

Basics of Designing of Fishing Vessels

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Introduction

The design of a fishing vessel is done to meet the requirement of the fisherman. The type of fishing, number of days for fishing, capacity of fish store and speed are very important. At the same time the vessel designed and built should be economical for the owner in terms of fuel consumption. The requirements of the owner are explained below.

Criteria of vessel design

Type of fishing and deck equipments

One of the most important criteria to be considered during the initial stages of boat design is the method of fishing. The fishing method decides the arrangements to be made in the boat. In the case of a stern trawler, the trawl winch will be placed in the aft of the wheel house. The wheel house of a stern trawler is placed in the mid ship on the main deck. The trawl gallows are to be fitted in the aft end of the main deck. The derrick needs to be placed just aft of the wheel house. This arrangement will suit the stern trawling activities. The fish hold is positioned forward of the engine room. This arrangement will balance the weight of the boat. The main engine, winch and other machinery will be placed suitably for meeting these requirements. This General Arrangement will vary for a purse seiner or tuna Long liner. A purse seiner will not have the gallows, trawl winch and derrick. Majority of the purse seiners operate the net manually. The net is spread on the forward deck and occupies complete deck space in the forward. Some of the vessels have started fitting a purse winch in the aft of the wheel house. The fish hold position is same as the trawler. The long liner will be fitted with a main line spooler on the forward deck in the port side and the line setter will be fitted in aft of the deck. The fish hold position remains in the forward. Gallows and derrick are not required for the long liners.

Material

Different materials are used for the construction of fishing vessels. The most popular materials used are steel, wood and fiber glass reinforced plastic. Aluminium, and FRP laminated plywood are also used for light vessels. Ferro cement was also used for vessel construction, but due its high weight did not become a popular choice. The selection of material depends on the size of the boat and type of fishing. Small sized beach landing boats are constructed with FRP, wood and plywood whereas larger sized deep sea going purse seiners and trawlers are built in steel.

Dimensions of the boat

This depends mainly on the capacities for fish store, fuel, fresh water and ice. The endurance is also a deciding factor of the vessel size. For boats with long endurance the storage capacity of fresh water, diesel and ice will be higher. This will increase the size and weight of the boat.

Capacity and method of fish storage

The capacity of fish hold and storing method are important in deciding the size of the boat. Vessels with insulated fish hold and freezing facility will have large size. The generators for running the refrigeration systems are to be placed in separate space. This requires additional space.

Speed of vessel

The speed of vessel is an important parameter since this decides the engine power. High horsepower means high expenditure on fuel and the cost operation of the boat will increase. Higher horse power requires higher storage space for fuel.

Draft of the vessel

The draft which is the depth of the vessel below water level is an important factor in fixing the dimensions of the boat. Some landing centers and lagoons in islands such as Lakshadweep, the water depth available is restricted. The boats to be operated from these places are to be designed with low draft.

Freeboard

The freeboard of long liners and hand liners are to be minimum so that the line fishing can be conducted easily from these boats.

Hull shape

A very important factor which decides the stability, speed, sea kindliness and fuel consumption is the hull geometry. A bulbous bow fitted in the forward portion below the waterline will increase the speed of the vessel. But this has to be designed and constructed properly. The bilge keel fitted just below the water level in the mid ship area reduces the rolling of the boat.

Other facilities such as accommodation, toilet and galley

At present the crew are sleeping in the wheel house of the boat. There is no toilet and galley facility even in the deep sea going fishing vessels. Additional space will have to be provided for accommodation, galley and toilet.

Selection of machinery and equipment

The choice of main engine, reduction gear box, winch, refrigeration system and other items shall be in such a way that spare parts are available locally and the service of the manufacturer or their representative is available locally.

Safety requirements

Necessary fire controlling appliances, life saving appliance and light and sound signals are to be included in the design of the boat.

Rules and regulations

The rules and registration regulations play an important role in the selection of main dimensions of the boat. For example, the vessels which are having a registered length of 20 meters and above are to be designed in accordance with the rules of classification society and registered with mercantile Department. This will increase the cost of construction of the boat. Moreover the operational expenditure will also increase for such vessels.

Types of boat construction

There are two types of boat construction in our country: First, Construction based on the design developed by experienced carpenters. Second, construction based on standard design procedure of a marine vehicle and construction by a properly established yard.

Boats built based on the design developed from the experience of fabricators

Existing and proven design of a boat will be picked by the builder. Sometimes they follow the same design or apply minor modifications to meet the requirements of the owner and build a new vessel. The next person will modify this one and end up with a third variety. Like this the fourth and fifth boat will be entirely different from the parent boat. They normally complete the construction and take the sea trials. After trials if the product is found to be performing well, it is called a successful boat. But this method becomes a very expensive experiment. Unfortunately the stability of these boats is not tested.

Modifying a boat which is already built is a very difficult task and expensive and extra time and efforts will have to be spent. This becomes very dangerous when the stability requirements are not met. There are several occasions when the trial design and constructions ending up as poor performing vessel. A boat was constructed with larger breadth. After construction it was realized that the speed is less. This ended in many difficulties such as the vessel reaching the fishing ground late compared to other boats and could not make very good catch. The boat crew was not interested in working on a slow boat. The fuel cost went up. On another occasion, it was found that an overpowered engine with 400 hp was fitted on a boat designed for 180 hp. The hull structure could not withstand the high vibrations and the hull cracked.

In most of the cases it can be noticed that there are no watertight partitions called bulkheads in boat constructed in this method. The water generated from melting of the ice can leak to the engine room and lead to high corrosion. The water leak from engine room to the fish storage area can contaminate the fish as this water may contain oil. Due to all these problems, it is not advised to follow this method.

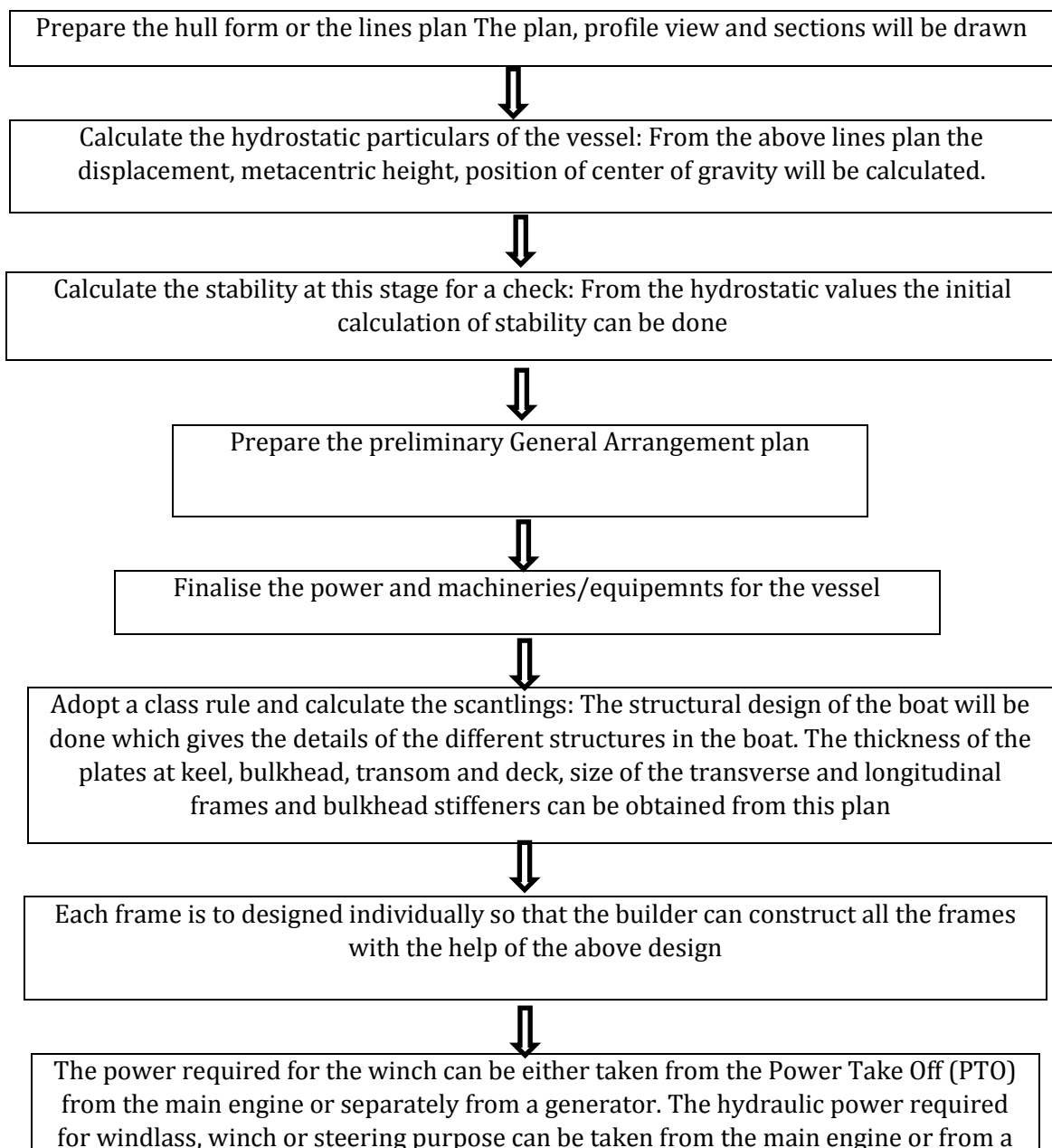
Construction based on standard design procedure

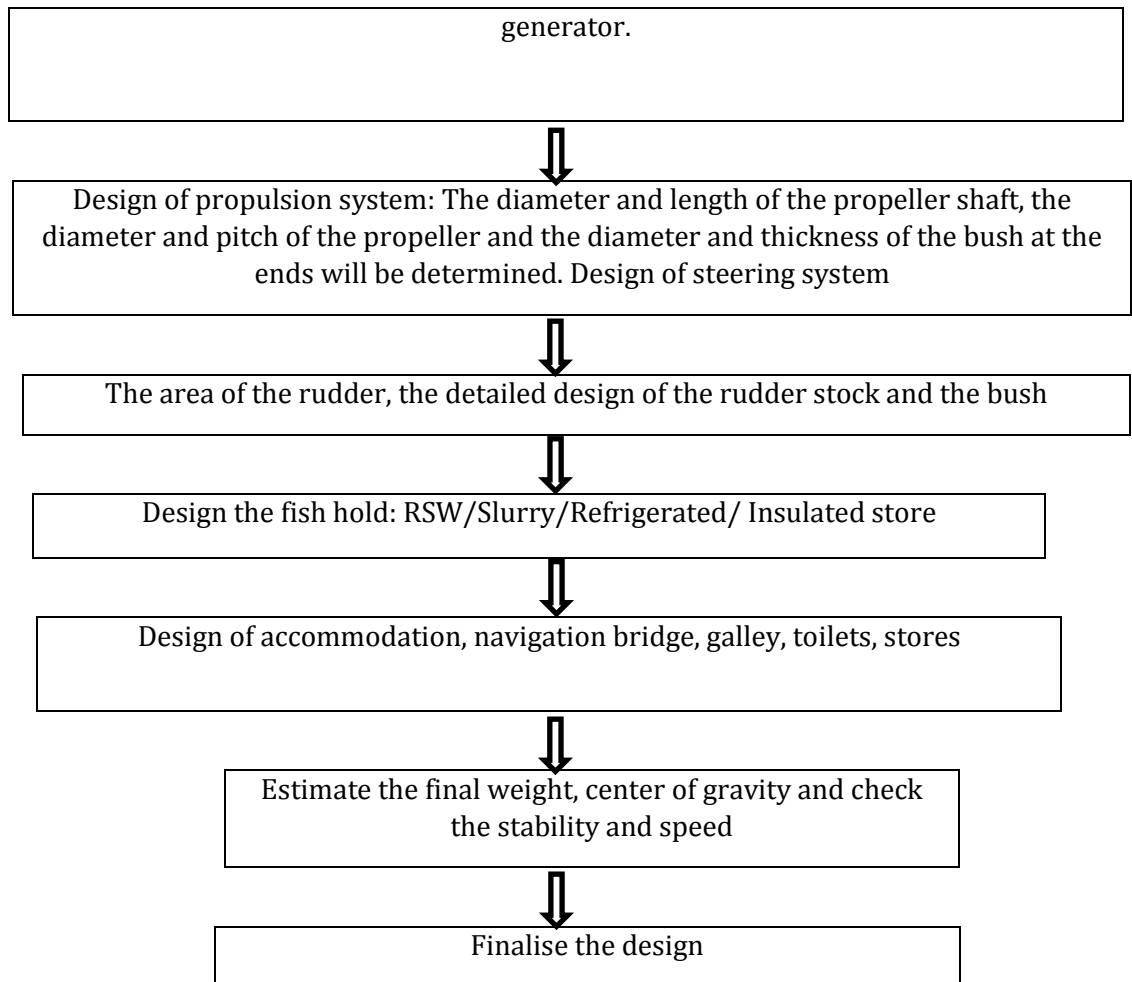
The standard design procedure follows a spiral form. The basic steps involved in the design of a fishing boat are the following. Analyse some of the existing boats with the same or similar parameters and arrive at preliminary dimensions and power. Make a preliminary General

Arrangement plan to meet the required capacities for diesel, water, fish storage, provision, crew requirements and power. Calculate the total requirement of material, machinery, equipment, etc Calculate the total cost. The preliminary assessment of stability is also to be done. When the requirements of the owner are met for the above cost, the final design will be prepared. Go to the previous stages whenever any of the above requirements is not met. Then carry out the modification and proceed from that step.

Detailed design

The following steps explains the design of a fishing vessel.





Such a plan is given in the Fig. 1. Modify the design incorporating changes in the structural plan, for any stability and speed problems.

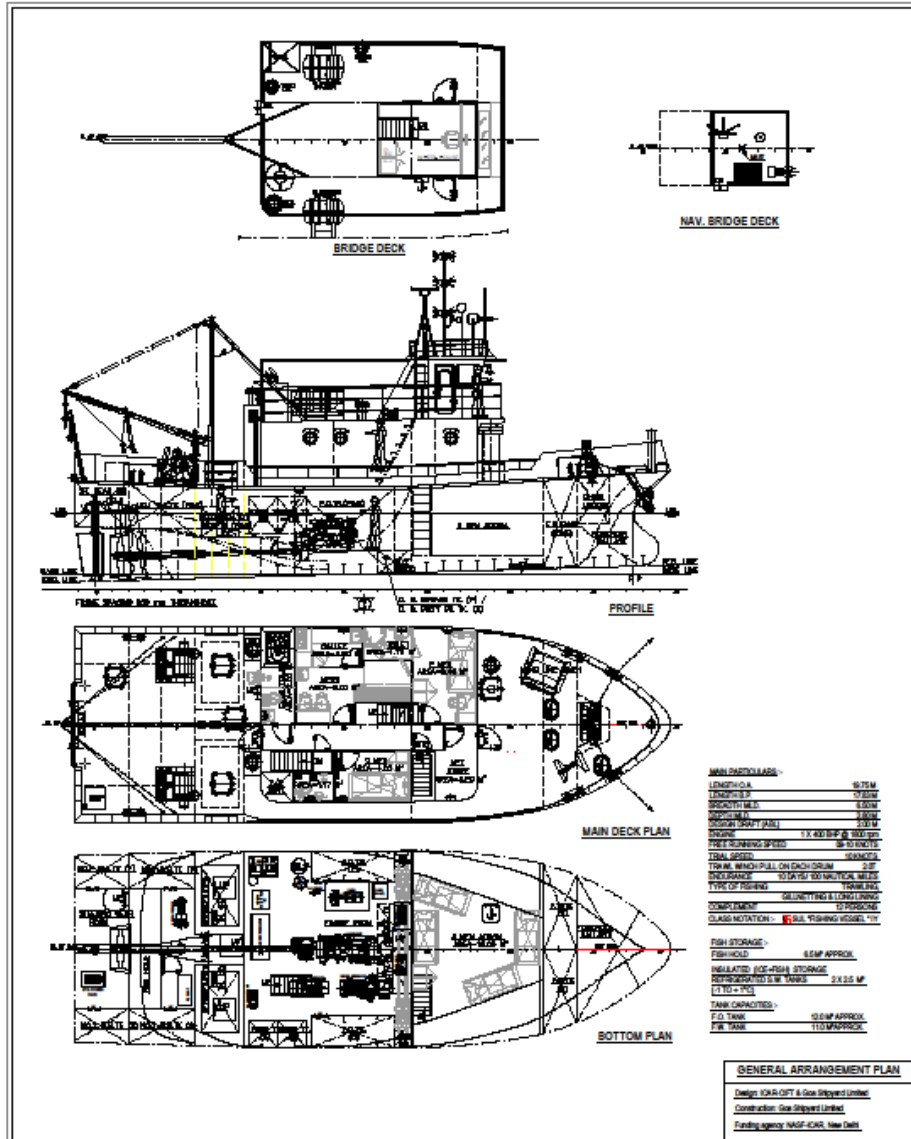


Fig. 1. General Arrangement plan of a 19.75 m long liner cum gill netter cum trawler

Construction and supervision

The detailed structural design will be based on the scantling rules by any of the International Association of Classification Societies. The Classification rules specify the mechanical properties of the steel plates/ laminate and sections to be used for marine crafts. Indian Register of Shipping (IRS) is such an agency in India. The construction of a steel vessel is to be undertaken by a yard with facilities such as materials testing, raw material storage, welding, machining, fire safety and skilled employees. Qualified supervisors are essential to construct fishing vessels so that strict adherence to the design requirements can be ensured. For FRP vessel construction, enclosed yard with humidity control is very important. The raw materials such as resin, glass mat and chemicals are to be stored safely. The fiberglass boat is constructed in a continuous process and the hull is made in a single mould or two parts. These parts of the boat hull are joined water tightly. In FRP boats sufficient overlapping of the glass mat is to be provided, especially in the keel and deck joints. During construction there can be again some minor modifications or compromises within the limit of the rules to suit the availability of plates,

sections, machinery and equipment. During construction, proper care has to be given for the joints. This aspect is very important in keeping the water tightness of the boat. For wooden constructions, only well-seasoned wood without any sap wood shall be used. In the case of steel boats, only marine plates shall be used for the construction. During the design stage sufficient care has to be given for the design of the joints. The type of welding, length of weld and the quality of the welding rod are to be specified during the design in the steel boat construction. The wooden joints are to be with sufficient strength and tightness.

Quality of materials and machinery

The quality of raw materials, welding rod, fiber glass, resin, wood, machines, pumps, winch and other items can be ensured with the help of the selection by an experienced person and installation under the guidance of this person. This will help in the proper and economical maintenance of the boat. The water tightness of hull is to be ensured after the construction.

Stability of boats

After the construction, the inclining experiment will be conducted in calm water in a protected area of the port. This test will give the position of the center of gravity of the vessel. The stability of the vessel can be calculated with the help of hydrostatic particulars and righting lever at different loading conditions. The calculation of stability and preparation of trim and stability booklet is important for all sea going fishing vessels.

Conclusion

The design of a boat requires careful consideration of input parameters so that the output will be a good boat. The systematic approach with the help of calculations will result in a stable vessel with fuel efficiency. Proper supervision and skill is required to construct a safe and standard vessel.

References/suggested reading

Gillmer, T. C. and Johnson, B. (1982) Introduction to Naval Architecture, E & F.N SPON

Hind, J. A. (1982) Stability and trim of fishing vessels and small ships, Fishing News Books, London
45-65 p

John Fyson (1985) Design of small fishing vessels, Fishing News Books, London

Rossel, H.E. and Chapman, L.B. (1958) Principles of Naval Architecture, Society of Naval Architects and Marine Engineers

