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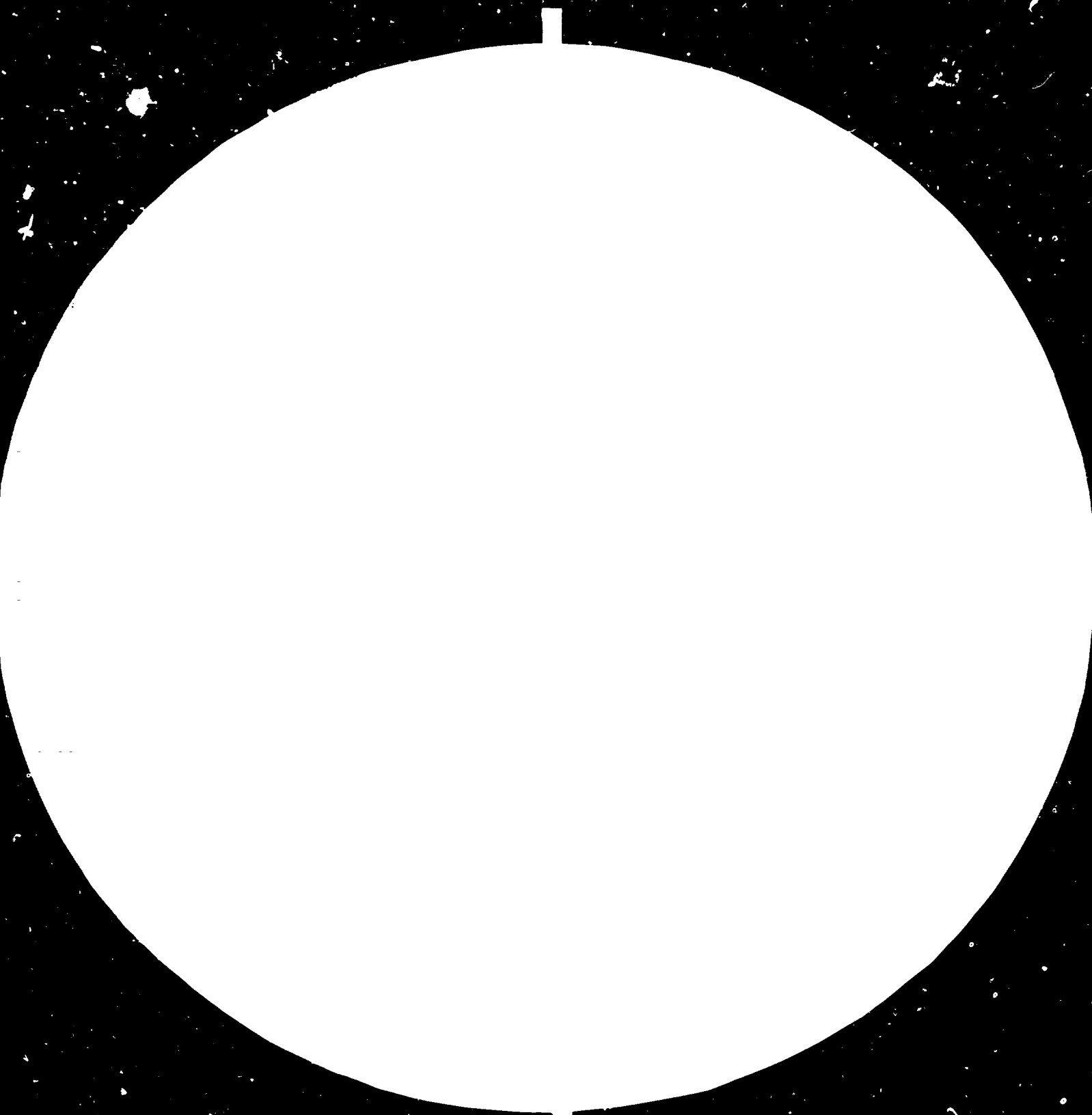
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BOATBUILDING AND REPAIR YARD FOR WOODEN FISHING BOATS*

by

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1.0. GENERAL PROGRAM AND BASIC LAYOUTS

1.1. PURPOSE OF THE BOATYARD:

Building and maintenance of wooden fishing boats.

1.2. OUTPUT OF THE SHIPYARD:

Building of 15 fishing boats 12 m long yearly or equivalent.
Maintenance and repair of the built boats in amount equal to yearly production.

1.3. TYPE AND DIMENSIONS OF BOATS TO BE BUILT AND MAINTAINED

Following two groups of boats are taken into consideration namely: pot fishing boats/handliners and shallow draft handliners/trollers /main:production/. The preliminary dimensions of the boats taken into consideration are as follows:

1.3.1. Pot fishing boat/handliner

Length over all : 6.30 M /20 FT 8 IN/
Beam over all : 2.30 M /7 FT 6 IN/
Length at D.W.L. : 5.80 M /19 FT 0 IN/
Draft to D.W.L. : 0.61 M /2 FT 0 IN/

1.3.2. Shallow draft handliner/troller

Length over all : 11.70 M /38 FT 4 IN/
Beam over all : 3.73 M /12 FT 3 IN/
Length at D.W.L. : 10.50 M /37 FT 5 IN/
Draft to D.W.L. : 0.81 M /2 FT 8 IN/

1.4. LENGTH OF PRODUCTION LINE AND OF THE BOATBUILDING AND REPAIR HALL

It is assumed that the axis distance between the structu-

ral supports of the hall structure in the longitudinal direction, will be 6.0 m. Taking into consideration the in point 1.3 defined dimensions of boats as well as the above axes distance, it is proposed to build a hall of length between axes of outer supports equal to $7 \times 6.0 = 42.0$ m. Thus the total production line for a support width of about 0.3 m and the outside wall thickness of 0.15 m may have a total length of 42.0 m. Assuming that the space between ships under repair or construction should be at least 2.0 m in the longitudinal direction, and that the space between the ship and the face of the hall structure should be 1.2 m, the following number of boats may be simultaneously built or repaired:

Pot fishing boats	5	3	1	-
Shallow draft handliners/trollers	-	1	2	3
Total number of boats	5	4	3	3
Total length of production line, m	41.9	39.0	36.1	41.5

1.5. PROPOSED NUMBER OF EMPLOYEES

It is assumed that the number of employees may vary depending on the actual contracts. However, the basic group of persons which should be employed may be estimated as follows:

Position	Number	Necessary working space, m ²	Separate room necessary
General Manager	1	12	+
Deputy Manager /Production engineer, boat designer/	1	6	+
Draftsman for deputy manager	1	6	
Administration clerk	1	6	
Financial clerk	1	6	+
Secretary/typist	1	6	
Carpenter /boatbuilder/ - master	1	20	
Carpenters /boatbuilders/	10	200	+
Painters - caulkers	2	30	
Sailmakers	2	30	
Mechanic - master	1	20	
Mechanics - fitters	4	80	
Electrician	1	20	+
Welders - caulkers - splicers	2	20	
Painter	1	20	
Tool and equipment storekeeper	1	-	in the store
Driver	1	-	not necessary
Total	32		

1.6. DIMENSIONS OF THE BUILDING AND REPAIR SHOPS

1.6.1. Carpenter shop

Length: 42.0 m

Width:

a/ Distance between the production line and between the hall structure face: 0.5 beam of the boat + 1.2 m =
= $0.5 \times 3.73 + 1.2 \text{ m} = 3.1 \text{ m}$

b/ Total width of the boatbuilding or repair area =
= 6.2 m

c/ Total width of the carpenter working area 280 m²
/necessary area/: 42.0 /length/ = 6.7 m

Distance between structural columns /preliminary height of a hall support cross-section = 0.6 m/ = 6.2 + 6.7 +
+ 2 x 0.3 = 13.5 m

Total carpenter shop area = /6.2 + 6.7/ x 42.0 = 542 m².

1.6.2. Mechanical Shop

Total necessary area: 185 m²

Distance between the axis of the structural supports /proposed/ = 9.0 m. Total width of the mechanical shop = distance between the axes of the structural supports + the width of the structural support - width of the outside and inside walls = 9.0 + 0.1 - 0.3 = 8.8 m.

Total length = 185.0 : 8.8 = 21.0 m /three and half fields of 6 m/.

1.6.3. Store for tools and equipment

An area of about 10% of the total production area of the hall /542 + 185 = 727 m²/ is assumed i.e. about 73 m²

Total length = 73.0 : 8.8 = 8.3 m (one and half fields of 6 m/.

1.7. DIMENSIONS OF THE OFFICE AND REST ROOMS

1.7.1. Offices

Total necessary area: 42 m²

Communication area: 10 m² / ~ 10% /

Total area required: 52 m² / one field of 6 m /

1.7.2. Rest rooms

Total number of employees = 32

Necessary rest rooms area: 32 x 1.25 = 40 m²

Breakfast room: 12 m²

Total area required: 52 m² / one field of 6 m /.

The proposed layout of the office and rest rooms is presented on Fig.1.

2.0. RECOMMENDED AND MINIMUM AREA OF THE BOATYARD

2.1. Boatbuilding and repair hall area = 1000 m²

2.2. Wood seasoning and storage area = 800 m² / 1400 m² /

2.3. Launching and boat outfitting repair area = 500 m²

2.4. Roads, parkings and inside communication area = 400 m²

2.5. Outfitting storage area = / 600 m² /

Total = 2700 m² /minimum/
= 4000 m² /maximum/

3.0. UTILITIES

3.1. Electric energy - delivered directly from own or outside power plant /240 and 380V/

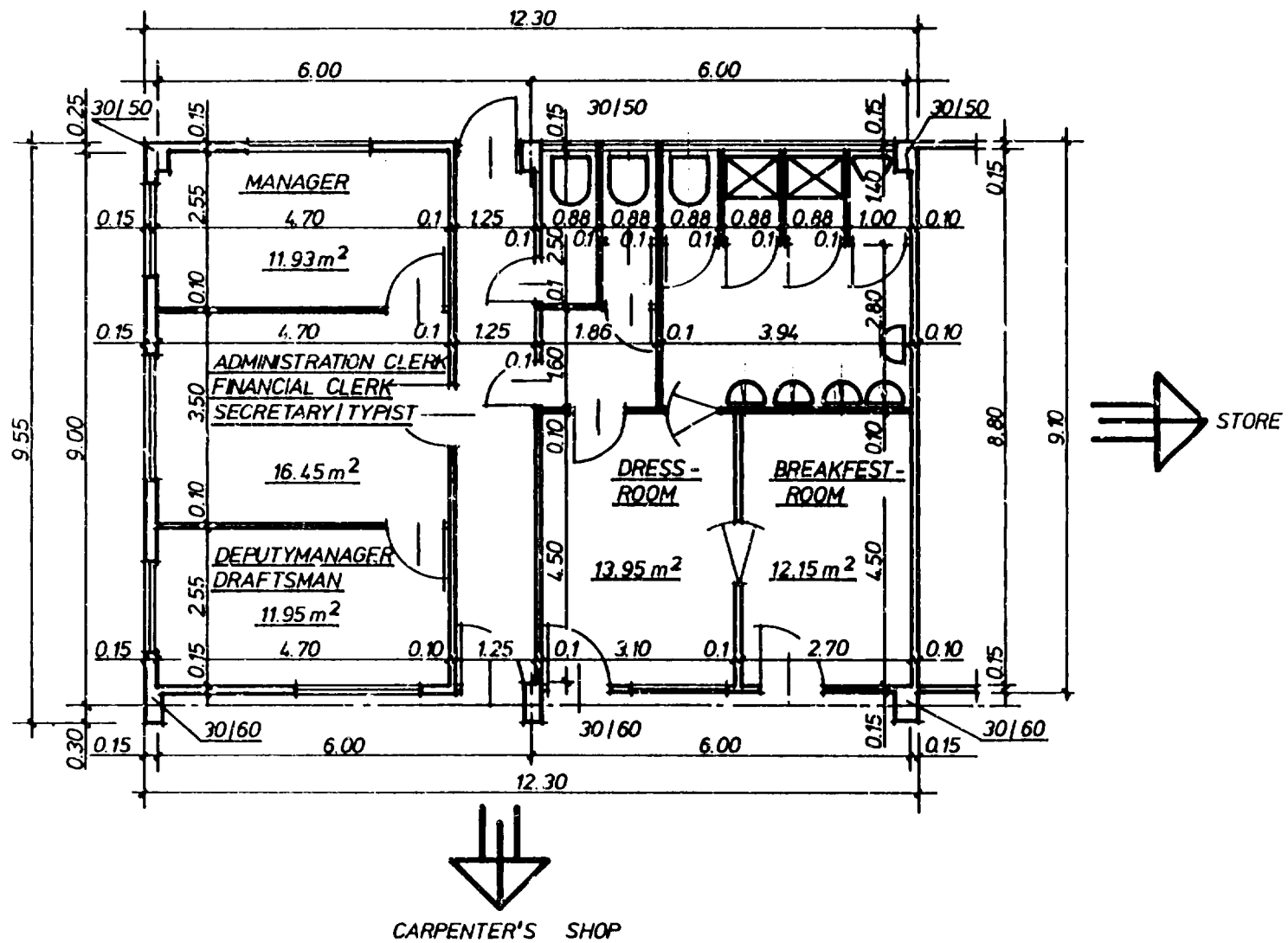


Fig.1. Proposed lay-out of the office and rest rooms

- 3.2. Compressed air - own air compressor.
- 3.3. Oxygen, Acethylene, Propane-delivered in gas cylinders.
- 3.4. Fresh water - delivered directly from own or outside water-pipe network to boatyard water tank of a daily use capacity. Inner distribution from water tank by own separate water - pipe network.
- 3.5. Sewage system-own septic tank or connection to outside sewage system.
- 3.6. Fuel oil-delivered from filling station.

4.0. OUTLINE OF BOATBUILDING PROCESS /GENERAL EQUIPMENT INDICATIONS/

Operation	Process	Handling
4.1. Wood delivery	by lorries or boats	forklift truck or manually
4.2. Wood drying	by seasoning	fork-lift truck or manually
4.3. Wood impregnation	by hot bath	fork-li't truck or manually
4.4. Keel, stem and sternport treatment	by choosing of naturally shaped trunk or gluing in a manually operated press of planks prepared by using among other circular and bard saws and moulding machine; finish by the use of carpenter manual and electric tools;	fork-lift truck and mobile crane or hoisting tackles

4.5. Planks treatment	by the use of thickening and planing machines and circular or band saws;	manually
4.6. Frames /ribs/ treatment	by choosing of naturally shaped trunk or nailed or glued from planks; using of circular and band saw, as well as carpenter manual and electric tools	manually
4.7. Planks bending	by putting the planks into steam tank and bending manually using clamps while assembling; fitting with bolts;	manually
4.8. Assembly	by laying the keel and joining it with stem and sternport by use of bolts; fitting of the frame /rib/ templates; assembling of the shell planks /hot/, bulkheads /if any/, longitudinals and deck planks /hot/; fitting the frames /ribs/ and beams with bolts; dismantling of frame /rib/ templates. If several layers of shells are foreseen a mastic coated cloth between shell layers shall be laid, riveting of shell planks using copper rivets and bolts; using of carpenter manual and electric tools.	fork-lift truck, mobile crane and hoisting tackles

4.9. Outfitting	by placing, fastening and aligning of the propeller, propeller shaft, engine and all foreseen mechanical and electrical equipment, pipelines, cables etc. using of mechanical and electrical tools	fork-lift truck, hoisting tackles and manually
4.10. Caulking and painting	by using manual tools	manually
4.11. Launching	by placing the boat on launching cradle and launching using steel rope	manually and winch
4.12. Sail's sewing	by using sewing machine and manual tools	manually

4.0. OUTLINE OF BOAT MAINTENANCE /REPAIR/ PROCESS:
/GENERAL INDICATIONS/

It is generally assumed that the maintenance /repair/ process may contain all works introduced in boatbuilding. Additionally works are concerned with dismantling of equipment and engine as well as shawing and cleaning of the whole hull before painting. All necessary replacements of planks etc /hull repair/ are made by carpenters using carpenter manual or electric tools. The treatment of planks is the same as in boatbuilding.

The inspection and maintenance service as well as repair /if necessary/ of the mechanical equipment as well as the engine, pipelines and tanks is made either in the mechanical and electrical shop or on the boat in the case when the

elements considered are not dismantled. These inspections, maintenance services and repairs may be carried out with the boat out of water /dry/ or alongside a berth /wet/. It is generally assumed that the accepted way of boat handling /dry or wet/ will depend on the scope of construction works being made /only slipway, slipway plus outfitting quay, etc/.

In addition to the main categories of maintenance service and repair it may be a need for specialised repair of navigation equipment and cooling installations /if any/. In such a case it has to be decided if the maintenance service or repair has to be done by the shipyard employees or ordered at a specialised repair company.

Generally it is assumed that in the boatyard the repair work will be done on boats built only by boatyard in consideration. This means that the planning of short term maintenance services and repairs as well as long term repairs have to be agreed in advance with the boat owners and the boat management. As short term maintenance services and repairs may be defined these which contain hull shawing and cleaning, engine and propeller maintenance, painting and general refurbishments. Long term repairs contain hull repairs, engine and propeller renovation as well as general refurbishment. It is here assumed that a short term maintenance service and repair may require docking but not more than one week while the long term repairs will be made in dry and of three weeks. Thus the planning of maintenance services and repairs in addition to the boat building activities is an essential element in the organisation of the

boatyard work as well as in its productivity and economical results.

5.0. BOATYARD BASIC EQUIPMENT

5.1. HULL BUILDING AND HULL REPAIR WORKSHOP

1. Cross - cutting saw - 1 pc
2. Circular saw with tilting blade
/cutting depth 115 mm/ - 1 pc
3. Band saw /wheel dia 600 mm and 800 mm/ - 2 pcs
4. Thicknessing machine /up to 250 x 630 mm/- 1 pc
5. Planing machine /up to 400 x 20 mm/ - 1 pc
6. Down spindle wood moulding machine /max
cutter dia 100 mm, table 900 x 1100 mm/ - 1 pc
7. Carpenter bench /2.0 x 0,7 m/ - 6 pcs
8. Boiler - 1 pc
9. Steam tank /6.0 m x Ø 1.0 m - 50 kPa/ - 1 pc
10. Mould loft fluor - 1 pc
11. Hand-operated polishing machines - 4 pcs
12. Tools for hull caulking - 1 set
13. Tools for painting - 2 sets
14. Portable electrical drills - 6 pcs
15. Portable circular saws - 5 pcs
16. Portable chain saw - 1 pc
17. Portable electrical bench plane - 2 pcs
18. Carpenter's tools and workshop
accessories - 6 sets
19. Hand-mechanical jack/5 metric ton
capacity - 4 pcs
20. Monorail hand-operated hoisting tackle
/1 metric ton capacity/ - 3 pcs
21. Hand-operated hoisting tackle/05
metric ton capacity/ - 3 pcs

Under the position of tools e.g. for carpenters etc one has to understand all tools necessary for the carpenter's work e.g. steel angle, carpenter marker, level, carpenter axe, hand saw, knife saw, planes/scrub, jack, smoothing, shooting, arcular etc/, chisels, hammers, clamps, scrapers, rasps, files, tongs etc. The final specification of these tools and workshop accessories should be made by the production engineer.

5.2. OUTFITTING AND REPAIR WORKSHOP

1. Guillotine shears /up to 2000 x 3 mm/	- 1 set
2. Boring - milling machine	- 1 pc
3. Universal lathe /1-1500 mm, Ø 560 mm/	- 1 pc
4. Universal milling machine	- 1 pc
5. Universal sharpener	- 1 pc
6. Sharpening machine	- 1 pc
7. Hand-hydraulic pipe bender	- 1 pc
8. Hack saw /up to 500 mm dia/	- 2 pcs
9. Electrical and gas welding equipment /250 A transformer welding, gas welding set, welding torch set, acetylene generator/	- 1 set
10. Oxy-acetylene cutting equipment	- 1 set
11. Racks /2.0 x 0.5/	- 5 pcs
12. Fitter's table /2.0 x 0.7 m/	- 2 pcs
13. Electrician's table /2.0 x 0.7 m/	- 1 pc
14. Tools and workshop accessories for me- chanics	- 2 sets
15. Tools and workshop accessories for electricians	- 2 sets
16. Hydraulic jack /2 metric ton capacity/	- 1 pc
17. Hand-operated hoisting tackle /1 metric ton capacity/	- 2 pcs

The remark given in point 5.1 is also valid here. In addition it may be considered to use pneumatic tools.

5.3. STORE

- | | |
|--|----------|
| 1. Self-supporting shelves /width 1.0 m/ | - 24.0 m |
| 2. Blocks /pulley blocks/ | - 2 pcs |
| 3. Hand-industrial truck | - 1 pc |
| 4. Mobile crane /8 metric ton capacity/ | - 1 pc |
| 5. Fork lift truck /2 metric ton capacity/ | - 1 pc |
| 6. Sail's sewing machine | - 2 sets |

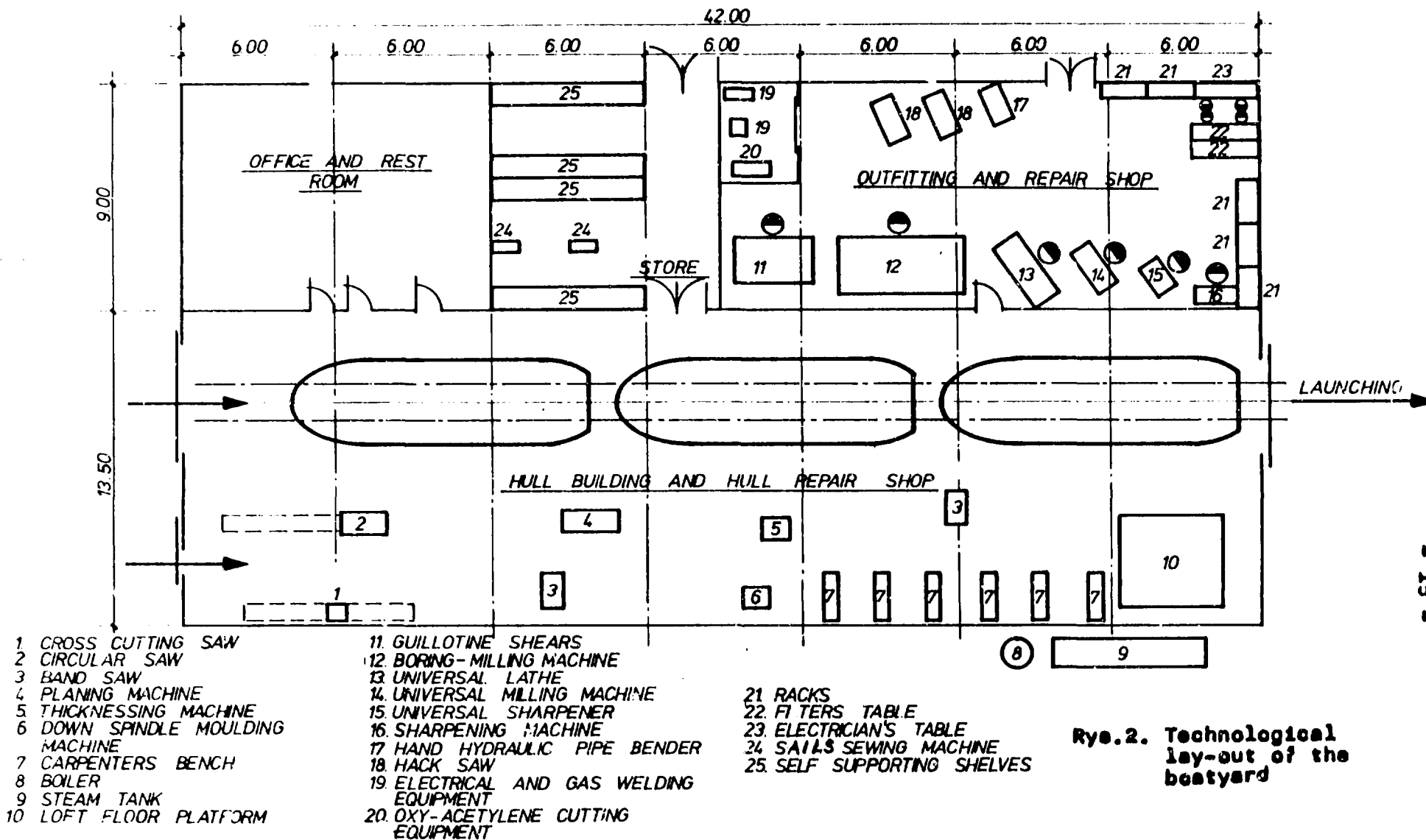
5.4. EQUIPMENT LAYOUT

The proposal of the layout of the equipment in different workshops is presented on Fig.2.

5.5. LAUNCHING-DOCKING EQUIPMENT

- | | |
|--|-----------|
| 1. Launching-docking winch /1.5 metric ton capacity/ | - 1 pc |
| 2. Launching-docking rope | - 100,0 m |
| 3. Launching-docking cradle four wheels /10.0 metric ton capacity/ | - 1 pc |

Taking into consideration the fact that the Launching weight of wooden boats of the length of 12 m is about 8 to 10 metric tons, a Longitudinal slipway with cradles of tyred wheels /Fig.3/ is recommended. The construction of the slipway /Fig.4/ would consist of reinforced concrete slab of the inclination of about 1:10, laid on a layer of crushed rock. It is recommended to reach with the slab end at least the lowest low water level. The fitting of the



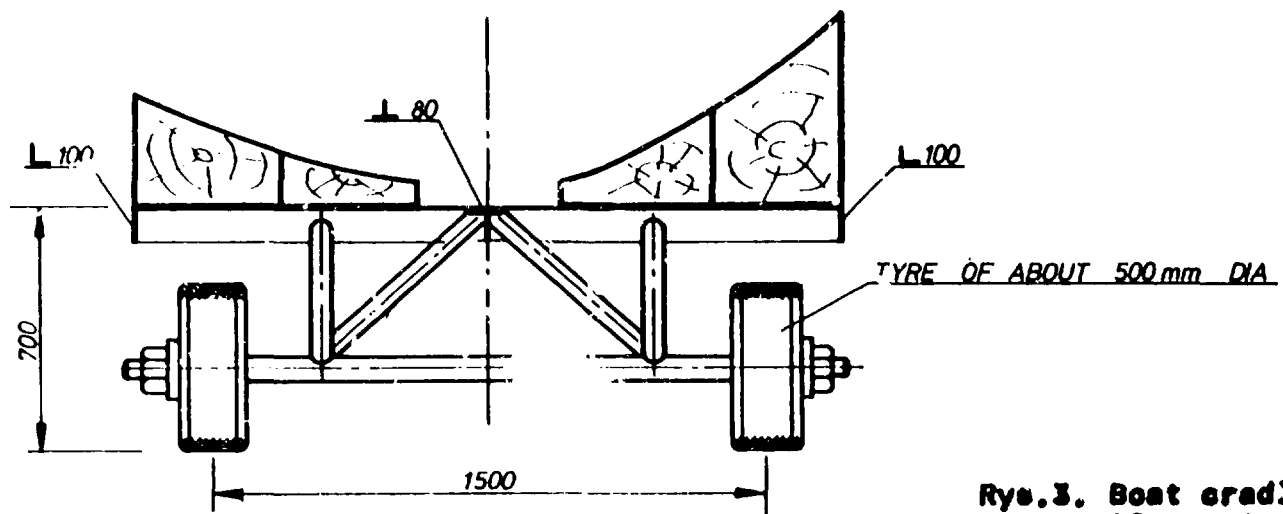
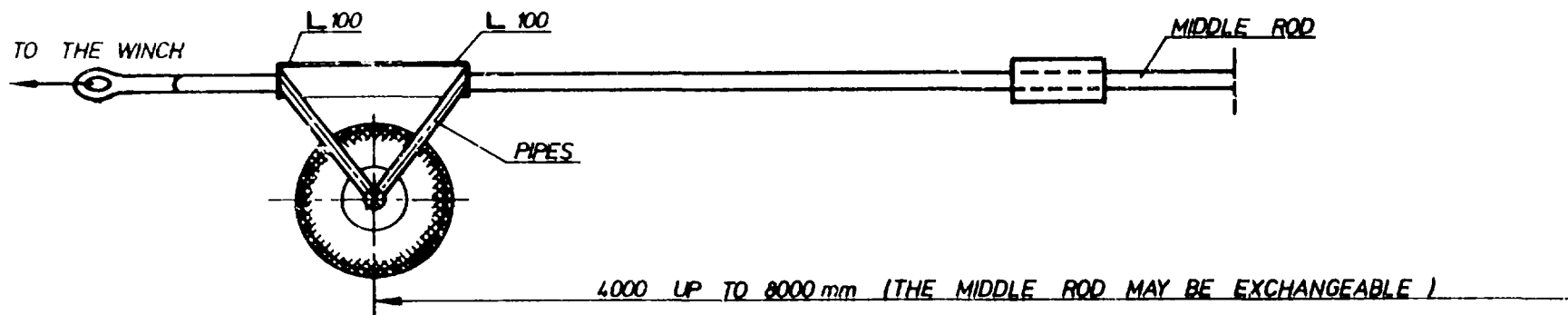


Fig.3. Boat cradle on tyred wheels of 10 metric tone capacity

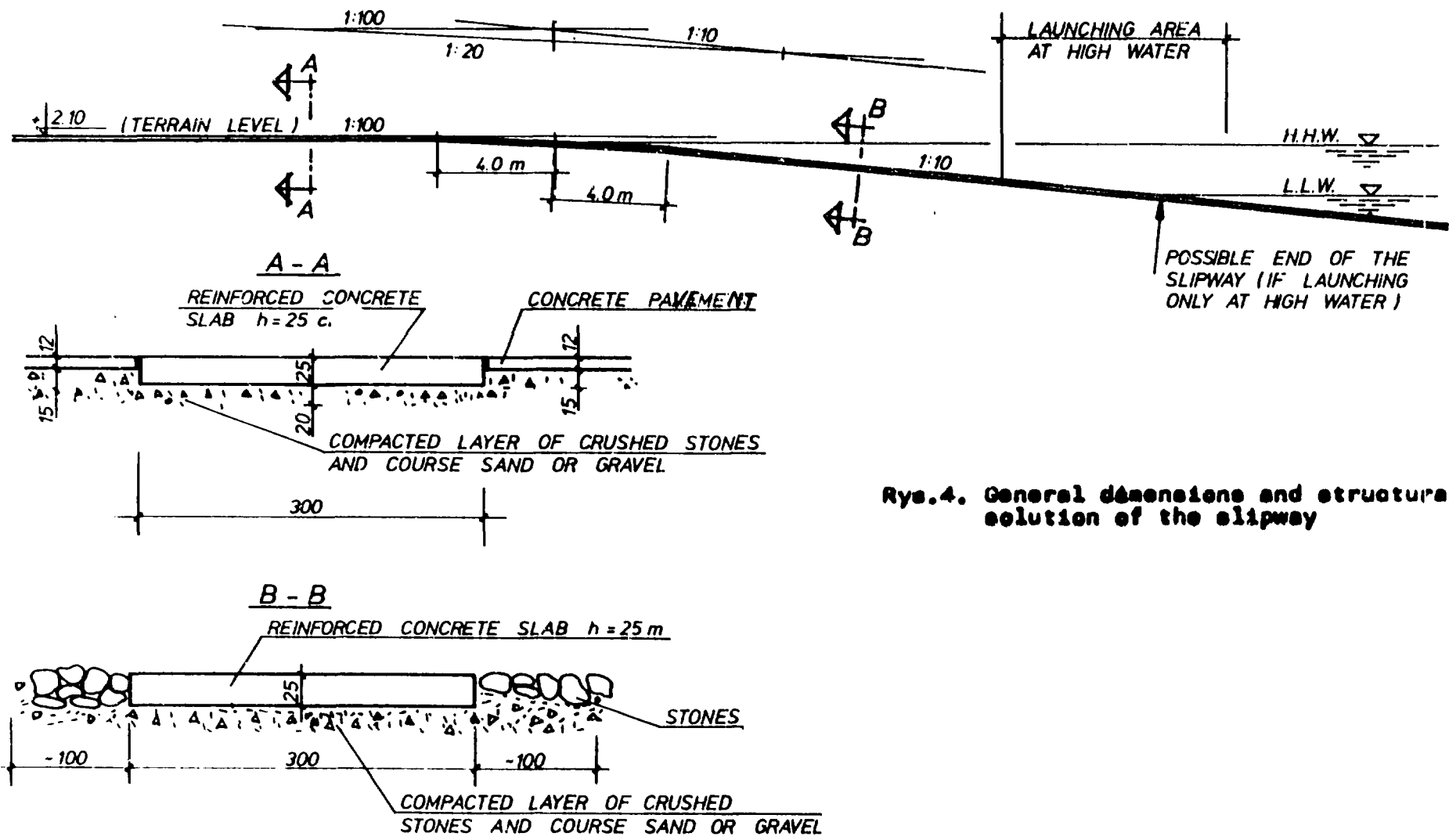


Fig.4. General dimensions and structural solution of the slipway

wheeled cradles is made just before launchnig, it is when the number of permanent supports may be considerably reduced.

6.0. THE PROPOSAL OF THE STRUCTURAL SOLUTION OF THE
BOATBUILDING DING AND REPAIR HALL

The boatbuilding and repair hall /Fig.Fig. 5,6,7, and 8/ consists of three rows of supports made as reinforced concrete or timber columns of dimensions estimated in the structural calculations. The preliminary concrete column dimensions are assumed to be 30 x 60 cm for the greater span /13.5 m/ and 30 x 50 cm for the smaller span /9.0 m/ /reference dimensions/. The columns are fixed in reinforced concrete footings calculated for the allowable stresses in the soil. A layer of 10 cm lean concrete under the footings is recommended.

The outer walls of the thickness of 15 cm /reference dimension/ and the inner of the thickness of 10 cm /reference dimension/ are made from concrete blocks. The walls are from both sides plastered.

The floor outside the 3.0 m wide strip for launching cradles /see Fig. 4/ is made as reinforced concrete pavement of the thickness of 12 cm. Expansion joints filled with bitumen should be foreseen at distances no larger than 6.0 m. The concrete pavement should be laid on a compacted layer of crushed stones and coarse sand or gravel of the total thickness of about 15 cm,

The carrying structure of both roofs is made either from timber or steel pipe trusses to which wooden purlins are

fastened. The roofing consists of corrugated galvanised steel sheets bolted to purlins.

The windows are of the normal type whilst in the ventilation openings in the roofs and in the walls timber louvres are installed. Also transparent corrugated sheets placed as parts of the roofing may be used for lighting purpose, particularly in the carpenters workshop.

On the roofing trusses the possibility of fastening of monorail hand-operated and hand-operated hoisting tackles is provided. Such a possibility should be, however, proved by structural calculations.

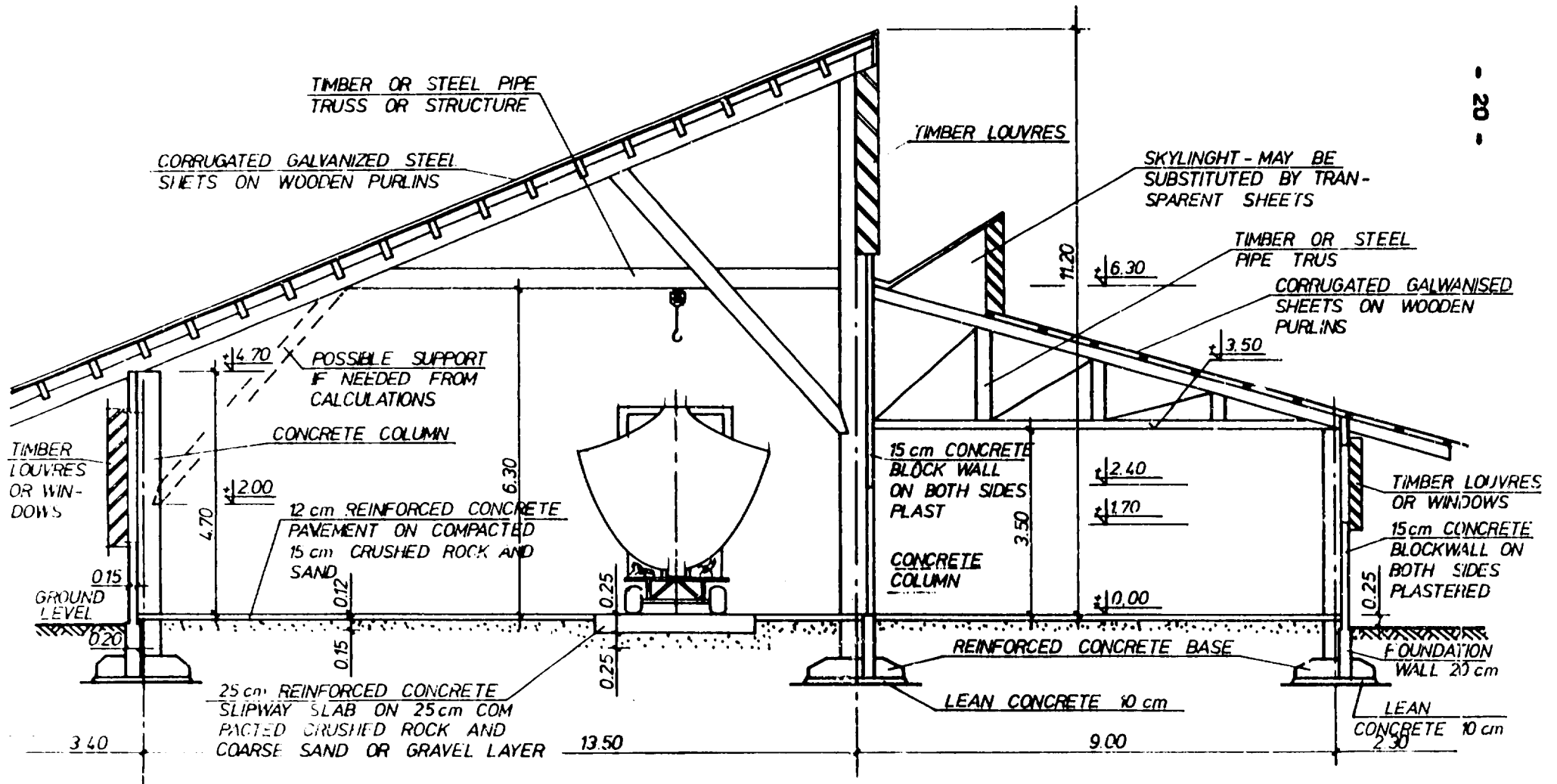
The heights of the different hall workshops are estimated as follows:

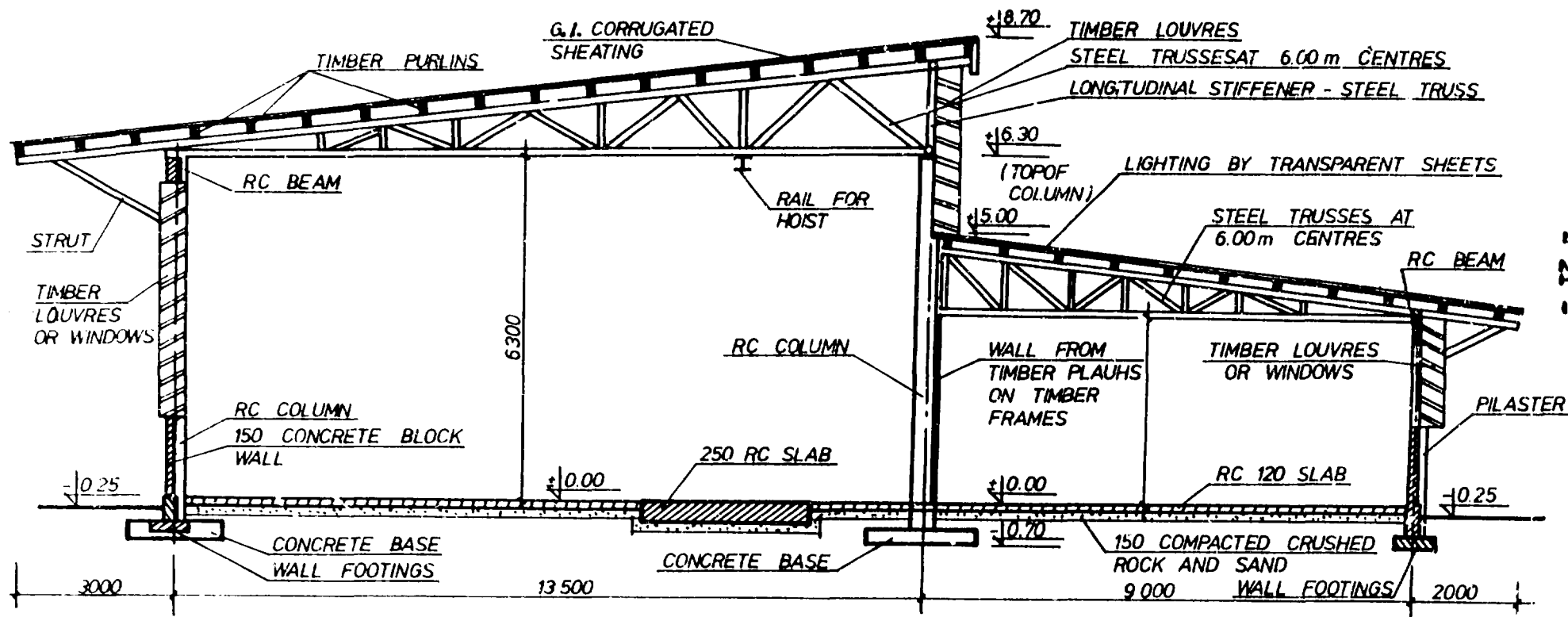
- a/ The workshops under the roofing of 9.0 m span - height 3.5 m.
- b/ The workshops under the roofing of 13.5 m span - height = height of launching cradle + height of the boat + height of one worker + height of the monorail tackle = $0.70 + 3.20 + 1.80 + 0.60 = 6.30$ m.

The proposals of the structural solution of the boatbuilding and repair hall given on Fig. Fig. 5,6,7 and 8 are possible examples. The final solution prepared may take into consideration the proposed on the above figures however, the selection of material /timber, steelpipes/ must be made on the basis of local possibilities. In any case the main dimensions as width, length and height of both parts of the hall have to be kept as indicated on there figures.

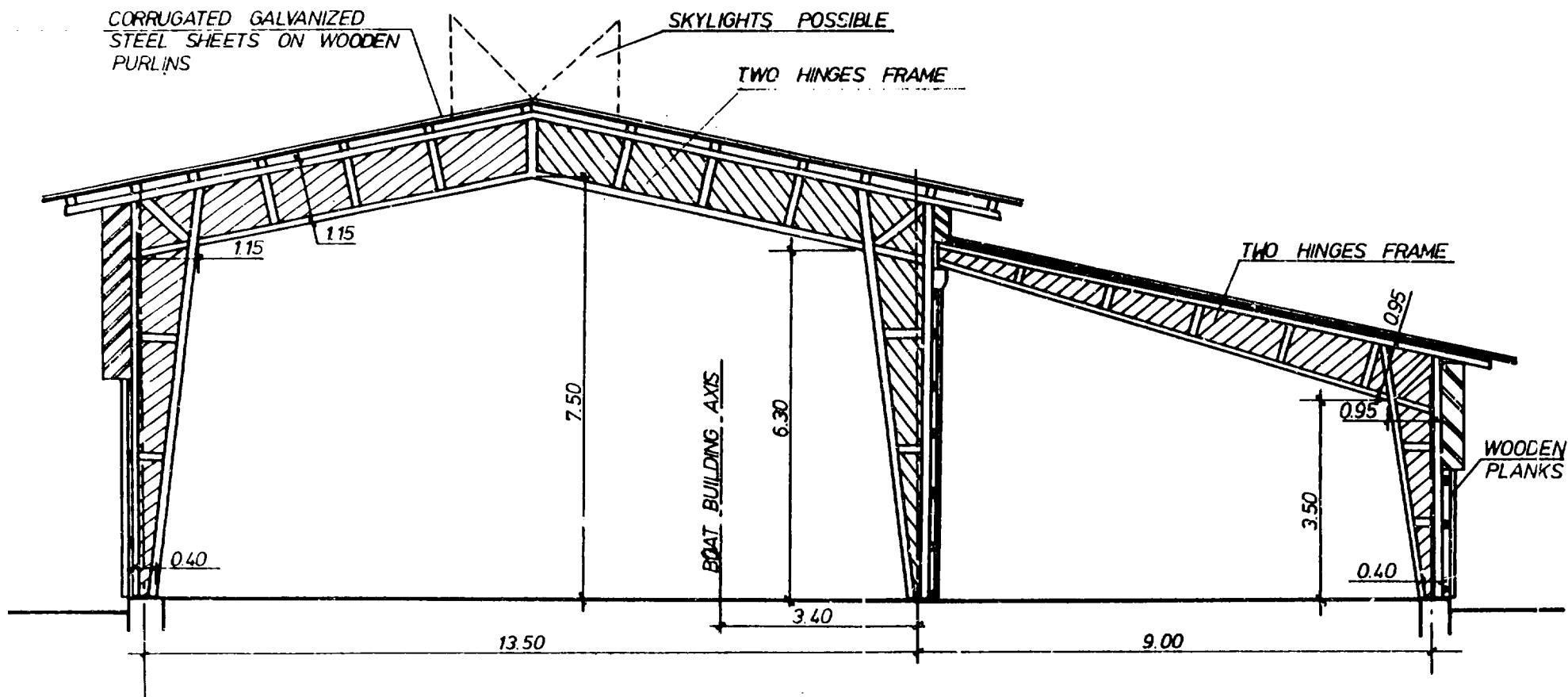
The gable walls above the level + 3.50 cm for the lower part of the hall and above the level + 6.30 for the higher

Fig. 5. Proposed structural solution of the boatyard hall

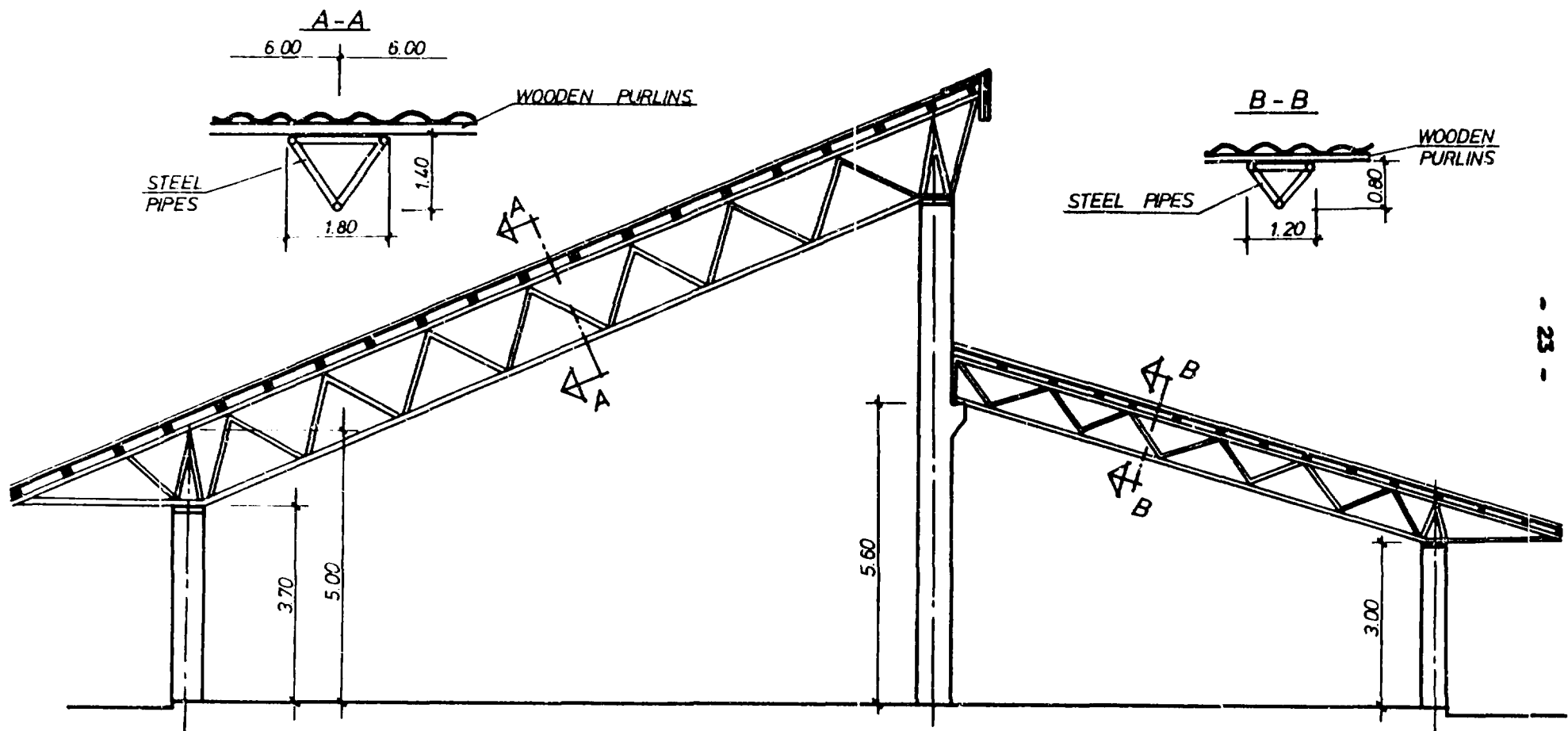




Rys.6. Proposed structural solution of the beatyard hall



Rys.7. Proposed structural solution of the boatyard hall



Rys.8. Proposed structural solution of the boatyard hall

part of the hall have to be made as wooden plankings.
In addition in minimum two fields of the hall stiffeners
for the longitudinal stability of the hall shall be intro-
duced. These stiffeners may be made as two crossing tension
rods placed between the trusses.

