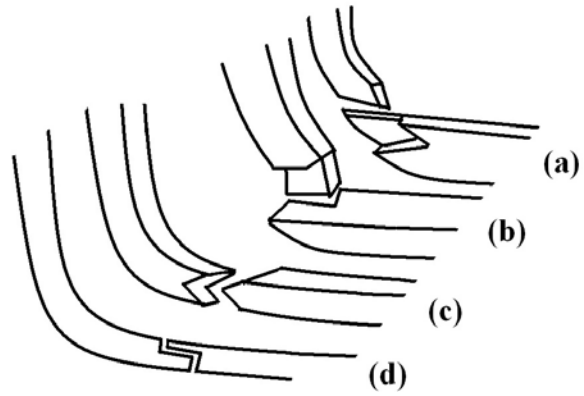
11. 'X' pattern stitching inboard after sewing.



12. "III" pattern stitching outboard after sewing.



13. Ribs fastened inside the boat.



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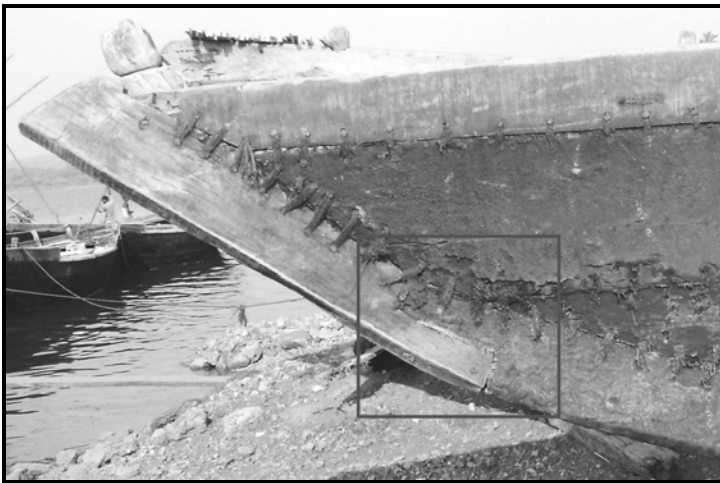
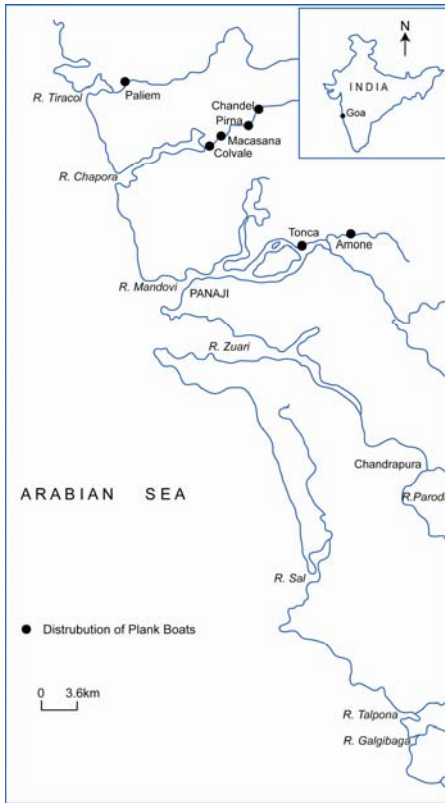


Fig. 15 The replacement of the damaged portion of stem post with 'scarf'.





16. Distribution of Plank built boats in Goa.

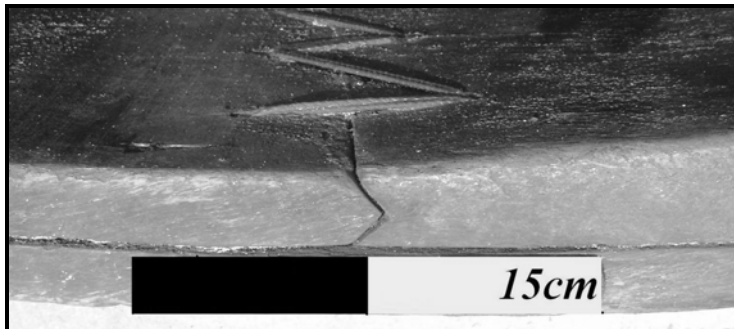


Fig. 17 illustrates the 'V' scarf plank joining method mostly being adopted in Goa.



18. Unloading of sand from plank built boat.