

SOUTH PACIFIC COMMISSION

ICLARM-SPC SMALL BOAT WORKSHOP

(Noumea, New Caledonia, 27 - 28 October 1975)

PLYWOOD BOATS FOR OFFSHORE FISHERIES

by

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Ministry of Transport, New Zealand

SUMMARY

The paper deals with the construction of offshore fishing vessels using ply skins on timbers framing. To strengthen and improve the ply against attack from marine borers, rot and fungus the outer surfaces are skinned with a reinforcing cloth and approved resin system. Many stock designs are available for the pleasure craft market to suit the amateur builder and these may be adapted with increased scantlings to provide a sturdy workboat which can be constructed by the handyman or jobbing carpenter without previous boatbuilding experience.

Construction methods, materials available and suitable including ply, timber from the South Pacific region, fastenings, glues and sheathing systems are dealt with and typical scantlings indicated. The problems of glueing and sheathing at higher temperatures and humidities are discussed.

Several designs for offshore ply vessels are included and these range from a fishing dory to small inshore shrimp trawler. A number of these have already been constructed in New Zealand as part of our overseas aid programme to Pacific and other overseas countries.

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Introduction

1. Every year tens of thousands of small pleasure craft of plywood are constructed in New Zealand and elsewhere from stock plans produced for the amateur builder by several New Zealand designers.
2. These designs with amendments are often used by owner/builders and some professional boatbuilders in New Zealand as the basis for fishing vessels of appropriate type. These usually constitute what we regard as Inshore Fishing Vessels where the higher speed, lighter scantling craft are employed in cray fishing and long lining. These craft can easily be adapted for offshore fishing in the Pacific region for tuna/skipjack etc.

Design

3. All stock designs are of hard chine form some having a gull wing configuration in the after sections. Basic designs for pleasure cruisers usually have extensive house structures which can be dispensed with for fishing craft and replaced with a smaller house forward with aft cockpit and fish boxes.
4. Typical layouts are shown in Figs.1. and 2., a modified 27' stock hull three of which were supplied to Fiji under a New Zealand aid programme is illustrated in Fig.3.
5. This form of construction may also be used for small craft involved in more robust, slower fishing operations in inshore areas. Illustrated in Fig.4 is a 27' general purpose vessel designed by the author for shrimp trawling and gill netting. Two such vessels have been supplied for a UN training school in Indonesia under our aid programme.

Construction

Construction in relatively simple sawn frames, ply bulkheads and transom are cut from full size paper templates. These transverse members are aligned in the upside down mode and the longitudinal members, hog, sawn timber stem, inner chines and gunwales, and finally stringers glued and screwed to the frames. The ply skins are glued and nailed to the closely spaced longitudinal stringers. Ply hulls may be of single skin but on the larger fishing vessels having stronger hulls they usually have double skins bonded with a suitable glue. A developable hull form is provided to permit the ply to be laid on in panels but right forward, particularly in the area of topside flare it may be necessary to lay the ply in strips. The width of strips being dictated by the amount of curvature. In double glued skins the ply panels are butted at the joints which are staggered in each skin. Single skin joints are scarphed the length of scarph to thickness of ply being at least 8 to 1. Deck ply with transverse beams can be butted and fitted with butt straps between beams.

Whilst still upside down the hull may be skinned with cloth and resin and the rubbing strip or for inboard engined craft the sawn or laminated keel glued and bolted on. Through bolts for the keel are taken through the sawn floors adjacent to the frames and midway between frames. The solid keel is normally additional to stock designs and is sided to suit the propeller shaft with bolts both sides of the shaft. A boat may then be turned over and the deck and house fitted and outfit completed.

To provide a robust fishing boat it is necessary to increase some of the scantlings specified for the stock pleasure craft designs. These are usually the moulding of hog and siding of inner chine and gunwale or rim to provide the desirable faying surface of at least $2\frac{1}{2}$ times the finished ply thickness. Adding additional floors of sufficient siding to take the keel bolts, reducing the stringer spacing and increasing the deck ply thickness. Other scantling increases are dependent on the original specification where there is some variation between designers. A number of the designs provide for the stringers to terminate in the forward third of the boat and for short diagonal stringers to be fitted to simplify the building. It is preferable if stringers are run out to the stem even if more skill is required to prevent them twisting, in the interest of maintaining strength.

Typical scantlings for ply offshore fishing craft are shown in Table I.

Plywood and Timber

Marine plywood to BS 1088 is preferred and is available from Australia and the United Kingdom. Marine plywoods with kauri or pacific maple veneers reputedly to NZS 3613 are available from New Zealand but are not of the same quality as plywood to BS 1088 the cores being inferior. Marine plywood of reported good quality is also available from Papua New Guinea.

Timber for these craft should be of the superior soft wood variety, light, tough and durable with long straight grain and reasonably free of defects. Kauri from Fiji, Papua New Guinea, Australia and New Zealand, Kahikatea from New Zealand, Hoop or Klinki Pine from Australia or Papua New Guinea, Huou Pine from Tasmania, and Vitex from Papua New Guinea are examples. The timber should be subjected to preservative treatment prior to use. In New Zealand there are various grades of preservative treatment specified, the most severe is for immersion in sea water and may be specified for boatbuilding timbers provided care is taken to prepare glue surfaces and a suitable epoxy resin is used as the adhesives. If using resorcinal glues the timber preservation treatment specified is as for posts and sawn timber in contact with the ground.

Fastenings

In this type of craft bolts are often only used for the keel fastenings. Bolts in this area should be of copper, silicon bronze, or monel, the material being purchased in rod form and threaded at one end and headed at the opposite end to suit the job. Bronze nuts are often used with the copper bolts, brass nuts should not be used as they deteriorate rapidly in sea water in association with copper.

Countersunk wood screws are used for attaching stringers and other longitudinal members to the frames and the best material for these is silicon bronze. Although expensive silicon bronze is vastly superior to galvanised iron or brass in stressed or corrosive conditions.

Modern practice is to use serrated nails for nailing ply to stringers, hog, chine and gunwale. These are great labour savers in comparison with the traditional clenched nail or turned copper nail. These serrated nails are of silicon bronze or monel.

In the pleasure craft field in developed countries the practice of stapling of ply in association with adhesives is not uncommon. This practice is not recommended for commercial craft except for pulling laminated ply skins together whilst the glue line sets in areas of difficult curvature clear of framing. The use of stapling puts too great an emphasis on the glue line.

Glues

Resorcinal glues and epoxy resins which conform to BS 1204/1965 being weather and boil proof, gap filling and close contact adhesives are used.

For many years resorcinal glues have been the approved adhesive for boatbuilding timbers being mixed with an appropriate hardener to provide a joint of maximum water resistance and durability. Once mixed with the hardener the usable life of the adhesive depends on the ambient temperature and in tropical zones a limited pot life is available. At 68°F a typical resorcinal glue has a pot life of 4½ hours and at 90°F a pot life of 70 minutes. At higher temperatures the setting time is reduced, the initial setting time at 68°F for a typical resorcinal glue being 22 hours and at 90 F only 3 hours. The setting time is that at which the joint has sufficient strength to allow the pressure to be released and joint lightly worked, the full cure at 90°F is 2 days.

Epoxy resins now available as timber adhesives have a wood to wood shear strength twice that of resorcinal glues. Initially there was a reluctance amongst boat-builders to using epoxy resins for laminating because they were thick and pasty and much less easy to apply to the timber surface but this drawback has been overcome with the introduction of low viscosity resins which can be brushed on like resorcinal glues. At 90°F the pot life of a typical epoxy is only 20 minutes with a full cure of 1 to 2 days. Epoxy resins should not be used on timber treated with boron.

The moisture content of the timber is important whichever adhesive is used and in theory should be down to 10%, but resorcinals will produce a satisfactory glue joint with up to 15% moisture content. Epoxy resins are more tolerant and will glue satisfactorily with moisture content up to 18%. If joints are glued before adequate drying is carried out drastic shrinkage can occur resulting in what appears to be failure of the glue joint but which in fact is failure of adhesion between the timber fibres.

Surface preparation is important in achieving satisfactory adhesion and all surfaces should be clean and resinous, oily or hardwood timbers washed with Carbon Tetrachloride and then washed and dried out.

Sheathing

Plywood boats for use in tropical waters must be sheathed with a reinforced plastic skin. The reinforcement can be either a fibreglass cloth or dynel fabric and an epoxy resin should be used. Early plywood boats were often sheathed using a polyester resin which did not give adequate adhesion to the ply in service and led to delamination between the sheathing and ply.

Where fibreglass reinforcement materials are used it is normal to use a 6 oz or 8 oz cloth on the hull, 6 oz cloth on superstructures and 24 oz woven rovings on the working deck. A small amount of sand may be mixed with the final resin application to give decks a non-slip surface. Dynel cloth is more expensive but superior to fibreglass in most respects and is easier to lay over complex curves.

It is not recommended that epoxy resins for sheathing should be used where the humidity is in excess of 90% as at higher humidities the resin has a tendency to absorb moisture which is not compatible and emulsifiable to a certain extent resulting in a milky and under-cured finish. Epoxies generally should not be used below 50°F but high temperatures will have no adverse effect on the curing other than of course accelerating the pot life and final cure time. At high temperatures the amount of resin and hardener mixed at one time should be limited bearing in mind the pot life. For example at 90°F it is recommended that 1 litre of resin and ½ litre of hardener be mixed with a pot life of 20 minutes and the mixture transferred to a shallow tray. The application of the resin should not be carried out under the direct sun.

The actual skinning should be done following carefully the recommendations of the resin manufacturer. Careful surface preparation and mixing of the resin is essential. The resin hardener mixture is applied with a mohair paint roller directly to the fabric which has been tailored to shape and smoothed out on the surface of the boat and the joints butted together. Great care must be taken to remove all air bubbles and wrinkles and excessively heavy coats of resin should be avoided which will cause the fibreglass to ripple and the lighter dynel to float on the surface. When the resin is beginning to set up which in hot weather can be as little as 1 hour after application the edges overlapping the gunwale etc. should be trimmed off. The whole of the hull skinning operation should be completed in one day and left to harden.

Conclusions

Sheathed plywood boats suitable for offshore fisheries can be produced from modified stock pleasure craft designs. These can be built by adaptable personnel who have a rudimentary knowledge of carpentry but not boat building experience using everyday wood working hand tools. Provided the correct materials are selected and recommended practices followed a robust and durable craft can be built at a reasonable cost.

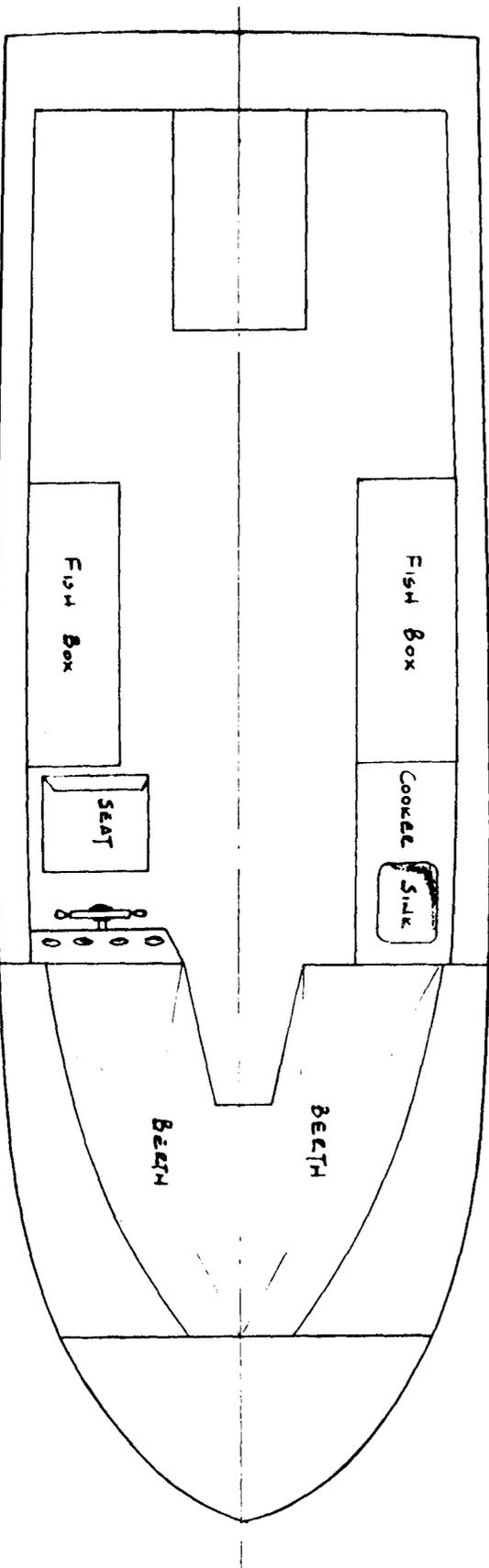
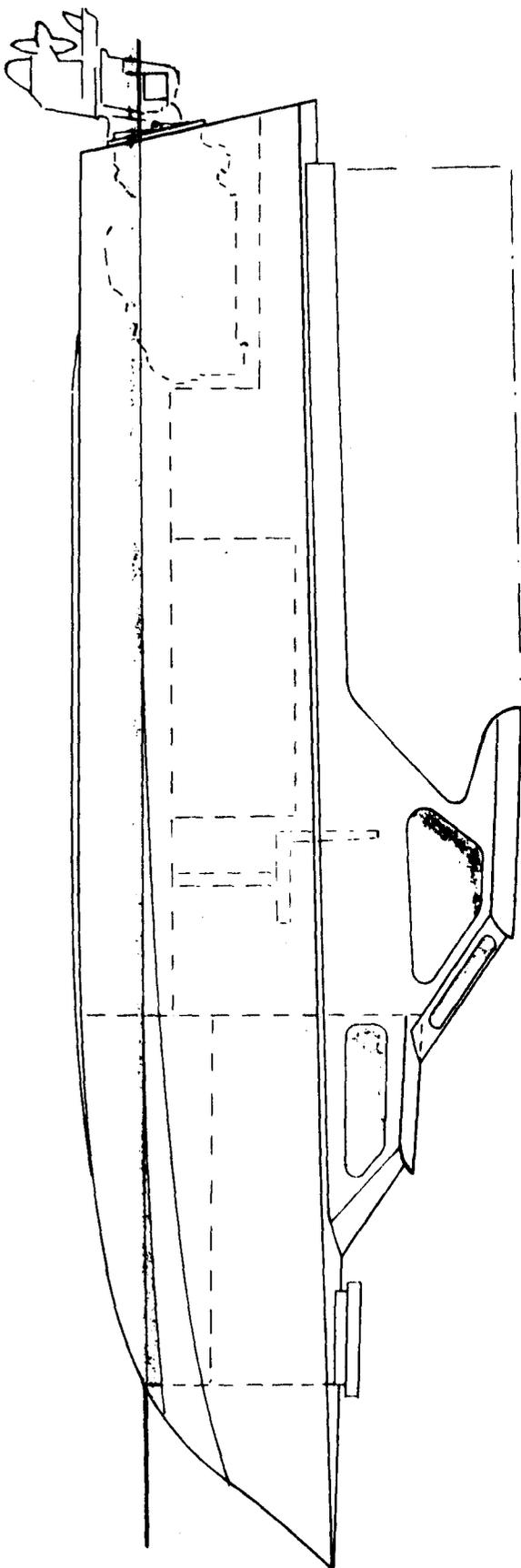
TABLE I
TYPICAL SCANTLINGS

BOAT SIZE	HOG FROM	FRAMES AT 36"	STRINGERS AT 5" APART	PLY BOTTOM/TOPSIDES	PLY DECK
25'	5" x 1½"	4" x 7/8"	1½" x 7/8"	½"/3/8"	9/16"
30'	6" x 2"	4" x 1¼"	1¾" x 1-1/8"	5/8"/½"	5/8"
35'	7" x 2¼"	4½" x 1-3/8"	2" x 1¼"	¾"/5/8"	¾"
40'	9" x 2¾"	5" x 1-3/8"	2¼" x 1-3/8"	13/16"/¾"	7/8"

TABLE II
TYPICAL FASTENINGS

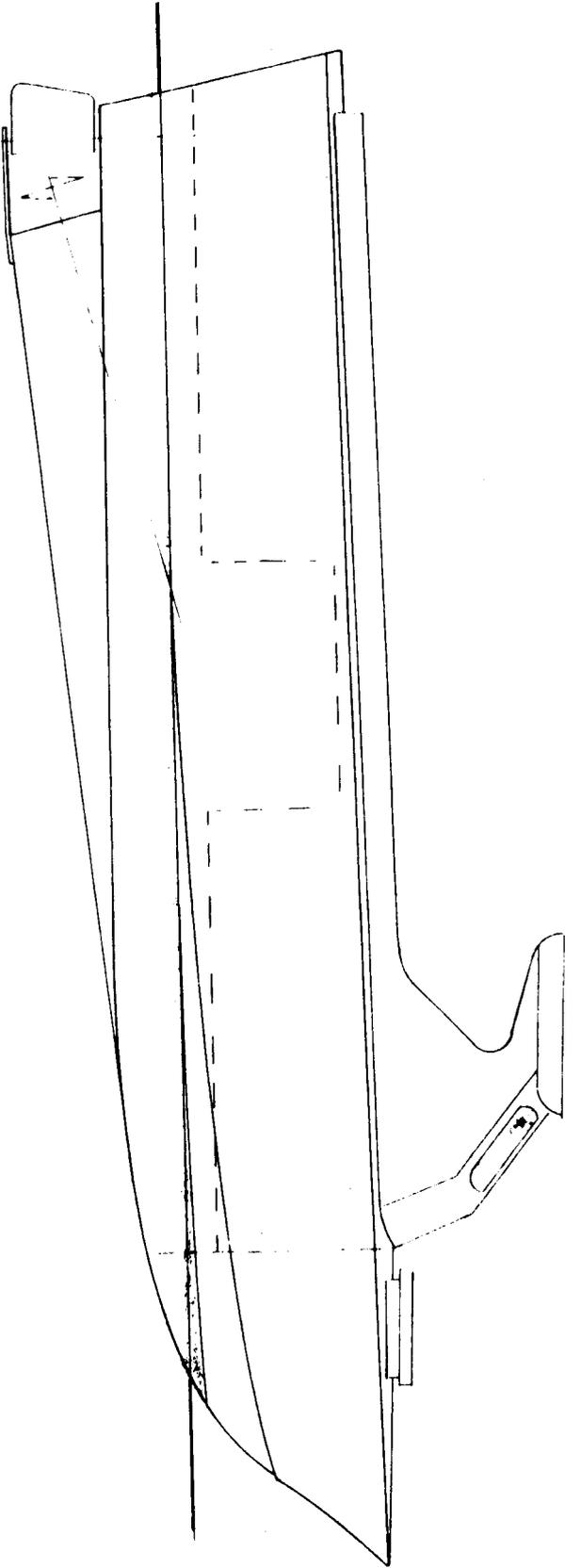
BOAT SIZE	KEEL BOLTS	SCREWS (STRINGERS TO FRAMES)	NAILS
25'	3/8"	1¾" x 12G	1¼"/1½" x 10G
30'	3/8"	2" x 14G	1½"/1¾" x 10G
35'	7/16"	2½" x 14G	1¾"/2" x 8G
40'	½"	2¾" x 16G	2"/2¼" x 8G

NOTE: Screw size is British Standard Gauge
Nail size is Imperial Standard Wire Gauge

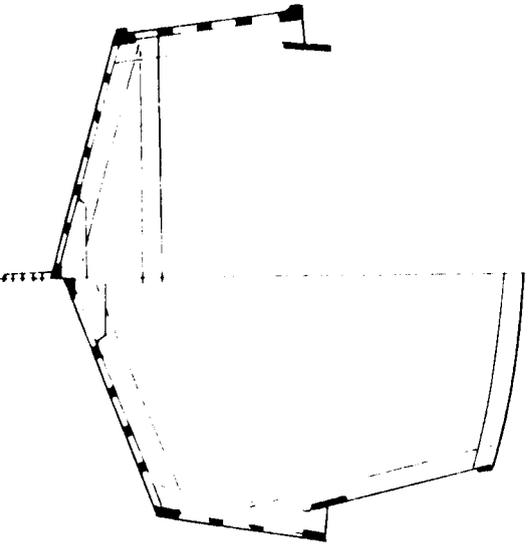


Volvo Penta App 32
18 knots

Drawn Checked Revised	D. S. Eyles	Fig. 1	Sheet 1 of 3 Sheets Scale 1/4" = 1 foot	24' Stock Design Modified FOR OPPOSITE FISHING	ISSUE
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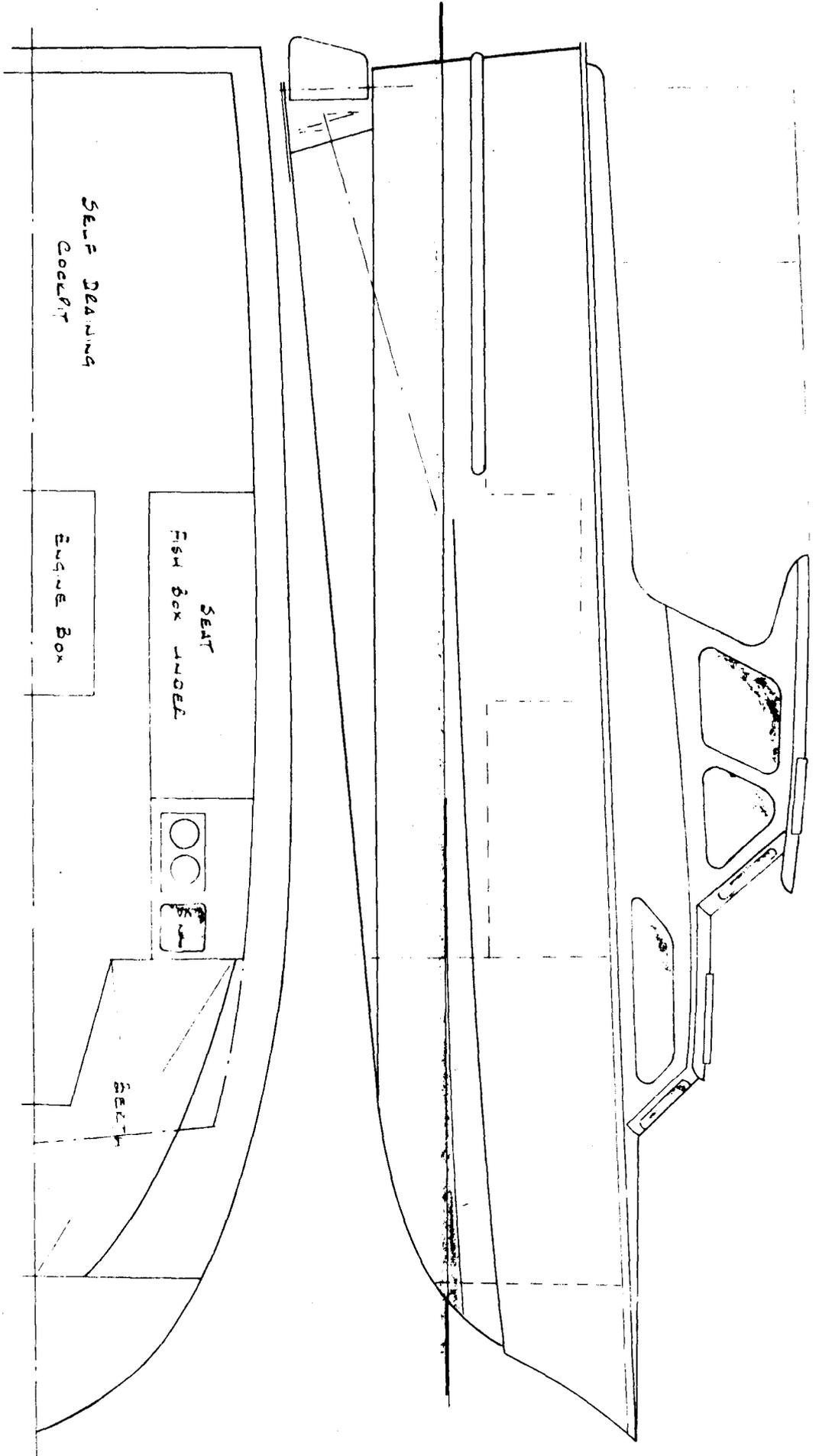


TYPICAL SECTIONS



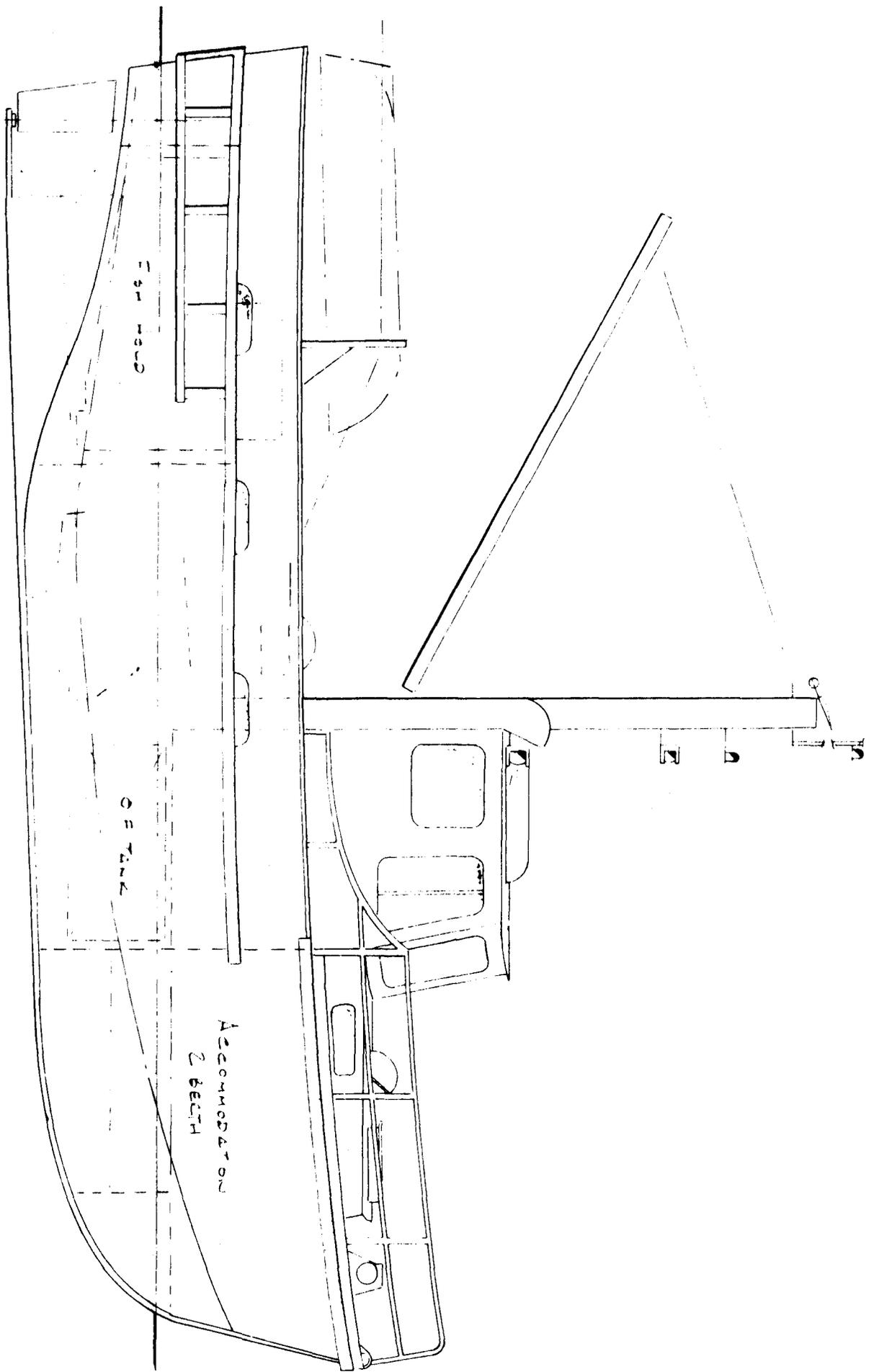
PERKINS 6.354
18 KNOTS.

2.5 Eyes	FIG. 2.		24' Stock Design Modified As Fishing Deck
		Sheet 2 of 3 Scale 1/4" = 1'-0"	15517



CALO 2704 E
 10 knots
 22W @ 2400

25 eyes	Fig 3		27 Stock Design Modified As OFFSHORE CRUISEY (7/10) - FIS I Size 3 3/4 1/2" to 1 foot
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D S EVELL	E. S. L. M.		37' RV SHALUP TRAWLER FOR UN TRAINING SCHOOL
SCALE 1/2" TO 1' FOOT			