Design and Construction of Multipurpose Boats for Coastal and Off-Shore Fishing

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What makes one fisherman a success and another a failure? In some cases, the reason is his boat. Perhaps it is the boat's inability to get to the fish either due to the distance from his home port to the fishery, or perhaps, it is because the prevailing sea conditions prevent him from fishing the most profitable species with enough regularity to make money. Or perhaps, it is because his boat is unable to carry enough crew or the most efficient fishing gear required to catch a variety of species.

In presenting this paper, I will attempt to review design and construction criteria for multipurpose boats for coastal and offshore fishing. The key words are: design, construction, multipurpose, coastal and offshore. The importance of these words and their relationship to profitable fishing will be explained. Unfortunately, time allows for only a brief outline but one which I hope will be followed by those already in the fishing industry and by those wishing to enter the fishing industry.

DESIGN CRITERIA

Before you can build a fishing boat, you must design it. This may seem obvious but the depth of the meaning of design must be explained. Essentially, it means the drawing up of specifications as to structure, form, positions, materials, accessories and decorations in the form of a layout for the building of a boat. Thus, before a designer can lay down the first line, he must review the following criteria: (1) Type and size of catch, (2) Distance to the fisheries, (3) Length of voyage, (4) Fishing methods, and (5) Size of crew. I will now break down each criterium into small, simple questions and answers as enumerated in Table 1.

Type and Size of Catch.--Before you can go fishing you must decide what type of fish are available in profitable quantities and what is the probable weight and volume of the catch per voyage. This is the first instance in which the term multipurpose comes to light. Since the objective is to produce a profit, this directly translates into fishing time and the pounds of fish produced within that time. The vessel should have the ability to fish for all of the species locally available and to do so with as much frequency as possible. This is the single most important decision since it affects every aspect of the vessel's design.

Distance to the Fisheries.--While you are determining what species are available in commercial quantities, the question will arise as to how far you intend to travel to reach a fishery. This is very important since it affects the size, speed and profitability of a fishing vessel. If the fishery is too distant, although it may yield substantial tonnage, the profits could be diluted through the costs of owning and operating a vessel large enough to reach the fishery. Thus, the proper combination of fisheries must take into consideration the distance to be traveled. A compromise is normally necessary in order to design a vessel capable of profitably fishing for something almost every day of the year.

For example, a smaller vessel may fish for a more distant water specie when the weather permits, then, due to its size, also have the ability to fish for more coastal species when the weather turns. The reverse is not usually true since many coastal fisheries are in water too shallow or cannot support the pressure nor the costs of larger, offshore vessels. Generally, the distance to be traveled and the length of the voyage have the greatest impact on the size and speed of a fishing boat.

Length of Voyage.--The length of a voyage is determined by the amount of time it takes to land a profitable catch. The distance to be traveled, each voyage, is certainly a factor, but not in all cases. A smaller, faster boat can cover more area in a coastal fishery and thus produce more fish per trip. This is particularly true in trap fishing wherein the more area fish, the more traps set and hauled, the more catch landed. Generally, the longer the voyage, the less important speed. If a vessel's speed has a direct positive effect on this time (thus allowing substantially more fishing time), then speed pays. However, if a vessel's fuel consumption has a disproportionate effect to profits, then speed is not important. Naturally, some compromise is also necessary here. The ideal vessel would be able to travel efficiently at planing speeds when required and also be able to travel efficiently at displacement speeds when required.

The length of a voyage affects not only the size and speed of a vessel, but also the type and size of crew accommodations. Since fatigue has a direct relationship to efficiency and injury, the comfort provided to each crew member increases in importance as the length of the voyage increases.

The length of a voyage also affects the size of the fish hold and, more importantly, the method of preservation. Usually, the longer the voyage, the larger the hold. If the voyage is to exceed 10 days, then freezing must be considered in order to land a quality catch. If ice is not readily available, the vessel has the options of making its own ice, using an ice maintenance system, using a chilled sea water spray system or freezing the entire catch. All of these options should be reviewed for every fishing boat as should the size, location, layout and insulation of the fish hold.

Fishing Methods.--After it has been determined what species are available, the designer and the fisherman must decide on the most efficient means of catching each specie. Consideration must

be given to costs, deck space, reliability and versatility. The more vesatile your gear is, the least amount of time and expense will be invested in changing from one specie to the next. A true multipurpose vessel will have winches capable of pursing nets, hauling nets, hauling longline, hauling traps, brailing and handling cargo - sometimes all with the same winch.

Obviously, to obtain such versatility, the deck plan must allow for the handling of different types of catching devices. The location and justaposition of deck gear is very important. A typical vessel might have a power roller on the stern for handling nets, a number of snapper or bottom fishing reels spaced around the gunwale (some of which may need to be portable), a trap hauler forward to one side and a gypsy hoist located amidships aft of the mast and boom. If this gear is hydraulic it would be both dependable and very portable. This is an important feature in smaller vessels with limited deck space. A fishing boat rigged in this manner could fish with traps, gill nets, purse seine nets and hooks (both bottom rigs and longlines). The addition of a drum winch would allow trawling and dragging operations.

Size of Crew.--Now that we have a boat with true multipurpose capabilities, we must have an equally versatile crew. This problem may be solved by allowing crew size to fluctuate from fishery to fishery. However, it is more efficient to have a smaller, nucleus crew with the ability to handle any of the fishing operations. These decisions affect the design in that the boat must be able to accommodate the crew. As was noted while discussing the length of a voyage; the longer the voyage, the more comfortable the crew's quarters. The size of the crew does have a minor impact on the size of the vessel, but only in the size and layout of the crew's quarters section.

In review, by outlining these design criteria, we have been able to formulate the fishing vessel's size, hull configuration, speed, deck plan, fishing gear, crew accommodations and the size and type of fish holding system.

CONSTRUCTION CRITERIA

Designing a fishing vessel is one thing, but actually building it is another. Proper design efforts, specifications and drawings will make the construction much easier and faster. In choosing a construction method, material and/or builder, there are again, certain criteria that must be reviewed: (1) Waters to be fished (coastal or offshore), (2) Ease of maintenance and repair, (3) Expected lifespan, (4) Maximum working area and internal volume and (5) Economy of operation. I will now explain how each of the above affects the vessel's construction (Table 2).

Waters to be Fished.--A vessel whose main fishery or fisheries are offshore must be built differently and stronger than one working in coastal fisheries. The strength of a vessel is not readily apparent to the untrained eye. If a naval architect or a marine surveyor has been retained, then he should assist the

Table 1. Design criteria and their impacts on multipurpose vessel construction

Design Criteria	Design Impact
Type and size of catch	Length, draft, speed, fish hold, fishing gear, crew size, deck plan
Distance to the fishery	Hull configuration, length, speed crew size
Length of voyage	Length, speed, crew accommodations, fish hold, catch preservation
Fishing methods	Deck plan, fishing gear, crew size, engine size
Size of crew	Galley, deck plan, crew's quarters, length

Table 2. Construction criteria and their impacts on multipurpose vessel construction

Construction Criteria	Impacts
Waters to be fished	Strength, weight method
Ease of maintenance and repair	Materials and methods
Expected lifespan	Materials and methods Quality control
Maximum working space and crew's quarters	Materials and methods
Economy of operations	Hull form, materials and methods

owner in both selecting a builder and overseeing the construction. For example, a builder of light displacement coastal vessels should not be selected to build a semi- or full-displacement offshore vessel. In selecting a builder, one should look at other boats the yard has produced, talk to their owners and generally find out if the builder is capable of meeting your requirements. In overseeing construction, one should assure that no short cuts are taken and that the designer's specifications and the owner's requirements are followed and satisfied.

Ease of Maintenance and Repair.--The cost of maintaining and repairing a hard working fishing boat is a major consideration when choosing between different construction materials and methods. The technical skills required to maintain and/or repair the vessel should not exceed the crew's or the boat yard's ability. Daily maintenance areas or items should be located and constructed in a manner that facilitates rather than hinders the crew's job.

Generally, the four main boat building materials have the following benefits and detractions:

Steel: Strong, versatile, easy to work and repair, but requires constant maintenance, is very heavy and if maintenance is lax, has a shortened life span.
Aluminum: Strong, light weight, low maintenance, but is very expensive, requires skilled repair and can be subject to damaging electrolysis.
Wood: Easy to work, easy to repair, but has high maintenance, subject to rot and worms, pound for pound not as strong and if maintenance is lax, has a short life span.
Fiberglass: Strong, low maintenance, easy to repair, very versatile, long life span but requires molds and molded parts if costs are to be kept low.

Expected Lifespan.--It is fair to say that the better a boat is built and maintained, the longer she will be able to work. However, the properties of certain construction materials tend to work against a long, productive life. As was pointed out in the preceding criteria, some materials require less maintenance and have a longer lifespan. If the lifespan of a boat is a critical factor in making such a capital investment, then the owner should first choose the proper building material, them assume that the builder takes all possible steps to protect the integrity of the material. For example, in a fiberglass boat this would mean assuring that all wood is properly encapsulated and covered with fiberglass and that all penetrations through coring materials are properly cut, filled and bedded.

Maximum Work Area and Interior Volume.--Certain methods of construction allow for more internal volume and more usable working space. Generally, molded or formed materials are stronger, require less internal support and thus allow more room for living and working. Of the four building materials discussed, molded fiberglass allows the most internal volume. It also has the best insulating properties when cored with foam.

The stiffness of this cored material reduces the number and size of supporting deck beams, stringers and frames thus increasing the amount of productive space.

Economy of Operation.--The two main factors affecting fuel consumption are hull form and displacement. The hull form was decided through the design criteria, but the displacement, or weight, of a vessel is partially determined by the materials used in construction and the method of construction. Hull form is the dominant factor in vessels seeking displacement speeds, but weight is still important and becomes increasingly important as the requirement for more speed increases.

In a semi-displacement or a planing hull form, weight translates more directly into miles per gallon and gallons per hour. These vessels should be constructed under a watchful eye and with weight-saving methods. These methods will often decrease weight while actually increasing strength. However, such methods also increase costs. The lightest materials versus strength per pound are fiberglass, aluminum, wood and steel in that order. (In vessels over 80 feet, the order changes).

In summary, a few key points should be underscored. (1) In designing and building fishing boats, form should always follow function. That is, the vessel's design and construction should place greater emphasis on the work the boat is to perform and the efficient performance of this work than on the pure aesthetic appeal of the end result. It is a common mistake to try to make a 30 footer do what a 40 footer can do, or to expect a boat designed for one purpose to perform efficiently for a different purpose. (2) Capital construction costs aside, a fishing boat should be designed and constructed to produce a profit in a number of different fisheries. In this way, the vessel and its owners are less subject to variations in the market place, variations on the fishing grounds or variations in the weather.