PART I

GENERAL

A WIDER CHOICE OF CONSTRUCTION MATERIALS FOR THE MODERN FISHING BOATS

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INTRODUCTION

Sea-fishing in India to-day, is not just a big business but has proved to be a well organised major industry with international recognition and reputation. The Indian fishing industry at present is earning the much needed foreign exchange for our country. It has exported 45,099m. tons of marine products valued at 684 million rupees during the year 1974-75. Further increase both in quantity and value is expected during the coming years. The seas around India have still greater potentialities for deeper exploration and extensive exploitation. To achieve this object in view, proper expansion of the present fishing fleet is an important aspect of development recommended under the fifth Five Year Plan period. More of modern fishing boats would mean more of food production and more of employment opportunities. A modern fishing boat forms an ideal platform which facilitates easy and quick transport provided with on board facilities for fitting all the necessary machinery, carrying out all types of fishing operations, hygienic preservation and storage of catch and amenities for rest and relaxation of the crew.

ESSENTIAL PARAMETERS

While the innumerable non-mechanised country crafts that are seen along our Indian coast have limited scope of operation in the seas, the modern mechanised fishing boats can cover an extensive area in the in-shore (less than 20m. depth), off-shore (between 20 and 75m. depth) and the deep seas (beyond 75m. depth) with catches better both in quality and quantity. While the coastal inshore fishing boats have to be light and easily operable with a limited number of crew, the deep-sea fishing boats are heavier with all specialised equipments and a full complement of specially trained crew and should withstand the arduous conditions prevailing out in the open sea for days together. The over-all length of modern fishing boats extend normally from 30 feet (9m.) to 120 feet (36m.) depending upon the exact duties to be performed by them. The choice of

construction materials for fishing boats not only decides the over-all size but also restricts the ultimate investment involved. Depending upon the size, construction material and the equipments fitted, a modern fishing boat may easily cost anything between one lakh to thirty lakhs of rupees. Under normal working conditions and with periodical maintenance these fishing boats may serve economically for a period of 10 to 20 years.

There are at present about 12,000 mechanised fishing boats, mostly of wooden construction besides 50 steel trawlers, actively engaged in all sea-fishing operations in India. In the coming years nearly 5000 wooden fishing boats as well as about 200 steel trawlers are expected to join the existing fleet. It is also known that the existing boat building yards in India can turn out 1000 wooden boats and 50 to 60 steel trawlers per year. A restricted number of sophisticated trawlers are also being imported into India. Thus the fishing fleet of India comprising of boats of various types and sizes form the biggest single investment in the fishing industry today and as such they have to be built out of excellent building materials and have to be carefully maintained thereafter for an efficient and prolonged trouble-free service life.

Wood has been the conventional boat building material for ages past, followed by steel. Today newer construction materials like aluminium, fibreglass reinforced plastics and ferro-cement (steel and cement) have come to play a very important role in the development and economy of the Indian fishing fleet.

Boat Building Materials

The use of wood in boats and ships is as ancient as ship building itself. Wood is one of the most durable of the natural raw materials. It is an important construction material on account of its various qualities. Among them, buoyancy, workability and treatability for durability appear to be the striking features. Boat-building timbers should be strong, elastic, moderately heavy and durable. Strength of wood is intimately related to the amount of moisture it contains. Wood in a very wet condition or in an absolutely dry condition will have poor strength. Usually a moisture content ranging from 12 to 15% is permissable in all structural members in a wooden fishing boat. Weights of two different woods at the same moisture content are good indications of their relative strengths. Wood has certain inherent plastic properties. It will shrink and swell without rupture and has capacity for bending and shaping when heated and steamed. Water and heat increase the natural plasticity of the wood, the water acting as a plasticizer. Timber logs should be free as much as possible from all natural defects and blemishes with a healthy heart-wood and straight grains. Timber should be able to withstand the constant immersion in sea-water and constant exposure to the weathering action of sun, rain and wind.

Wood, being a hygroscopic material is subject to rapid changes in its physical condition. The dimensional instability of wood is one of the important characteristic features which is the least desirable. Wood, being an organic material is subject to several types of deterioration following its removal from the forest. The strength of wood is not uniform and is very much dependant on the orientation of its grains. Timbers for boat building have to be carefully selected. Their moisture content has to be

regulated by proper seasoning. Wherever and whenever necessary they should be adequately treated with chemical preservatives or otherwise protected against degrading biological agencies like white ants, fungii, marine wood borers and the like. Timber easily deteriorates due to mechanical wear and tear and is most easily destroyed by fire. If proper care and adequate preventive measures are taken in time, it is easily possible to take more useful life out of timber structures at a moderate cost.

Nearly 5000 species of Indian tropical trees are known to yield the timber though only 400 species are actually in use as building materials. It is also known that only about 200 of them are put to great commercial use of which only a selected few have been found to be ideally suited for the construction of modern mechanised fishing boats. Teak, aini, padauk, sal, b'jasal, gurjan, sissoo and kindal are some of the well known conventional timbers for boat-building. These timbers will be most suitable for trawler sizes of lengths between 9 and 18m. (30-60 feet) and their service life will be limited to about 10-12 years normally. The 12,000 mechanised wooden fishing boats that are now in use have consumed about 80,000m. tons of timber. The 5000 fishing boats comprising of larger sizes that are yet to be introduced during the Fifth Plan period would need about 1,60,000m. tons of boat-building timbers estimated to cost roughly about 15 crores of rupees. This may be a big strain on our timber resources as many of the conventional timbers have become scarce. Many of the secondary species of timbers have been found to be equally good after careful seasoning and proper preservative treatment. The extensive use of well seasoned and adequately treated timbers in boat building will reduce the present high cost of wooden fishing boats to a great extent. The Central Institute of Fisheries Technology at Cochin has successfully introduced cheaper fishing boats constructed out of venteak wood. The utility of mango wood and haldu wood for boat building after prior seasoning and treatment have also been explored. Copper sheathing for the protection of the wooden hulls of fishing boats can now be replaced either with the marine quality aluminium sheets or fibreglass reinforced plastic sheathing as have been innovated and recommended by the C. I. F. T. Economy and efficiency have led to the use of plywood, laminated wood and modern synthetic wood materials in boat building while steel and other newer materials like fibreglass, ferrocement and aluminium are still there as alternatives, thereby widening our choice.

Steel

The versatality of steel as a construction material for fishing boats is well known all over the world. The large vessels are still constructed out of steel. The engineering, planning and building of steel ships including fishing vessels, have recently reached a fairly high state of development. The conventional mild steel today has been considerably improved in its composition. Steel offers significant savings in the construction of standardised designs in large numbers. By adopting latest techniques in welding larger sections of steel can be fabricated with maximum efficiency and minimum wastage of material particularly for the construction of bigger boats beyond 60 feet. Eventhough steel trawlers were originally imported into India, today Indian boatyards have started producing well

designed trawlers suiting to our working conditions.

Steel and their alloy materials, irrespective of their varying mechanical properties and diversified application, are prone to corrosion, in the marine atmosphere. However, the seawater corrosion of steel can be controlled with good quality protective paints and other surface coatings than by the manipulation of the composition of steel. Under adverse tropical climatic and hydrographical conditions, given reasonable annual care and maintenance, the life of steel trawlers in India can be placed near 15 to 20 years. The sea water corrosion gradually eat away the hull plates in layers. By constant chipping and scraping off the rust, eventually there will be no steel left on the hull. Eventhough steel is the most sought after material for bigger boats, when sea water is particularly a virulent corrosive environment for most metals and also when it has a deteriorating force on all organic materials like wood naturally the choice has to fall on newer materials which would be absolutely free from these problems.

Aluminium

The advancement in metallurgical science together with the latest advancements in welding techniques have made possible the free use of aluminium-magnesium alloy in fishing vessel construction. This special quality alloy is very light (Specific gravity 2.7 as against 7.9 for mild -steel) and has high strength to weight ratio. The marine quality alloys containing 2 to 5% of magnesium are extremely durable and they resist seawatvr corrosion without water absorption, rotting, rusting and warping. Aluminium is non-sparking and non-magnetic. It is non-porous and non -peeling and provides a most desirable hygienic condition for fish handling. Due to a good elastic modulus, aluminium construction has greater impact resistance than steel. The use of this material will result in a light boat with high strength per weight, low centre of gravity for proper stability, greater speed for horse power and a minimum cost of maintenance.

Smaller crafts are already operating in the Inland waters of India and a number of light life-boats are in use in bigger steel ships. The steel trawlers that have been recently constructed in India have their superstructures built out of marine quality aluminium and this will improve the stability of the vessel by lessening the top heaviness. India can make the best use of this indigenous material for fishing boat construction not only for the hull but also for various other shipboard applications including fish-holds, containers etc. to a great advantage whenever other conventional materials have failed for one reason or other. The C. I. F. T. at Cochin has successfully made use of this special alloy as a protective sheathing material for the under-water portion of the wooden hulls of fishing trawlers in lieu of the imported copper and this procedure has given some relief to the present copper crisis.

Aluminium is mostly not compatible with other conventional metals more so in sea water due to electrolysis. Its low melting point has an adverse effect on the material and so also heat on its strength properties. Marine paints containing lead, mercury, iron or copper cannot be directly applied on aluminium surfaces without adequate barrier coats because of galvanic corrosion and aluminium is the worst sufferer.

Fibreglass Reinforced Plastic:

Of all the structural materials available at present fibreglass or glass reinforced plastics (FRP or GRP) is probably the most suitable group especially for boat building. Glass fibre in combination with certain thermosetting resins offer a construction medium which is light, durable and astonishingly strong yielding to fabrication to any desired size and shape. The material is free from corrosion both in air and water and undergoes no deterioration at all at the hands of biological agencies, specially the marine organisms. FRP is a proven hull material providing satisfactory service in commercial, naval and pleasure crafts all over the world. This new material and the novel method of construction from pre-formed moulds is ideally suited for fishing boats where mass production of standardised design is envisaged.

FRP, once popular for life-boats, rafts and fast pleasure boats, has today taken a firm place for small and medium class of fishing boats. No other material is taken so much advantage of as FRP even for larger vessels and sophisticated trawlers including hover-crafts and rockets. FRP boats have already gained worldwide popularity particularly in U.S.A., Canada and U.K.

The required glass fibre and the resins that are now available in India are highly priced when compared to world markets. The cost of a parent mould, because of the excellent perfection that is required, is sometimes 2 to 3 times than the off spring hull. Unlike the other yards the concept of FRP boat yard is quite elaborate and complicated besides being expensive. Fabrication of boats out of FRP requires a special technical know-how. It is not merely assembling of preformed components as in the case of wood and steel boat construction but a new structural material with the careful combination of fibreglass and resin has to be made on the spot at the time of fabrication. FRP boats require special design characters and construction details as otherwise if built on the existing lines of wooden or steel vessels, they may tend to float excessively and may not be quite stable. This undue lightness should be taken to advantage in as many ways as possible such as increased speed, increased fish-hold capacity greater endurance or lesser horse power.

Though FRP fishing boats require greater initial investment, because of minimum expenditure on maintenance and prolonged service life, they ultimately prove to be the most economical material for fishing boats that have to work well under adverse tropical conditions. No doubt, FRP boats will last longer than wood and steel counterparts with minimum care. A reasonable reduction in the raw materials cost and adoption to mass production techniques will make FRP boats an acceptable proposition in India. A 16.5m. (54 feet) FRP fishing boat imported from Norway is already working in India now. Today an Indian firm is offering FRP hulls in two different sizes of 9.7m. (32 feet) and 13.7m. (45 feet) at a fairly reasonable price. Many new projects on FRP boat building in India are being planned in the coming years. In a developing country like India with so many problems with wooden and steel fishing boats, FRP has apparently a bright future.

Ferro-Cement

'Ferro-cement' or 'ferro-concrete' is the name given to a material consisting of a reinforcement essentially of a number of layers of galvanized iron chicken wire mesh over an arrangement of mild steel rods and fully plastered with a mortar mix of sand and cement combination. The resulting material after a period of continuous wet curing exhibits all the mechanical properties of a new material so well suited for fishing boat construction with very many advantages. The steel content works out to be 22 to 25%, while the mortar mix is about 78 to 75% in a cubic foot of well cured material (specific gravity 2.4 to 2.6). The careful use of mortar mix will restrict the ultimate thickness of the shell which will range from a minimum of 18 mm. ($\frac{3}{4}$ inches) to a maximum of 38 mm. ($1\frac{1}{2}$ inches).

The material is easy to fabricate into complex shapes without the use of forms and moulds. It has good strength to weight and stiffness to weight ratios; it is water proof and is also corrosion resistant. This is the only material that becomes stronger and stronger with increasing age more especially under constant contact with water. Ferrocement boats, if sound otherwise will have the longest life in water since reports prove to show that experimental boats built nearly 100 years ago are still structurally sound! Based on theoretical calculations and with the limited experience we have with this new material, ferrocement boats are likely to cost very much less than the conventional wooden hull. The construction procedures are simple requiring simple tools and ordinary unskilled manual labour. It must be borne in mind that ferrocement boat construction as described here differs very much from the conventional reinforced cement concrete (RCC) with which the civil engineers are familiar. From an economical point of view and from the strength-weight studies of the new material, fishing boats in the size range of 13m. to 18m. (40-60 feet) will give satisfactory service and at which range of size, ferrocement boats would be lighter and cheaper than the coventional wooden hulls.

"Ferrocement" as a successful constructional material for machanised fishing boats has been unanimously accepted by the various International authorities such as Lloyds Register of shipping, Bureau of Veritas, the United Kingdom White Fish Authority and the Food and Agriculture Organisation of the United Nations. Appreciating the worldwide interest on this material, the F. A. O. had organised a seminar on the design and construction of ferrocement fishing vessels at Wellington in New Zealand during October 1972, when many newer findings on this material were brought to light. Most of the wooden 'Sampans' in the Chinese waters today are made of ferrocement turned out by women labourers. Canada, New Zealand, Korea, developing African countries, Sri Lanka and Bangladesh are going fast ahead in the handling of this material for boat building. "Pak Tak" of HongKong (16.6m.) and "Caranx" of the West Indies (15.15m.) are some of the outstanding ferrocement boats working most satisfactorily today in their respective waters. In India too, at the Central Institute of Fisheries Technology, a number of investigations and observations on ferrocement have been completed both in the laboratory as well as in the field and as a result of which a basic guideline for the construction

of ferrocement fishing boats has been formulated for the benefit of builders in India. A 9.7m. (32 feet) ferrocement prototype trawler was successfully built in Cochin in a private yard during early 1970 followed by similar attempts in Tamil Nadu. There is considerable interest in ferrocement fishing boats both in India and in our neighbouring countries. If the specified mild steel rods and good quality cement are made freely available in open markets at competetive price, ferrocement fishing boats will soon acquire a greater importance and will compete very favourably with fishing boats built out of other conventional materials.

Thus it is evident that we have today a wider choice of materials and the required technical know how for the construction of the modern fishing boats in India. May be in the coming years with our experience we will be able to compete with other progressive countries in this field and the time is not far off when we will be in a position even to export trawlers built in India just as fish, shrimp and many other commodities.