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Fishing Boat Designs 1: Flat Bottom Boats FAO Fisheries Technical Paper No. 117

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FISHING BOAT DESIGNS: 1 FLAT BOTTOM BOATS



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FLAT BOTTOM BOATS

Compiled by

Arne Fredrik Haug Fishing Vessels and Engineering Branch Fishery Industries Division

PREPARATION OF THIS PAPER

The paper contains a selection of designs of flat bottom boats suitable for fishing and transport work in lakes, rivers and protected coastal waters. The paper and the designs were prepared to provide detailed technical information to boatbuilders and Fishery Officers in interested member countries. First published in 1972, this 1974 revised edition by J.F. Fyson contains the same basic designs, updated in accordance with experience gathered during construction and operation of some of the boats presented, notably AFR-1. IVC-4. IVC-6. PDY-1. SUM-1 and IVC-7.

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CONTENTS

		Page
1.	INTRODUCTION	1.
2.	BUILDING PROCEDURE	2
3.	SELECTION OF TIMBER	3
4.	SELECTION OF FASTENINGS	3
	TABLE 1	4
	DRAWINGS	
	AFR-1 4.90 m Flat Bottom Boat	7
	IVC-4 5.10 m Flat Bottom Canoe	11
	MLW-6 5.40 m Flat Bottom Boat	15
	IVC-6 5.94 m Flat Bottom Boat	23
	IVC-5 6.80 m Flat Bottom Canoe	27
	PDY-1 8.23 m Flat Bottom Boat	31
	SOM-1 8.43 m Transport Boat	35
	IVC-7 11.25 m Transport Boat	39

1. INTRODUCTION

THE PURPOSE OF THIS PUBLICATION is to present some basic designs of boats that are simple to construct, for use in small-scale, non-industrial fisheries. All the designs shown here are of the flat bottom type; that is: the bottom is flat when seen in the transverse direction, while lengthwise there is a slight curvature. In the majority of the present designs, the shape is simplified to the extent that the sides are built up with parallel planks and the rocker of the bottom is determined simply by the curvature and the flare of the side planks, so no building jig is necessary.

THE EASE OF CONSTRUCTION of flat bottom boats, because of the simple, straight-lined frames and the uncomplicated planking, is considered to be their main advantages, realizing also that this normally makes them the least expensive of all planked wooden boats.

THE SHALLOW DRAUGHT is an important feature for many purposes like navigation on shallow rivers and lakes or in swamp areas or close to the shore. For beach landing operations, it means that the boat can be kept affoat until it actually touches the beach, and because of its flat bottom it rests firmly on the ground after hauling up.

GOOD TRANSVERSE STABILITY when compared with round bilge or V-bottom boats with the same weight and overall beam is another advantage of flat bottom boats. This means that they give a stable working platform for fishing operations.

BIG FLOOR SPACE INSIDE THE BOAT is a valuable asset for certain fishing operations like gillnetting or pot fishing where a working position standing near the side is normal; this is another easily possible, favourable feature of the flat bottom boat configuration.

THE ADAPTABILITY FOR SERIES PRODUCTION is high, utilizing simple moulds and templates; series production is possible with a small labour force. In one country in Africa, the system of kit production in a central place with good access to suitable timber, and assembly in the different fishing villages, has been introduced with great success.

EXPERIENCED BOATBUILDERS are not necessary for the construction of flat bottom boats since the amount of difficult boatbuilding work is reduced to a minimum. Knowledge of general carpentry is required, supplemented with a few weeks training in this particular type of construction.

STANDARD SIZES OF TIMBER can be used throughout in the majority of the designs presented. The requisite timbers can be obtained directly from the timber store or saw mill without spiling or other difficult adjustments of the edges being required. Since standard timber sizes are different in different countries and strength and stiffness are not the same for all boatbuilding timbers, the specifications given should be taken more as guidelines than as strict instructions.

THE MAIN DISADVANTAGES of flat bottom boats are their general tendency to slamming in waves, resulting in discomfort, and requiring speed reduction, and the tendency to side—drift in wind and waves, due to lack of a deep keel. These features restrict the area of use for these boats to protected waters, inland waterways and some lakes. Spray and water that enter the boat can also be quite uncomfortable, since there are no bilges where this water can be collected and easily bailed or pumped out.

THE BOAT DESIGNS presented here are suitable where low cost, or ease of construction, are all important factors and where a somewhat reduced seaworthiness or seakindliness can be accepted, or where extreme shallow draft requirements are an over-riding consideration.

2. BUILDING PROCEDURES

THE SIMPLEST VERSIONS of flat bottom boats have cross-laid bottom planks nailed directly to the sides, and the lower side planks on each side are increased in thickness to take the nails without splitting. The frames are mainly necessary to hold out the sides during construction, because the main transverse strength comes from the cross-laid bottom planks. The bottom planks have to be held together by longitudinal bottom stiffeners, and the side planks by vertical side stiffeners (intermediate side frames). A slight bending of the bottom planks when crossing waves can be tolerated as long as it does not affect watertightness. Except for MLW-6, which is built over a jig, when one or several boats only are to be built the construction procedure is as follows:

- 1. Select timber and fastenings according to specifications on drawings (see Chapters 3 and 4 regarding selection of timber and fastenings).
- 2. Make templates for frames and transom.
- 3. Prefabricate frames, transom and stem complete with bevels.
- 4. Join lower side planks to obtain the required length using butt blocks on the inside. Mark position of all main frames and intermediate frames.
- 5. Assemble the lower side planks, frames, stem and transom on the ground or on a flat floor. When this is done the shape of the boat is given.
- 6. Fasten side stiffeners to lower side planks and complete side planking.
- 7. Turn the boat over, check the bevel on the lower side planks for a perfect fit with the bottom planks. Start planking the bottom from the stern, working toward the stem. Apply a strand of cotton and bitumastic compound in the joint between the sides and the bottom. If the bottom planking is made of a timber that swells and shrinks considerably it is necessary to leave a gap, the thickness of a hacksaw blade between the planks. Never fit the bottom planks tight if they are made of pine or similar timber since the bottom planks will buckle as they swell. With most stable tropical hardwoods, however, the bottom planks can be fitted tight on the inside with a small outgauge for caulking the outside.
- 9. Apply wood preservative on all surfaces. A strand of cotton is driven into the seams with a proper caulking iron and not a screwdriver, chisel or putty knife. The seam is finally rendered watertight by filling the joint with bitumastic compound.
- 10. Painting the outside of the bottom with bitumastic paint is the best and cheapest way. The sides can be painted but application of wood preservation will give a better and cheaper protection to the timber against rot.

When series production of 10 or more boats is envisaged, building upside down over a jig is the quickest and most economical method. In this case the construction procedure follows that shown for boat MLW-6. Slight differences in procedure may be necessary to incorporate fixed frames which are indicated in some designs and these should be prepared and fitted to the jig with the moulds and permanently fastened to the hull before it is removed from the jig.

SELECTION OF TIMBER

THE MAIN QUALITIES sought in a boatbuilding timber are:

(a) Rot resistance - Rot is the main enemy of wooden boats operating in tropical fresh water and the timber should be selected with this in mind. The types of timber with high natural resistance to rot are normally known by the boatbuilders in the area but Forestry Departments will also be able to give precise information regarding durability of various local timbers.

High resistance to rot can also be achieved by pressure-impregnation of timbers. The local Forestry Department can give advice on which species of timber would be suitable. Besides being easily treated by pressure-impregnation it must be relatively stable, with good strength qualities and not split easily when nailed or screwed.

- (h) Stability A timber that is not stable will shrink excessively when it dries out and thereby open up the seams with resulting leaks. On the other hand, if the same timber is dry when the boat is being built the bottom planks will swell excessively after being put into water causing great strain on the fastenings and making the planks buckle with consequent leaks along the chine. The tangential shrinkage should preferably be below 4 percent when dried from green to 15 percent humidity. The best hardwoods have a tangential shrinkage of only 2 percent a boat built of such timber will, therefore, have less problems with leakage due to swelling and shrinkage.
- (c) Good strength qualities The weight of the timber will give an indication of the strength. The heavier the timber is the stronger it will be. A heavy timber will, therefore, permit a slight reduction in planking thickness compared with a lighter timber.
- (d) Take nails and screws without splitting The problem of splitting when nailing the planks can partly be solved by preboring holes for the nails. Holes for screws must always be prebored.

4. SELECTION OF FASTENINGS

- (a) All nails, screws and bolts should be hot-dipped galvanized.
- (b) Copper nails or brass screws are expensive and their use is not warranted for boats operating in fresh water.
- (c) Bolts should be of carriage type with cupped head and a square nut. A galvanized washer should be placed under the nut.
- (d) The type of galvanized nails to be used is often determined by what is available. Round nails or square nails are both acceptable but the diameter should not be less than 1/7 of the plank thickness and the length at least 2½ times the plank thickness. For example, for 20 mm planking nails should have a minimum diameter of 3 mm and a minimum length of 50 mm.
- (e) If the timber has a tendency to split, a hole slightly smaller than the nail diameter should be drilled before nailing. If the nail is to be clenched, the nail should be tapped over at the end and, with a dolly against the nailhead, tapped down so that the point enters the wood and hammered hard down to draw up tight. The point should be clenched across the grain, not along the grain since this often leads to splitting.

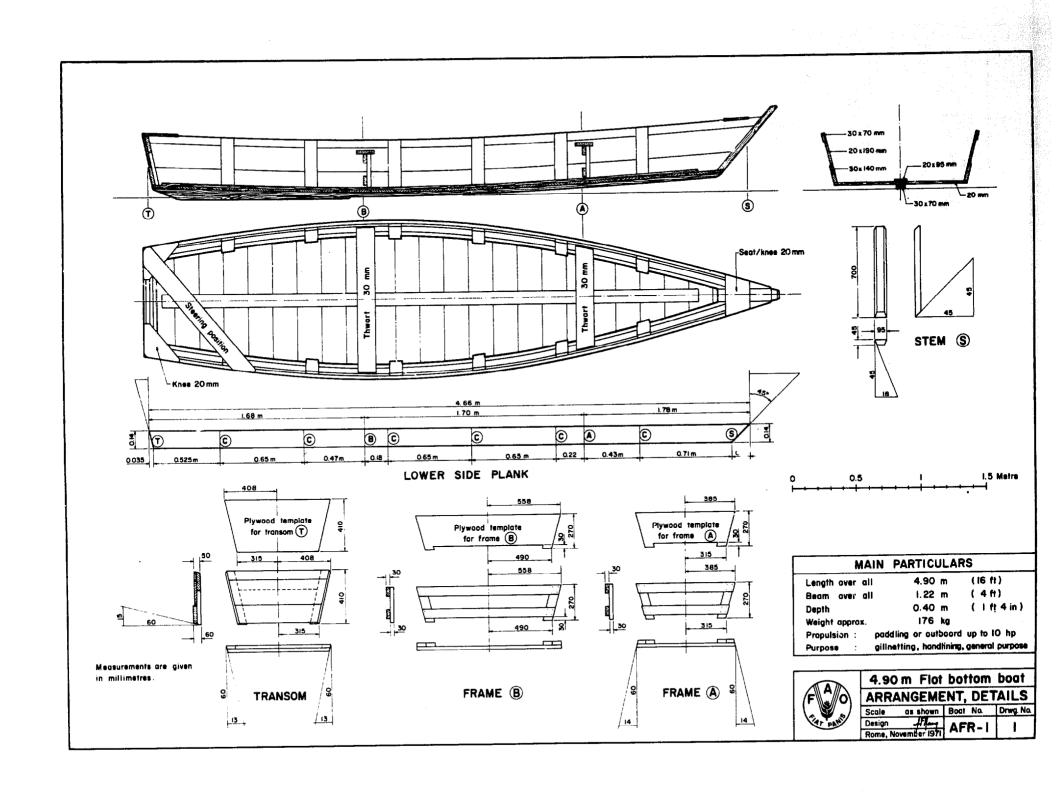
Table 1: MAIN PARTICULARS

				Cubic Number		Propulsion			Building time with	Approx. Cost in Africa
Boat No.	Overall Length L	Beam Maximum B	Depth D	LxBxD m3	Approx. Weight	Paddles or Cars	Outboard Motor	Inboard Engine	skilled Carpenters	1972 in U.S.\$
AFR-1	4.90 m 16 ft	1.22 m 4 ft	0.40 m 1 ft 4 in	2•4	176 kg 388 lb	Paddles or oars	4-5 hp	No	2 men in 5 days	\$ 110
IVC-4	5.10 m ·17 ft	1.14 m 3 ft 9 in	0.40 m 1 ft 4.in	2.3	170 kg 375 lb	Paddles or oars	4-5 hp	No	2 men in 5 days	\$ 100
MLW-6	5.40 m 17 ft 9 in	1.68 m 5 ft 6 in	0.49 m 1 ft 7 in	4•5	270 kg 595 1b	0ars	Long shaft 4-6 hp	No	2 men in 12 days	\$ 200
IVC-6	5•94 m 19 ft 6 in	1.94 m 6 ft 4 in	0.56 m 1 ft 10 in	6•5	408 kg 900 kg	No	6-10 hp	No	2 men in 12 days	\$ 200
IVC-5	6.80 m 22 ft 4 in	1.19 m 3 ft 11 in	0.43 m 1 ft 5 in	3•5	210 kg 462 lb	Paddles or oars	4-5 hp	No	2 men in 7 days	\$ 130
PDY-1	8.23 m 27 ft	1.80 m 5 ft 11 in	0.57 m 1 ft 10 in	8.4	700 kg 1 540 lb	No	Long shaft maximum 20 hp	8-10 hp	4 men in 10 days (outboard version)	\$ 350 (outboard version)
SOM-1	8.43 m 27 ft 8 in	2.26 m 7 ft 5 in	0.73 m 2 ft 5 in	14.0	945 kg 2 080 1b	No	Long shaft 10-20 hp	10 - 20 hp	4 men in 14 days	\$ 500
IVC-7	11.25 m 36 ft 10 in	2.24 m 7 fi 4 in	0.73 m 2 ft 5 in	18•5	1 220 kg 2 687 lb	No	Long shaft maximum 20 hp	10 20 hp	4 men in 16 days	\$ 650

AFR-I

4.90 m

Flat bottom boat



TIMBER SPECIFICATIONS:

	20x190mm	20x 95 mm	30x145mm	30x70mm	45x95mm
Weight pr.m (at 0.65kg/dm ³)	2.50 kg	1.25 kg	2.80 kg	1.40 kg	2.20 kg
Side planking	2 x 4.90 m		2 x 4.75 m	2 x 5.00 m	
Bottom planking	23.00m				
Fromes				6.00 m	
Stem piece					0.75 m
Transom	0.80 m	0.85 m	1.50 m	0.90 m	
Side stiffeners		5.50 m			
Bottom stiffener		1x 4.20 m			
Keel and skeg				1 x 4.50 m 1 x 1.50 m	
Thwarts and knees	1.20 m		4.00 m		
Total length	34.80m	10.55 m	15.00 m	22.90 m	0.75 m
Weight	87 kg	13 kg	42 kg	32 kg	2 kg

The timber should preferably be medium heavy and medium hard with good holding power for nais and low tendency to split.

For maximum durability, the timber should be treated with the best locally available impregnation system, preferably pressure impregnation of all planks before the construction.

CAULKING:

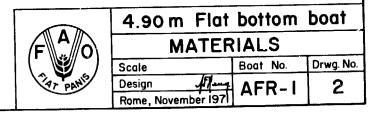
All joints should be treated with an asphalt-based or bitumastic compound during the construction. It may be necessary to caulk eventual bad leaks with caulking cotton afterwards.

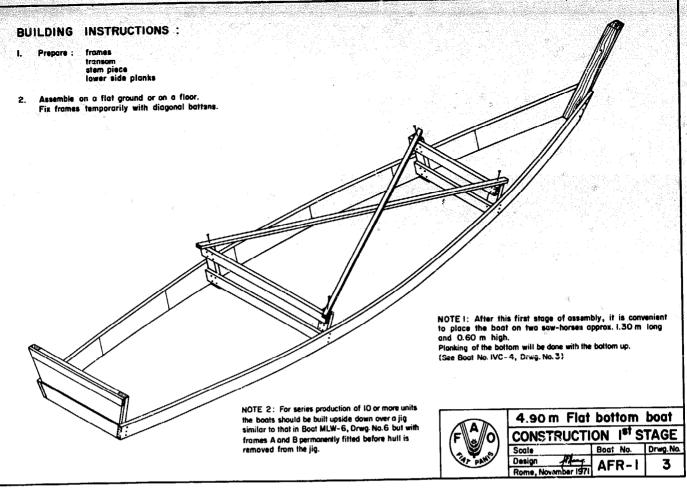
FASTENINGS:

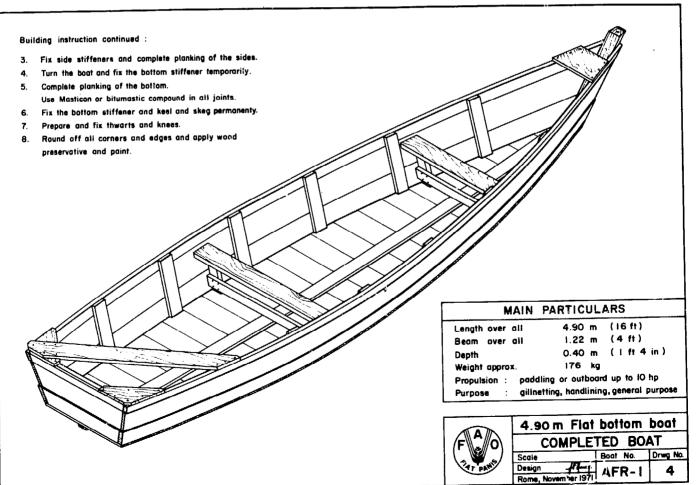
For assembly of frames: galvanized 50 x 5 mm flat head wood screws.

Elsewhere:

60 x 3.0 mm galvanized round nails.



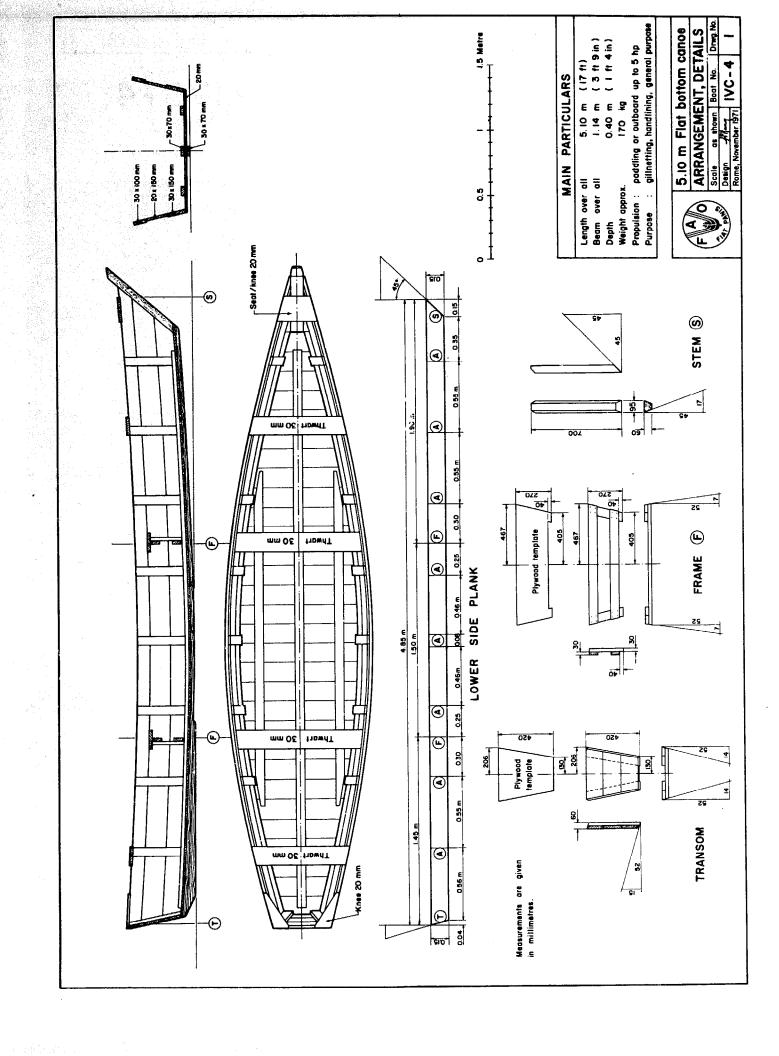




IVC-4

5.10 m

Flat bottom canoe



TIMBER SPECIFICATIONS:

	20x 150mm	2 30×70 mm	30x150mm	30x100mm	(50x95mm
Weight pr.m (at 0.65 kg/dm ³)	1.95 kg	1.40 kg	2.90 kg	1.95 kg	3.70 kg
Side planking	2 x 5.10 m		2 x 5.00 m	2x5.15 m	
Bottom planking	20.00 m				
Frames		5.00 m			
Stem piece					0.75 m
Transom		1.00 m	1.30 m		
Side stiffeners		7.00 m			
Bottom stiffener		1x 4.40 m 2x 2.80 m			
Keel and skeg		1x 4.60 m 1x 1.50 m			
Thwarts and knees	0.35 m	0.60 m	4.00 m		
Total length	30.55 m	29.70 m	15.30 m	10.30 m	0.75 m
Weight	60 kg	42 kg	45 kg	20 kg	3 kg

The timber should preferably be medium heavy and medium hard with good holding power for nails and low tendency to split.

For maximum durability, the timber should be treated with the best locally available impregnation system, preferably pressure impregnation of all planks before the construction.

CAULKING:

All joints should be treated with an asphalt-based or bitumastic compound during the construction. It may be necessary to caulk eventual bad leaks with caulking cotton afterwards.

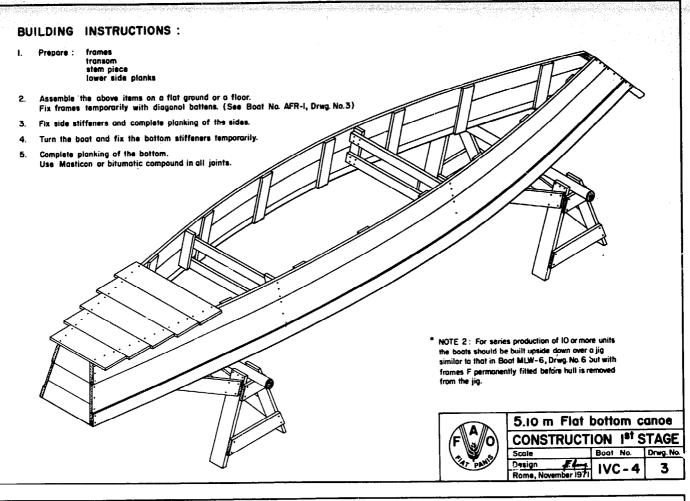
FASTENINGS:

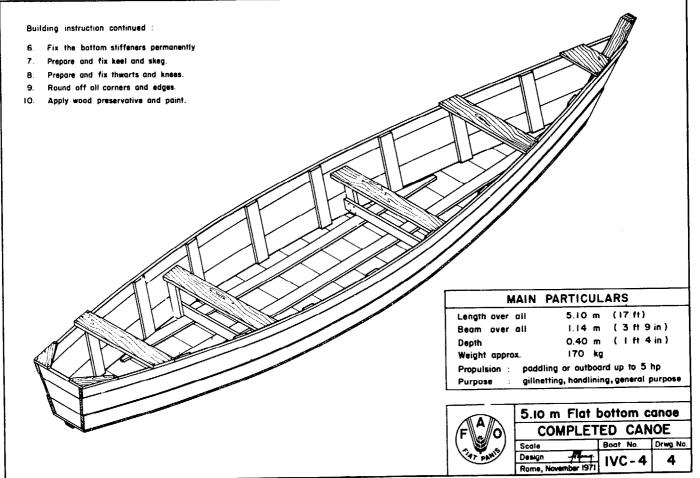
For assembly of frames: galvanized 50 x 5 mm flat head wood screws.

For planking of bottom : 50 x 3.0 mm golvanized round nails. Elsewhere : 60 x 3.0 mm galvanized round nails.



5.10 m Flat	bottom c	anoe				
MATERIALS						
Scale	Boat No.	Drwg. No.				
Design Flag. Rome, November 1971	IVC_4	2				
Rome, November 1971	1 4 /2 - 4					

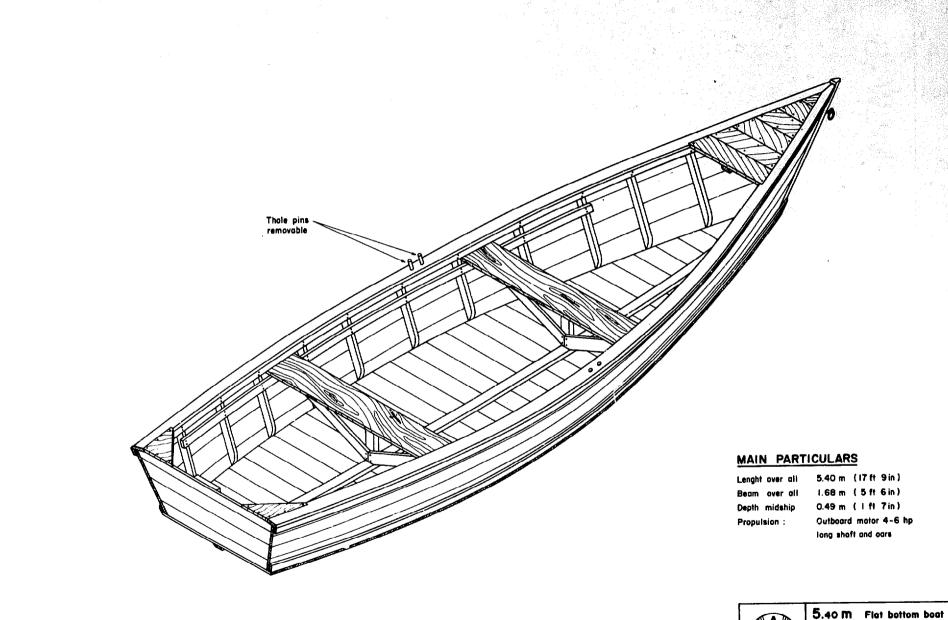




MLW-6

5.40 m

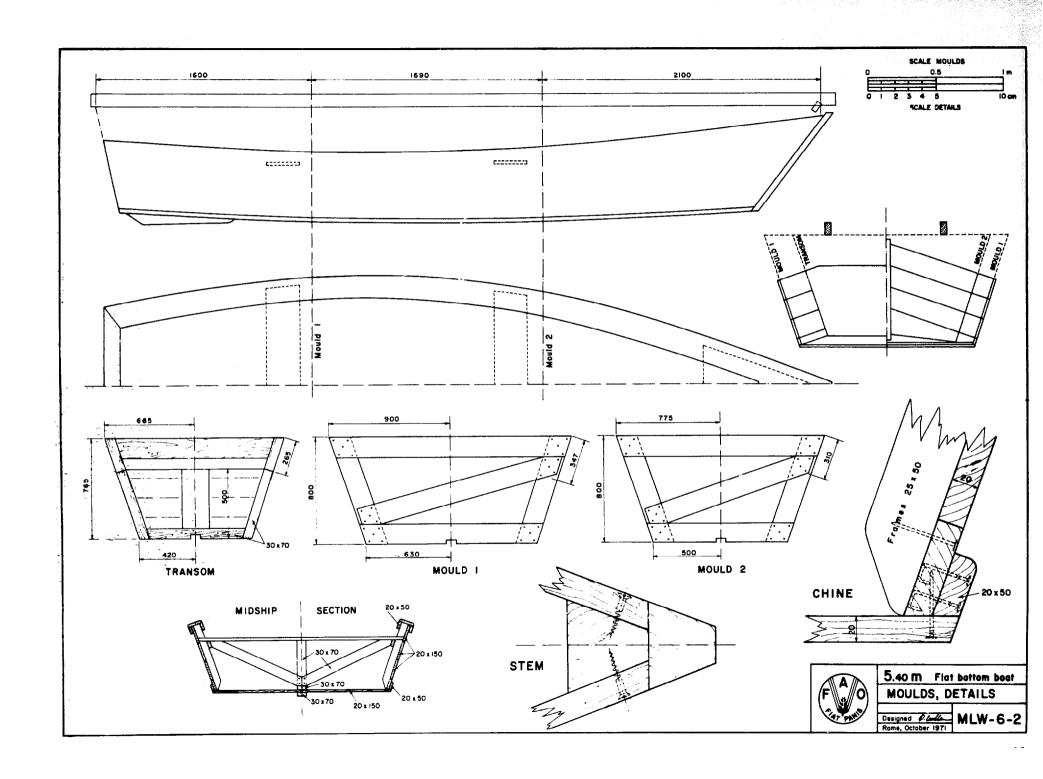
Flat bottom boat

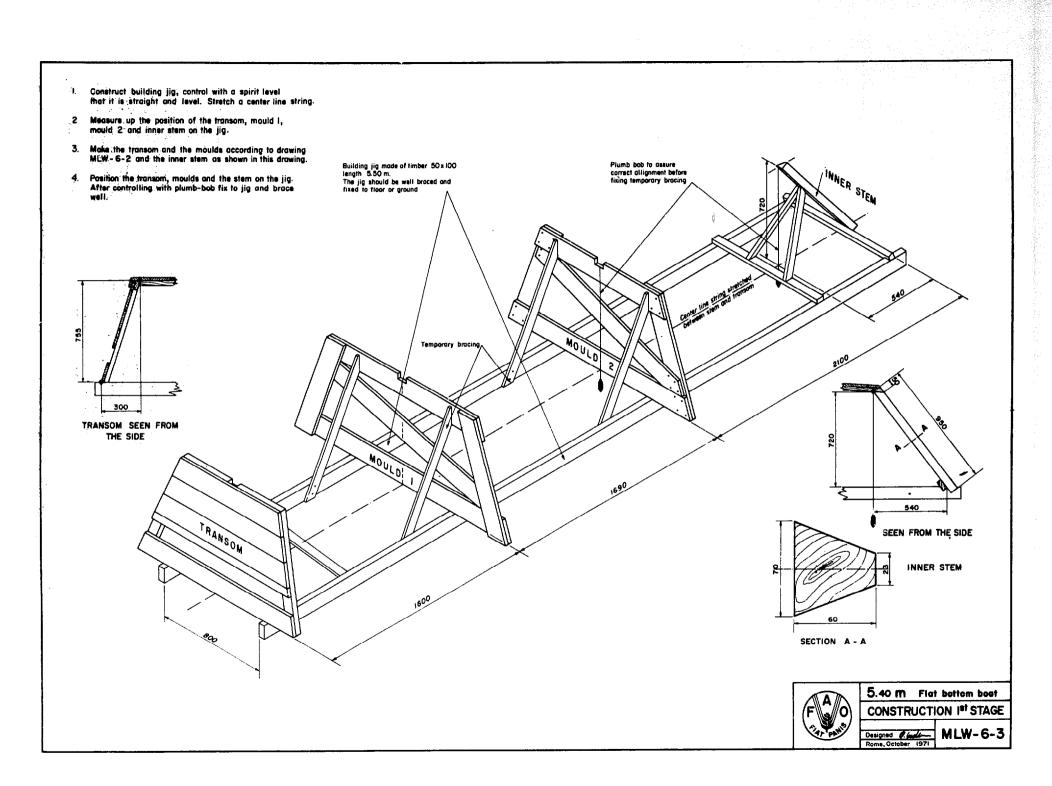


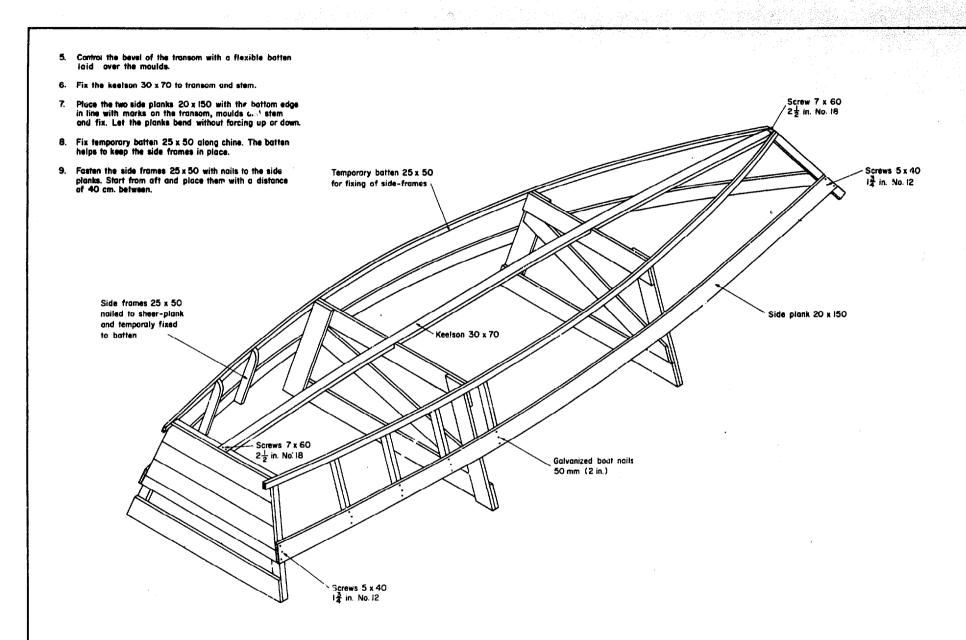


COMPLETED BOAT

Designed *P. forde* Rome, October 1971





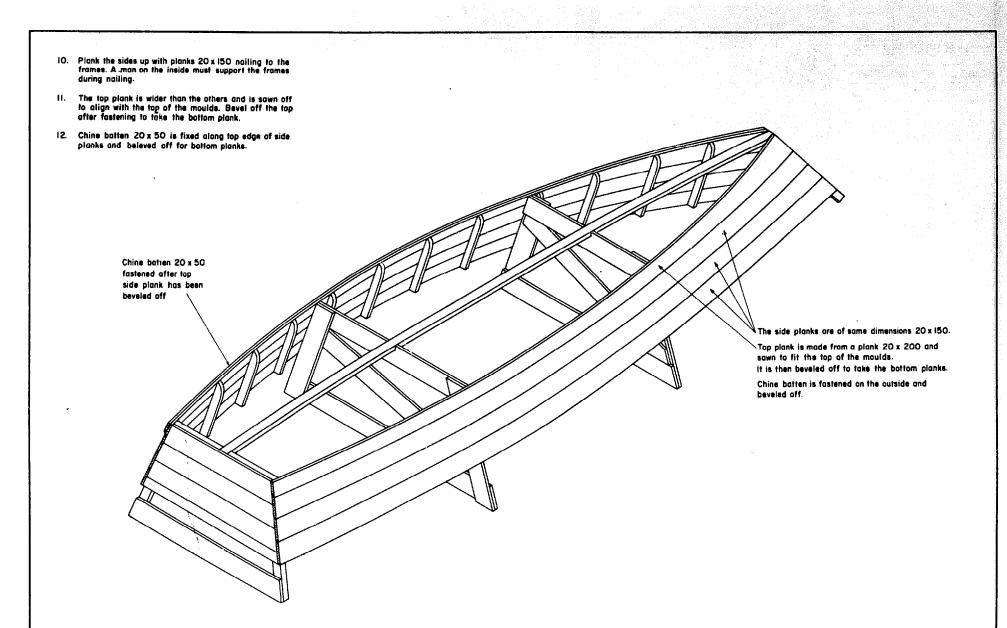




5.40 m Flat bottom boat CONSTRUCTION 2nd STAGE

Designed P. Lade Rome, October 1971

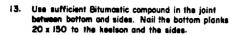
MLW-6-4





5.40 M Flat bottom boat CONSTRUCTION 3rd STAGE

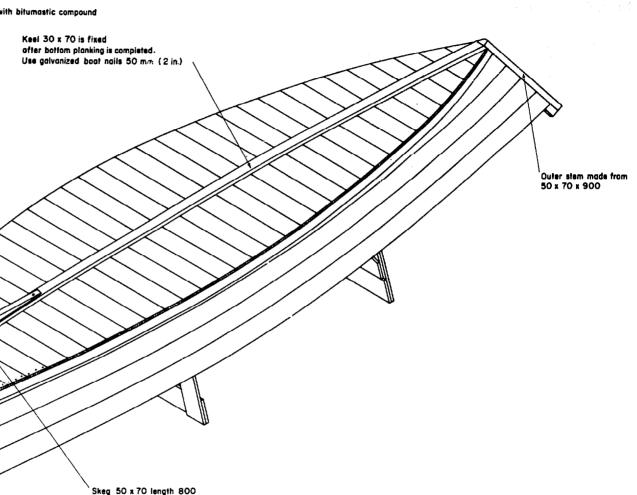
MLW-6-5



- 14. Caulk the sides and the bottom and fill the seams with bitumastic compound
- 15. Fix the outer keel 30 x 70 with nails through the bottom planks into the keelson.

Bottom - planked with boards 20 x 150 starting from aft. Use galvanized boot nails 50 mm (2 in.) \

 Bott the skeg and the outer stem with IO mm galvanized bolts.



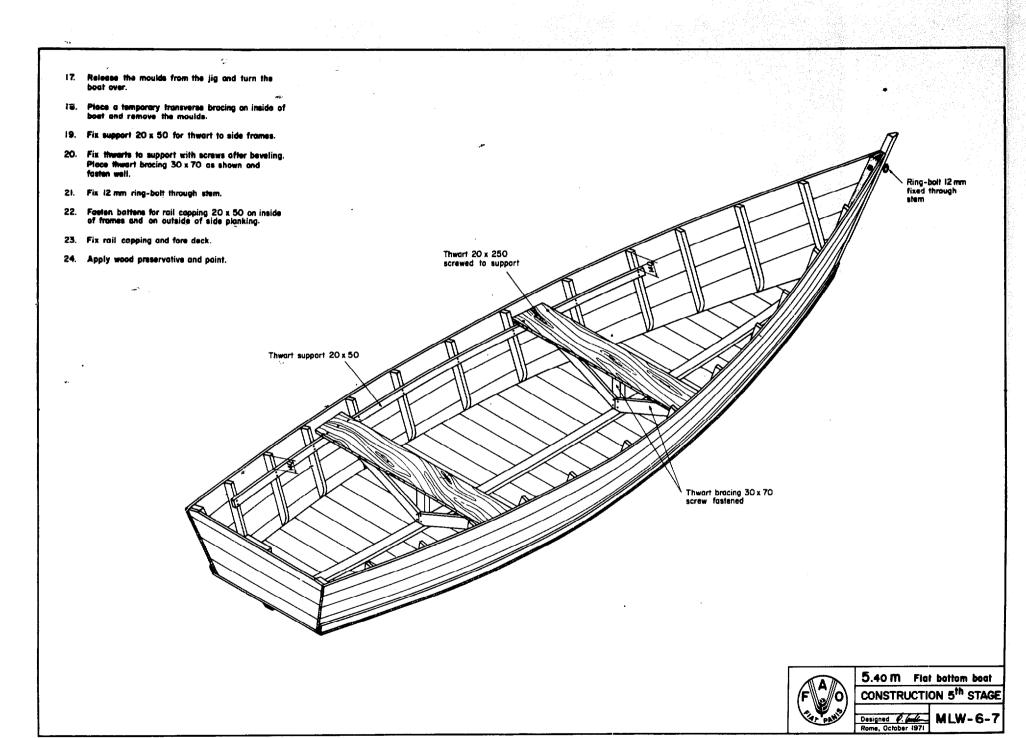
reduced in height forward. Fixed with galvanized bolts IO mm (출 in.)



5.40 m Flat bottom boat CONSTRUCTION 4th STAGE

Pesigned P. Godf-Rome, October 1971

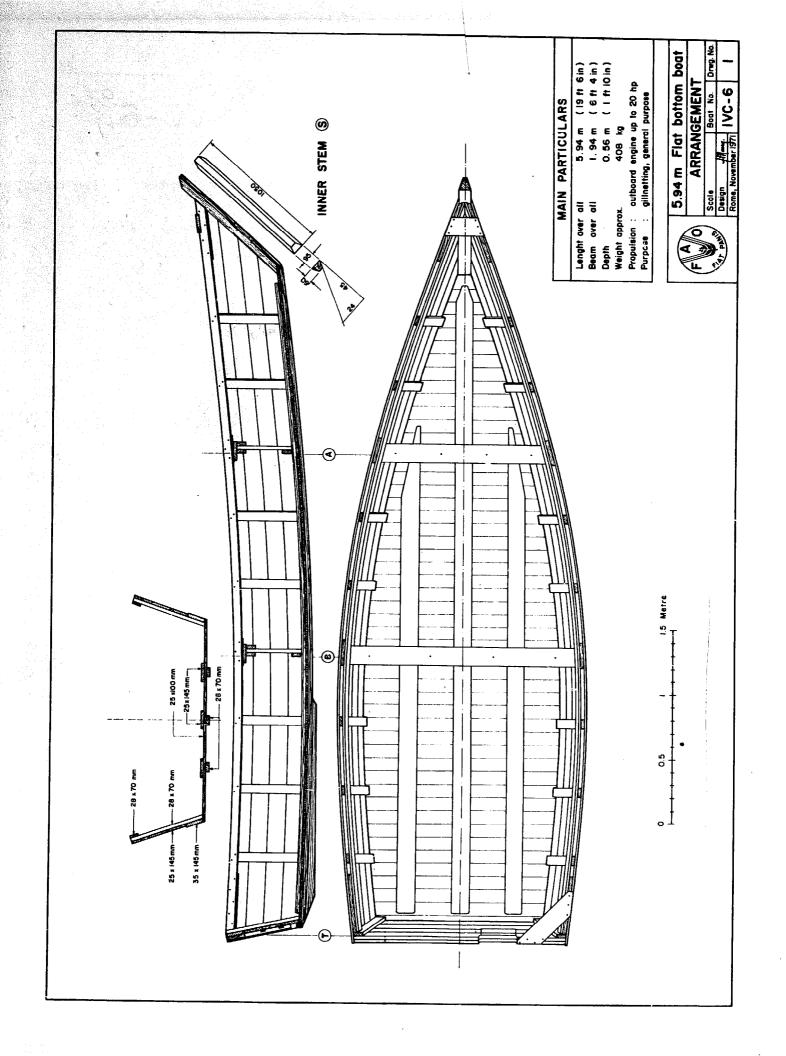
MLW-6-6

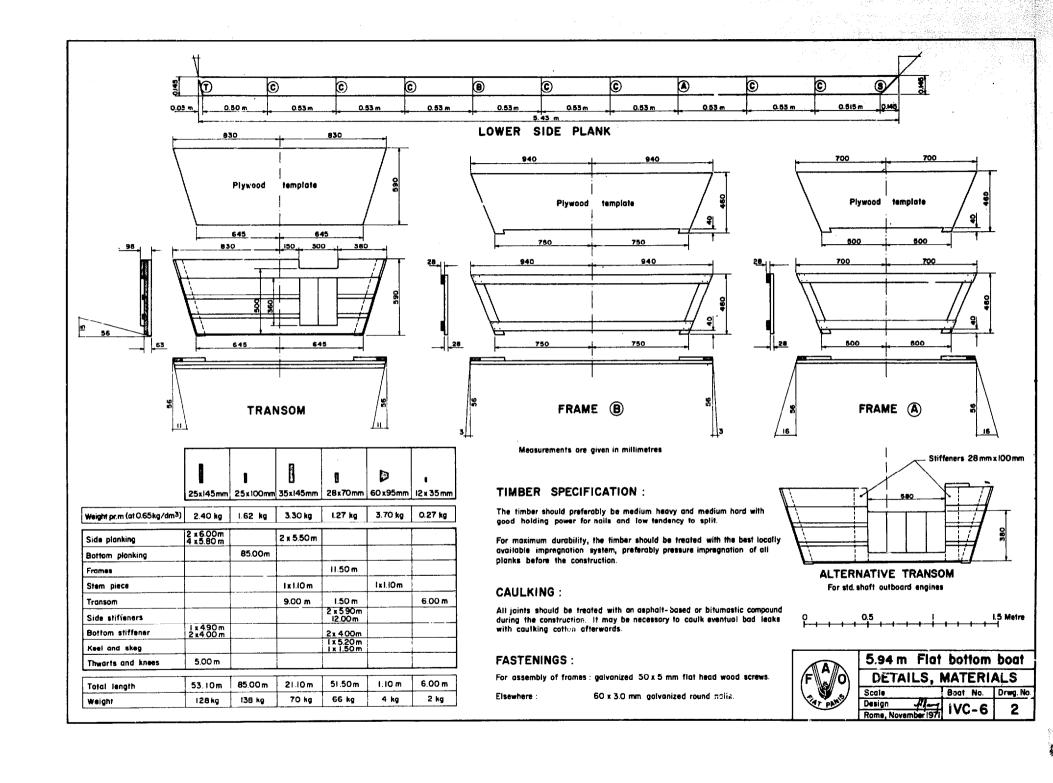


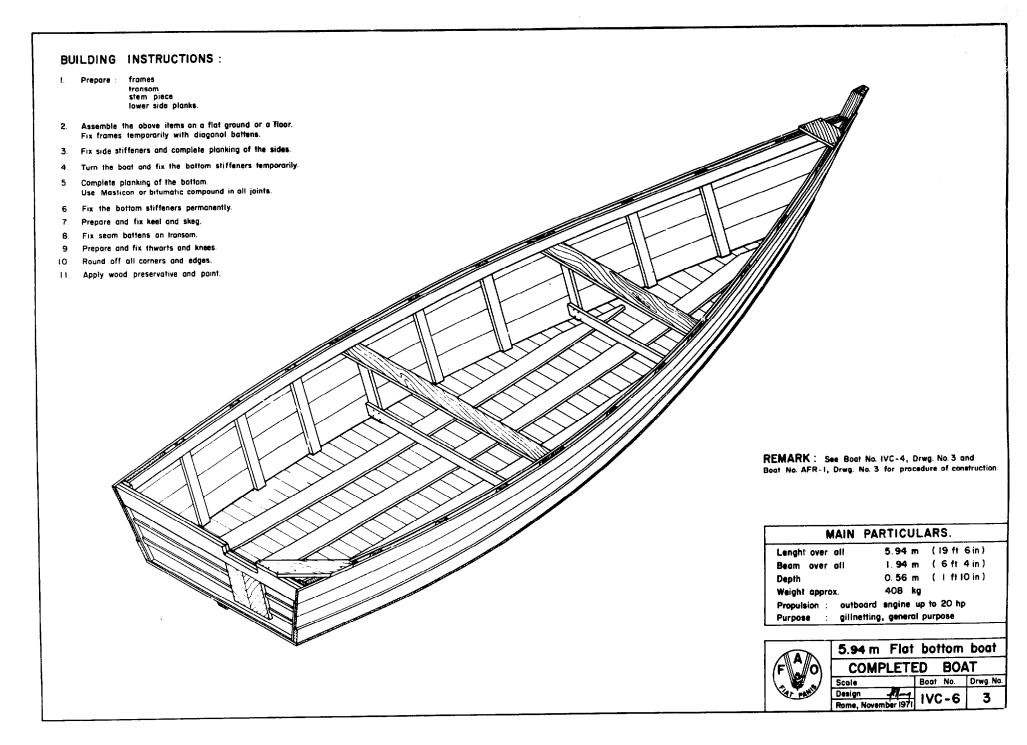
IVC-6

5.94 m

Flat bottom boat



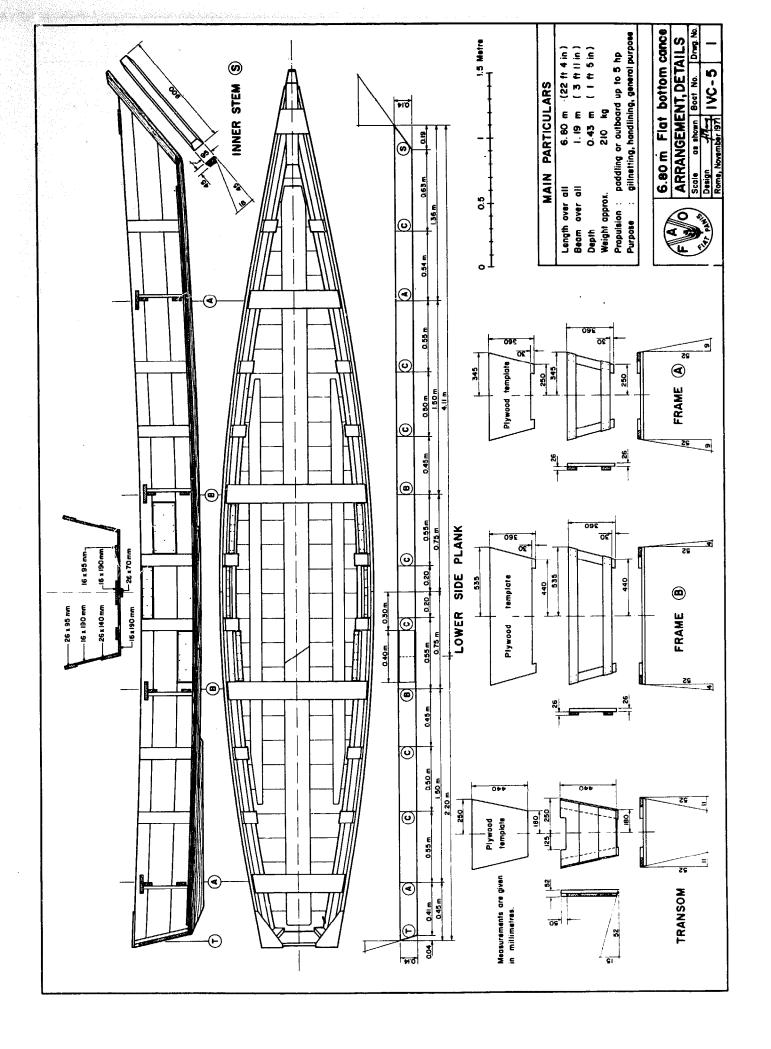




IVC-5

6.80 m

Flat bottom canoe



						D
	16x190 mm	20x95mm	26x145mm	26x95mm	26x70mm	45 x 95 mm
Weight pr.m(at 0.65kg/dm³)	2.00 kg	1.00 kg	2.45 kg	1.60 kg	1.20 kg	2.20 kg
Side planking	15.00 m		14.50 m	15.50 m		
Bottom planking	26.00 m					<u> </u>
Frames					11.00 m	
Stem pieces			0.90 m			0.90 m
Transom			1.60 m		1.00 m	
Side stiffeners		7.00 m				<u> </u>
Bottom stiffener	5.80 m	2 x 3,40 m				
Keel and skeg					7.60 m	
Thwarts and knees	0.70 m		3.70 m			
Total length	47.50 m	13.80 m	20.70 m	15.50 m	9.60 m	0.90 m
Weight	95 kg	I4 kg	51 kg	25 kg	24 kg	2 kg

The timber should preferably be medium heavy and medium hard with good holding power for nails and low tendency to split.

For maximum durability, the timber should be treated with the best locally available impregnation system, preferably pressure impregnation of all planks before the construction.

CAULKING:

All joints should be treated with an asphalt-based or bitumastic compound during the construction. It may be necessary to caulk eventual bad leaks with caulking cotton afterwards.

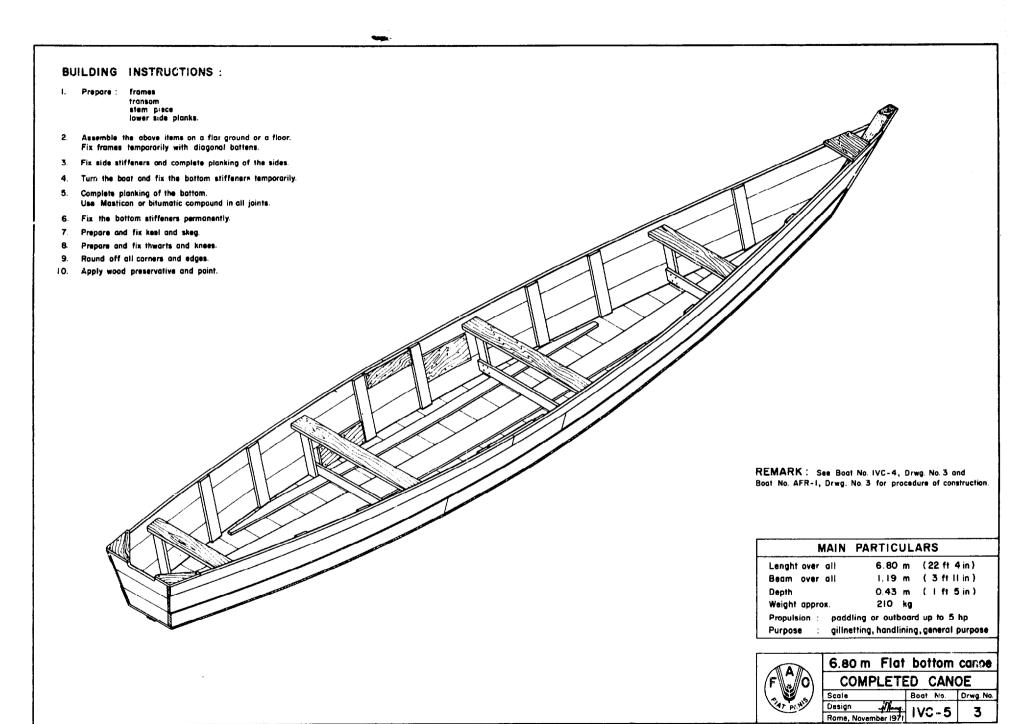
FASTENINGS:

For assembly of frames: galvanized $45 \times 5 \text{ mm}$ flat head wood screws.

For planking of bottom: 50 x 2.7 mm galvanized round nails. Elsewhere: 60 x 2.7 mm galvanized round nails.



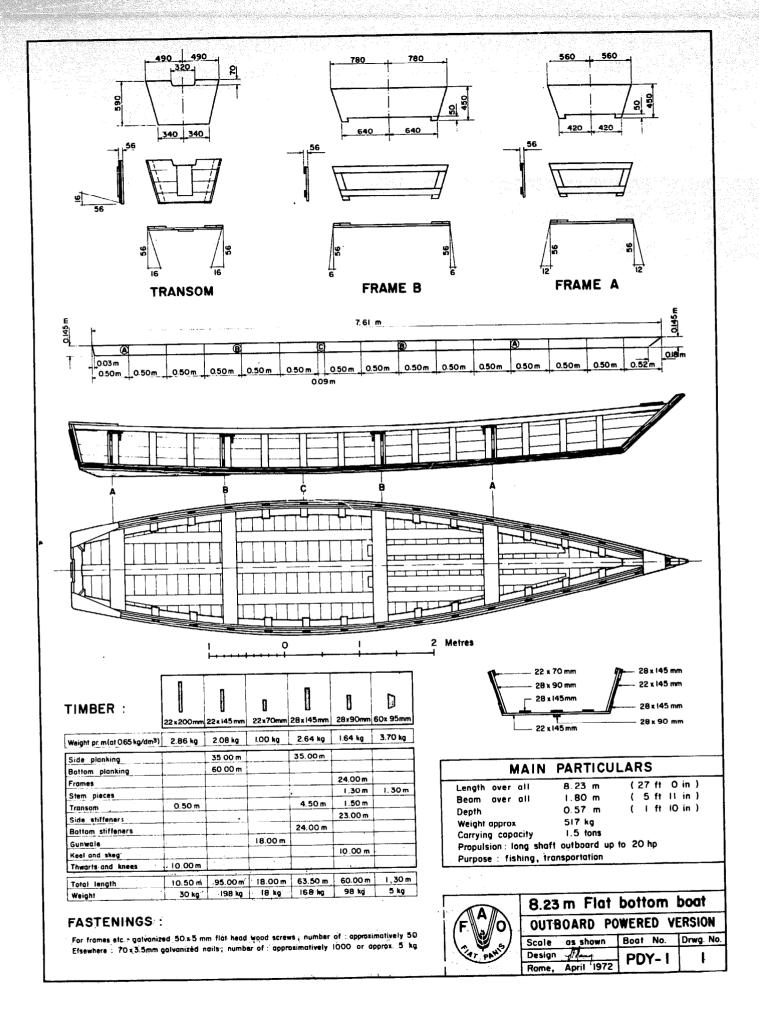
6.80 m Flat	bottom	canoe				
MATER	MATERIALS					
Scale		Drwg. No.				
Design Flore Rome, November 1971	IVC-5	2				
Rome, November 1971	100-5					

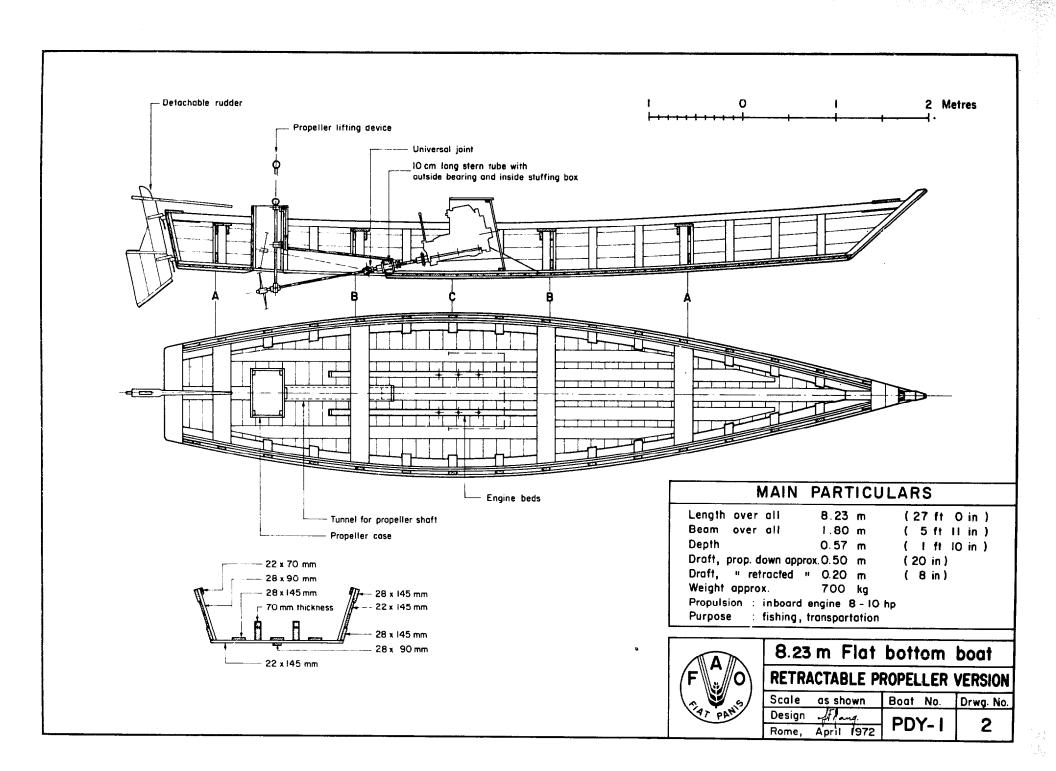


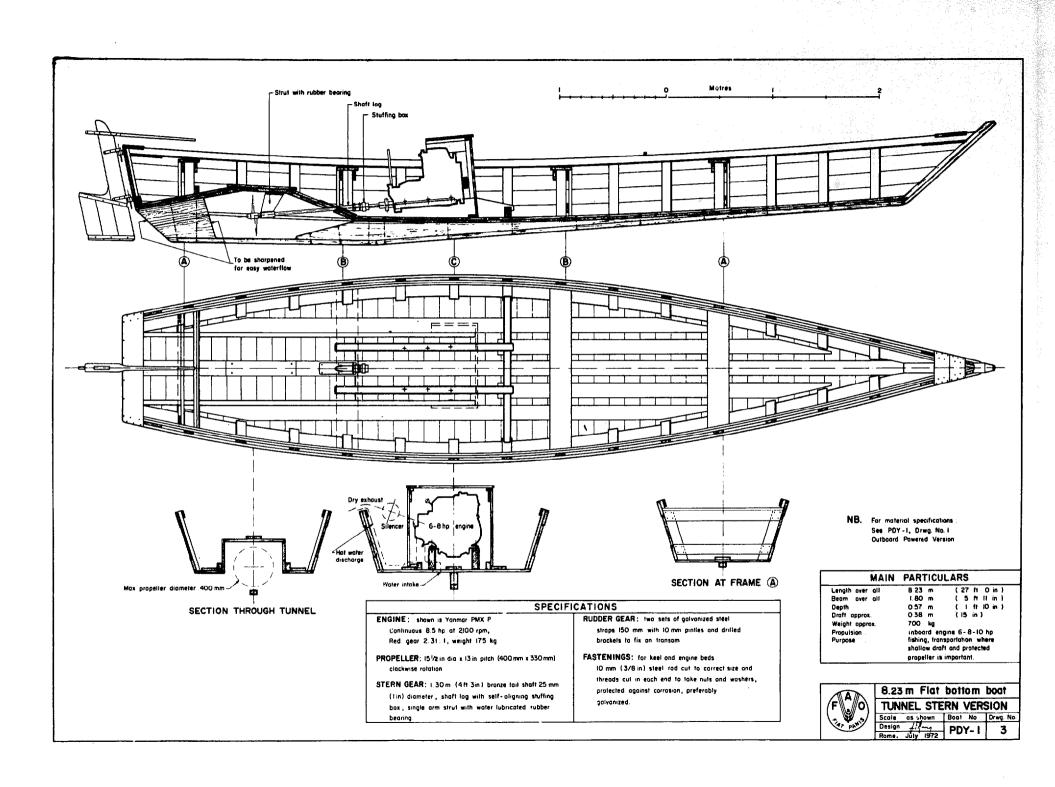
PDY-I

8.23 m

Flat bottom boat



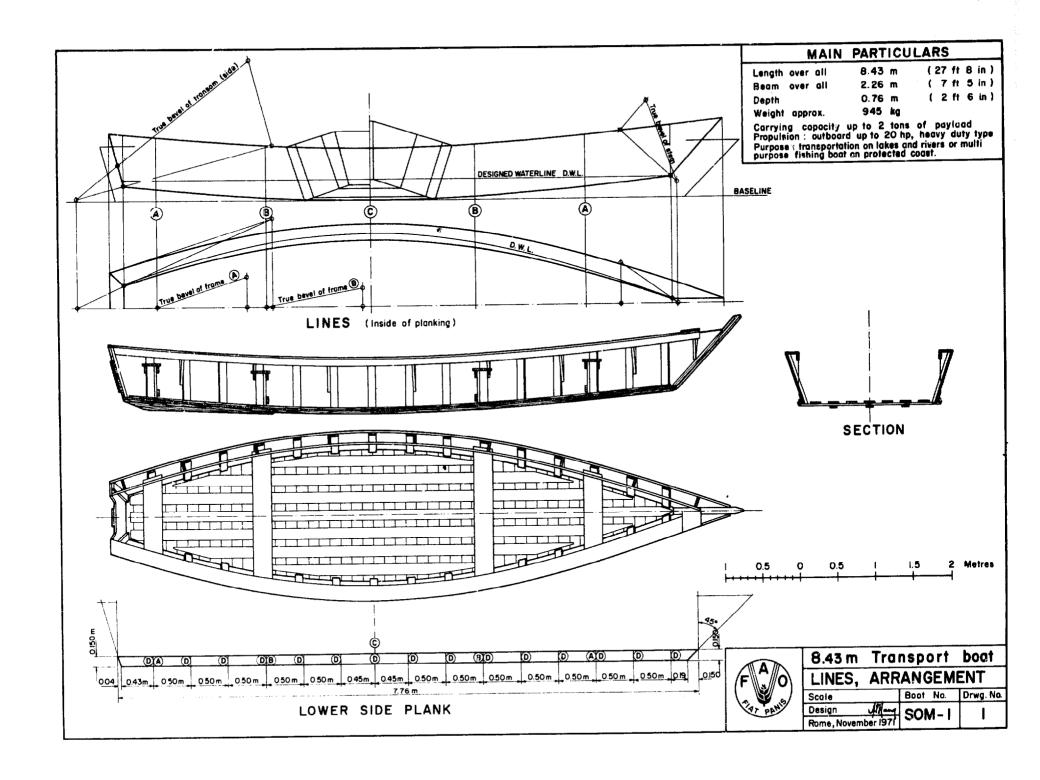


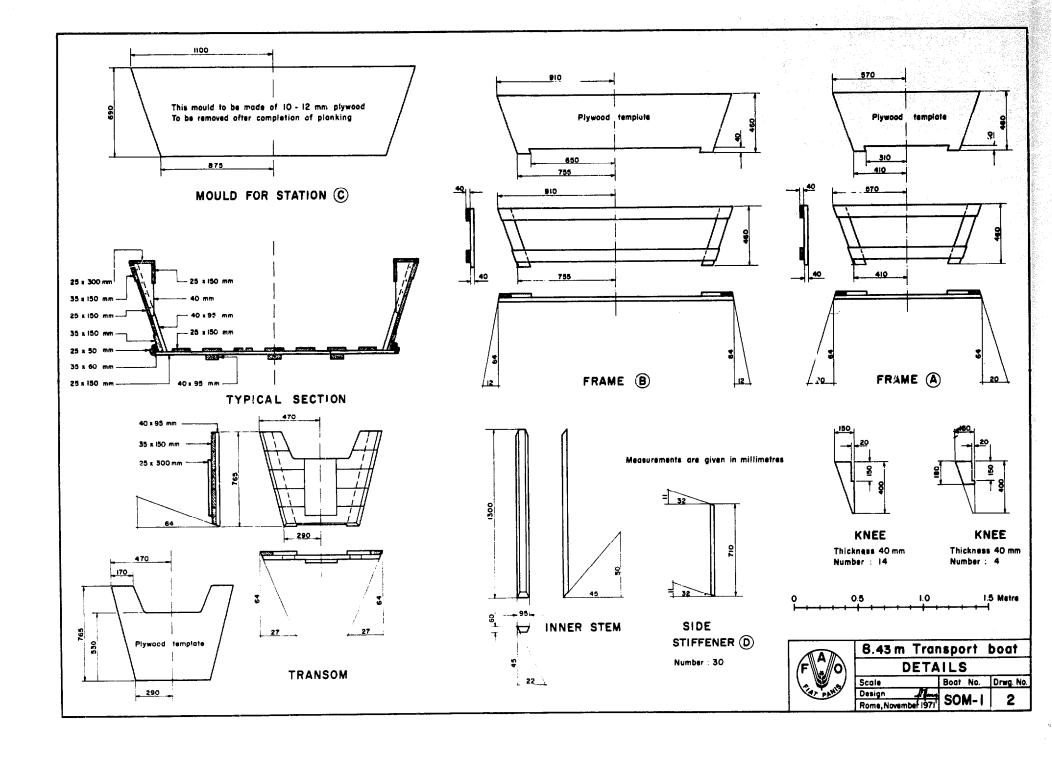


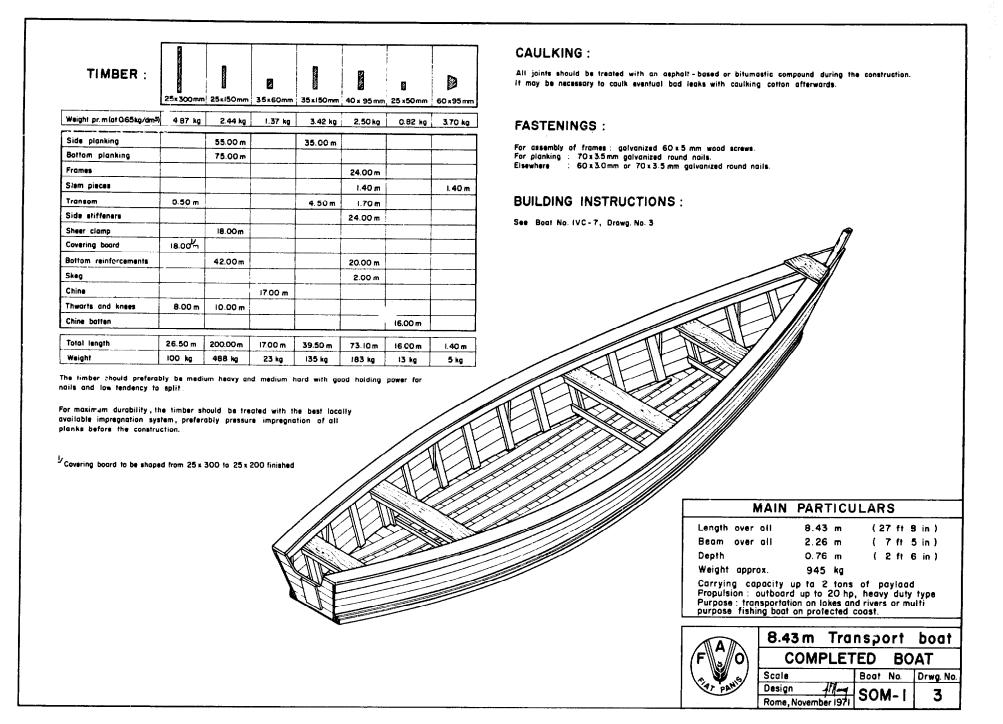
SOM-I

8.43 m

Transport boat



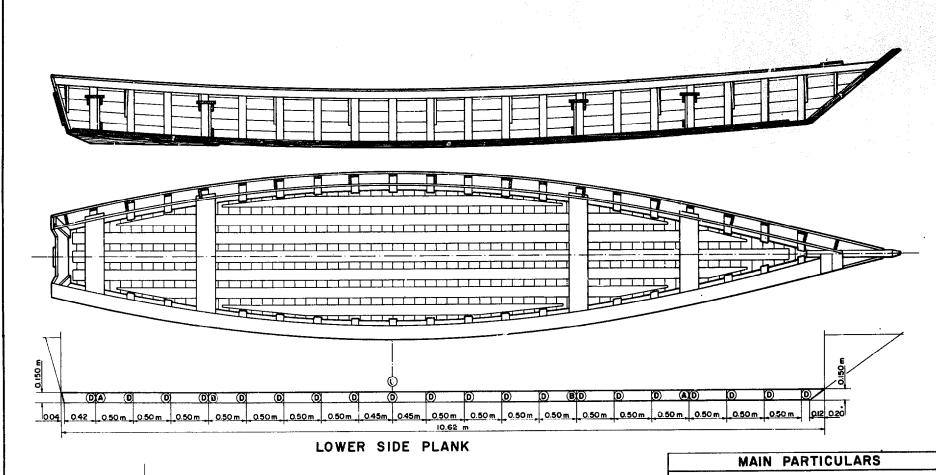


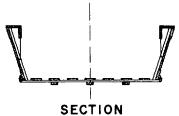


IVC-7

11.25 m

Transport boat





t	0.5	0	0.5	j	1.5	2	Metres
 		+++		-+-			

Lenght	over	all	11.25 m	(36	ft	IO in	
Beam	over	all	2.24 m	(7	ft	4 in	
Depth			0.76 m	t	2	ft	6 in	

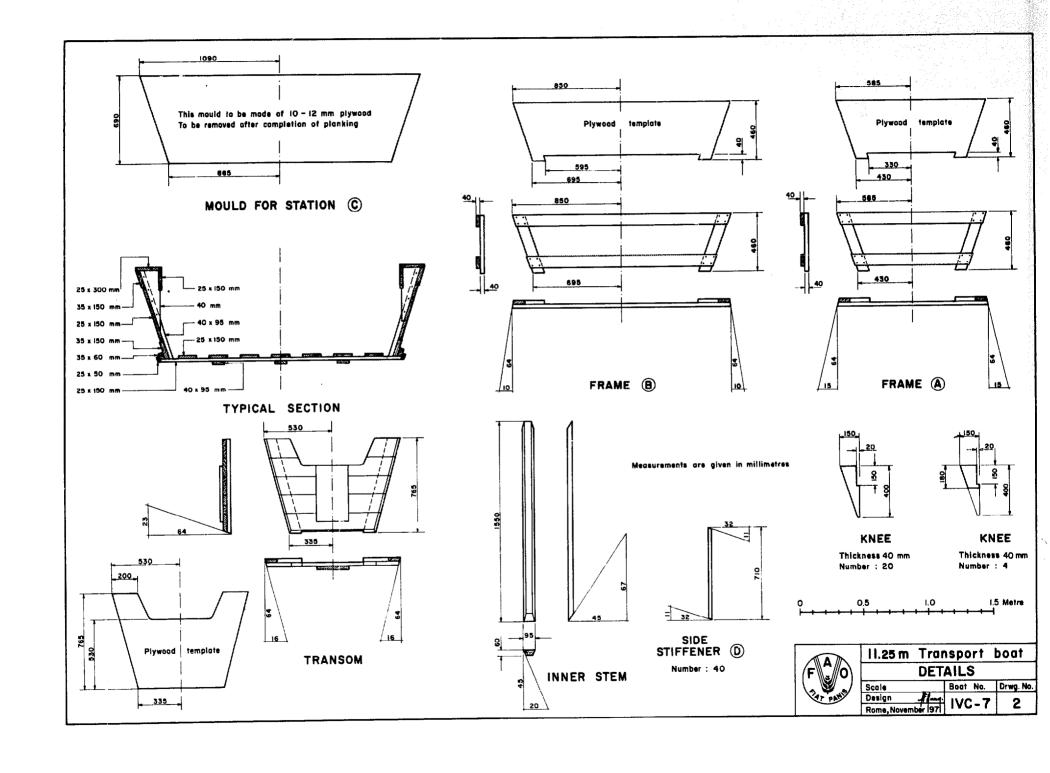
Weight approx. 1220 kg

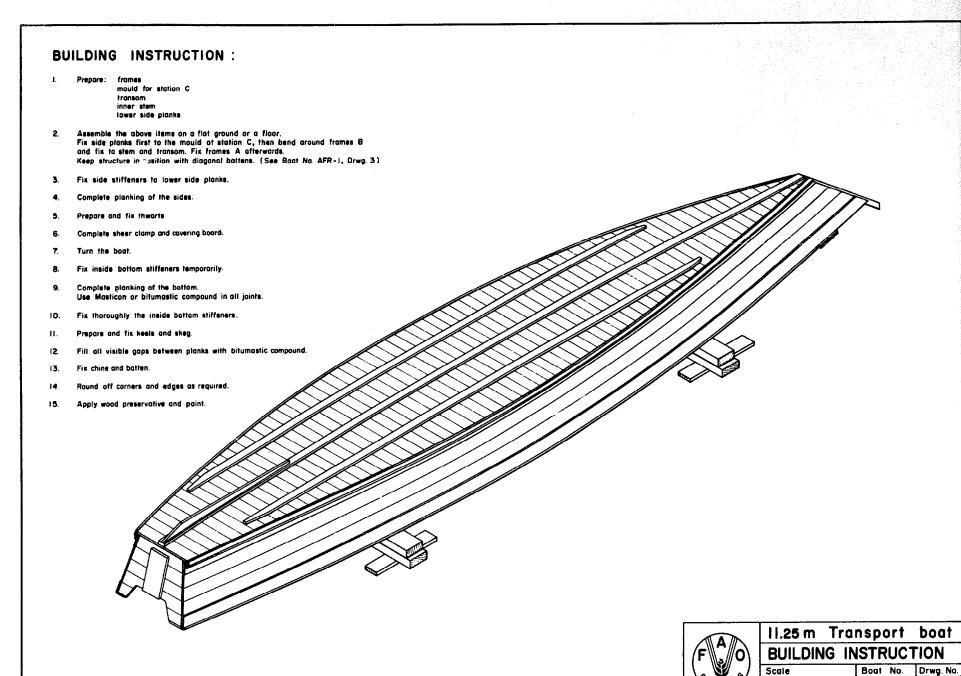
Carrying capacity up to 3 tons of payload Propulsion : outboard up to 20 hp, heavy duty type Purpose : transportation on lakes and rivers



11.25 m	Transport	boat
AF	RANGEMEN	
Scale	Boat No.	Drwg. No

Design Flore, November 1971 IVC - 7





Design

Rome, November 1971

