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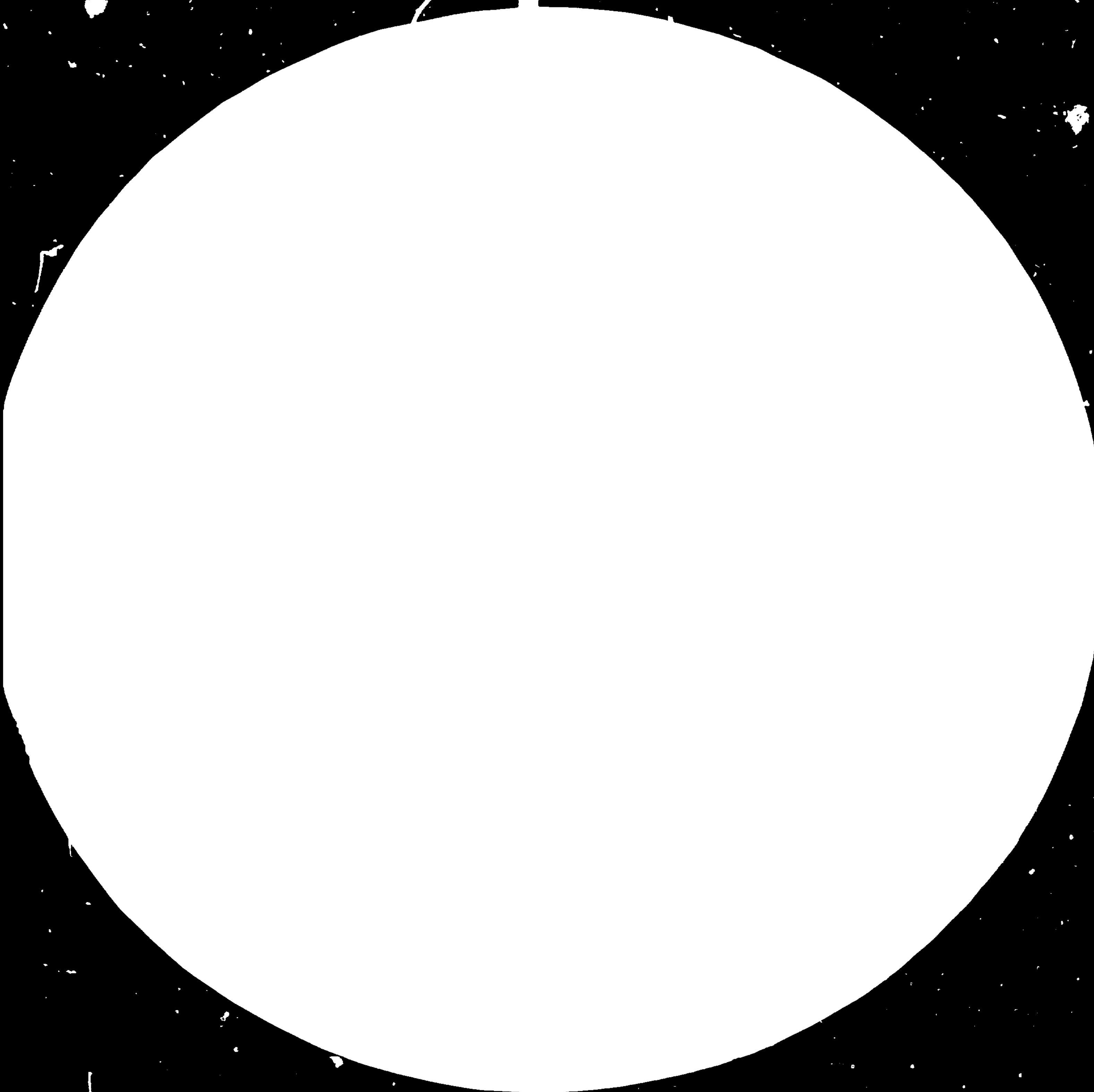

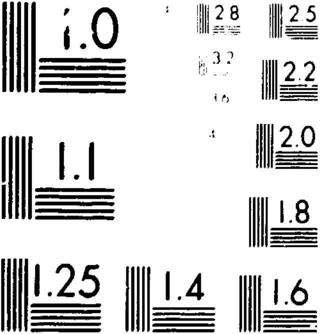

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United Nations Industrial Development Organization

Distr.
LIMITED

ID/WG.375/2
24 June 1982

ENGLISH

Expert Group Meeting on Small-Scale Shipbuilding and Shiprepair Development for Latin American Countries
Havana, Cuba, 7-10 September 1982

SHIPYARD STRUCTURES FOR BUILDING AND REPAIRING OF SMALL SHIPS *

prepared by

B. Mazurkiewicz **

003091

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** Expert in shipbuilding and shiprepair.

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1. INTRODUCTION

The organization of shipbuilding and shiprepair activities in a developing country has a significant bearing on the economy of that country. The existence of these activities allows not only the enlargement of the fleet but also helps to maintain the fleet in good condition which, in turn, results in a longer life span for the fleet. However, to organize a shipbuilding and shiprepair yard it is necessary to build certain shipyard structures which allow the launching and docking of ships.

The shipyard structures for building and repairing of small ships are divided into the following categories: hoists lifts, shipways and slipways (marine railways). These facilities may be used for building and repairing (hoists, lifts and slipways) or only for building (shipways).

In this paper a short description of these facilities will be presented which will show the need for these structures when planning a new shipyard.

The size of the hoist, lift, shipway etc. depends upon the size of the ship which is to be built or repaired. It should be noted, however, that the principles are the same regardless of size. Thus it is not necessary to present structural solutions for each size of the chosen shipyard structure. It is more relevant to describe the general principles required in order that a solution to the area under consideration is found.

2. HOISTS

The hoists are used primarily for the launching and docking of small boats. They are divided into boat hoisting derricks, trailer hoists and marine hoists.

A fixed derrick hoist (Fig. 1) is usually located at the waters edge. It can be the mast and jib type, or a column type with revolving boom, or a pair of boat davits, or an A-frame type with overhead travelling hoist, or any combination of these basic types. Hoisting, slewing and rolling movements are usually made by electrical motor winches. The boats are lifted by means of wire slings which should have sufficient strength to support the weight of the boat, and adequate padding so as not to damage the boat at the contact area. Spreaders and spacing pieces, or rigid frames to which the slings are attached, are also required. A heavier boat may be first placed on a cradle then slings fastened to it before hoisting.

Trailer hoists are designed for loading, off-loading, launching or lifting boats from shore and vice versa. The shore may be unprotected or protected by a concrete pavement. The trailer hoists are manually or hydraulically operated and connected to a heavy duty tractor through a gooseneck.

The trailer hoist is immersed in the minimum amount of water required to provide draught clearance. Then the boat is guided into position where it will settle automatically into the heavy duty lifting slings.

When the lifting slings have been adjusted to fit snugly under the boat keel, the hydraulic controls are put into operation resulting in an independent lifting of each beam which allows the boat to be levelled. The manual lift has four hand chain blocks installed in place of hydraulic equipment.

As an example, let us refer to the heavy duty trailer hoist produced by WISE HANDLING LTD., England, (Fig. 2). The standard structure is fabricated from hollow steel box section members with bolted sections for easy assembly. The two rams with piston rods are controlled by independent hydraulic valves mounted on gooseneck. They are available in 8, 12 and 16 ton capacities.

This company is also producing the marine hoist which is fully mobile and independently powered for lifting craft up to 100 tons deadweight (Fig. 3). The main frame is fabricated from hollow steel

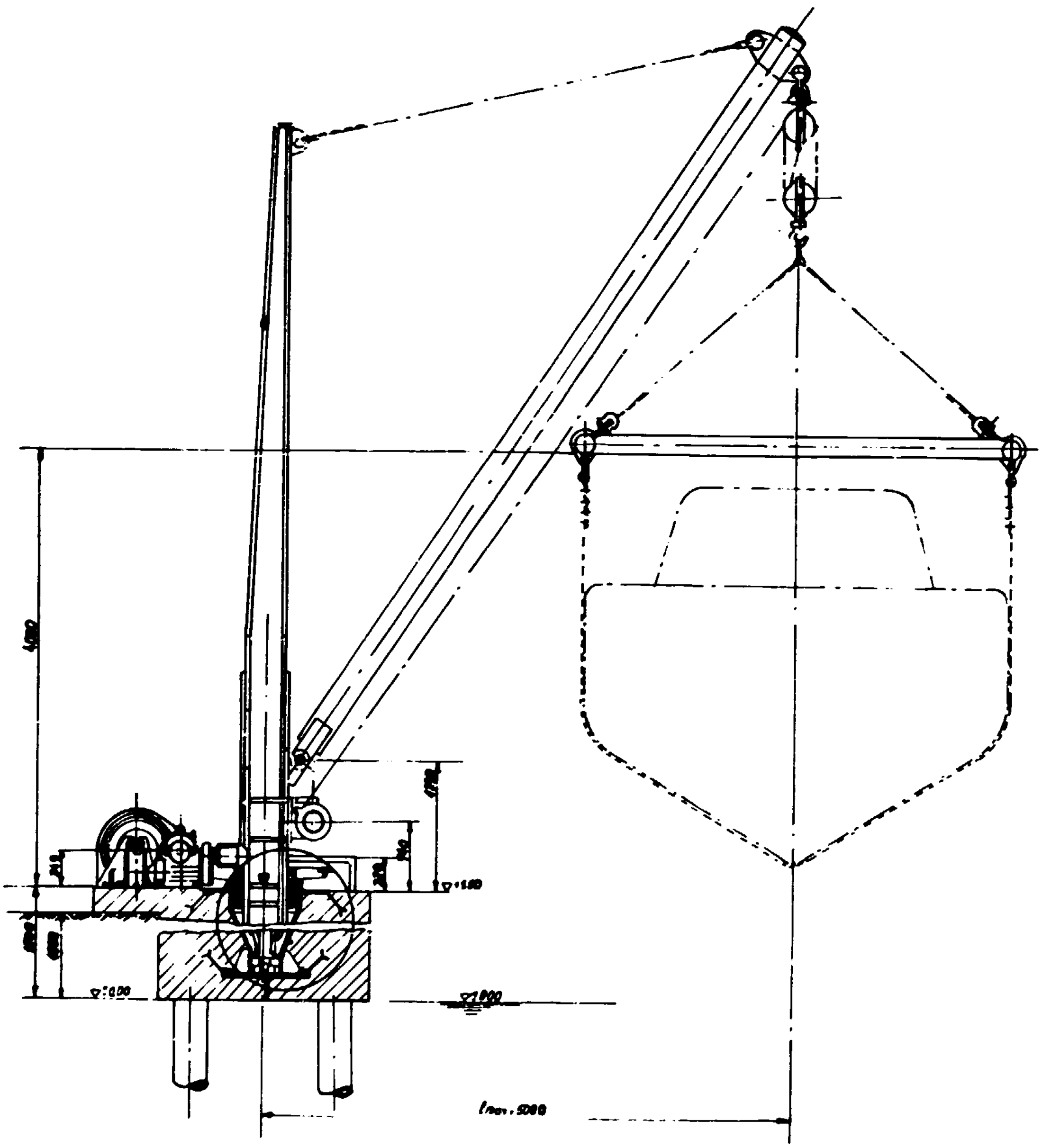
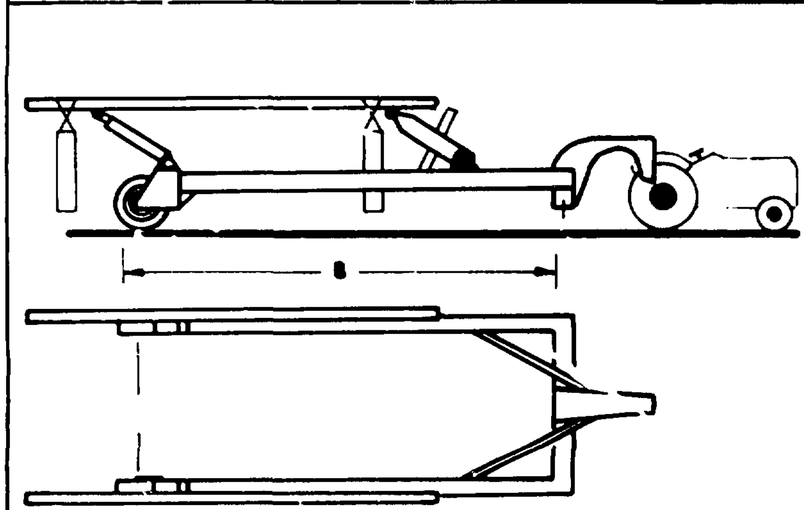


Fig.1. Fixed derick hoist

HYDRAULIC LIFT MODELS	W8		W12		W18	
	Imp	Metr.	Imp	Metr.	Imp.	Metr.
Capacity	8 t	8000 kg	12 t	12000 kg	18 t	16000 kg
Width A	12 ft	3660 mm	12 ft	3660 mm	14'6"	4420 mm
Length B	24 ft	7320 mm	26 ft	7925 mm	28 ft	8535 mm
Lift height	5 ft	1500 mm	5 ft	1500 mm	5 ft	1500 mm



MANUAL LIFT MODELS	M8		M12		M18	
	Imp.	Metr.	Imp.	Metr.	Imp.	Metr.
Capacity	8 t	8000 kg	12 t	12000 kg	18 t	16000 kg
Width A	12 ft	3660 mm	12 ft	3660 mm	14'6"	4420 mm
Length B	24 ft	7820 mm	26 ft	7925 mm	28 ft	8535 mm
Lift height	5 ft	1500 mm	5 ft	1500 mm	5 ft	1500 mm

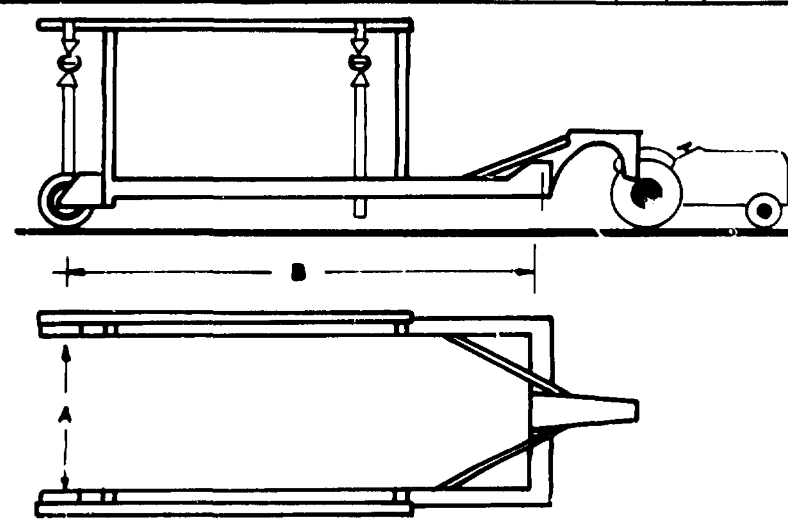
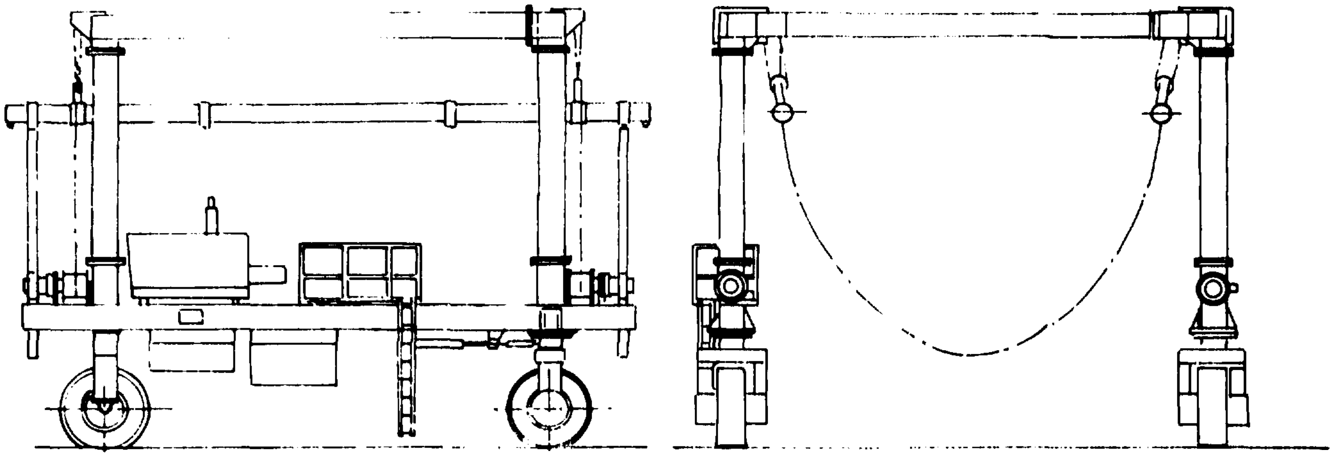


Fig.2. Trailer hoist



Model	W 20/2	W 25/2	W 2[illegible]/4	W 30/4	W 40/4	W 50/4	W 60/4	W 80/4	W 100/6
Capacity	20.000 kg	25.000 kg	[illegible] kg	30.000 kg	40.000 kg	50.000 kg	60.000 kg	80.000 kg	100.000 kg
Inside width, mm	5181	5800	5800	5800	6100	6100	6400	7925	8535
Inside height, mm	5181	5181	5181	5500	5800	6100	6400	7315	7925
Overall width, mm	6850	6850	6850	7150	7620	7925	8230	10160	10465
Overall height, mm	5100	6300	6300	6300	6600	6700	7010	8686	9296
wheel base, mm	4572	4572	4572	6100	6100	6100	6100	9750	9750
max. sling spacings, mm	7010	7620	7620	8535	9140	8140	9750	12800	12800
Lift speed	3 m/min	3 m/min	3 m/min	3 m/min	2 m/min	1.5 m/min	1.2 m/min	1.2 m/min	1.2 m/min
Gradability	6%	6%	6%	6%	5%	5%	4%	4%	4%
tyre size	46x16	46x16	46x16	46x16	49x17	49x17	50x20	49x17	49x17
number of tyres	4	4	4	4	4	4	4	8	8

Fig.3. Marine hoists

sections with an open ended frame for mast or tower clearance. Cross beam bearings enable side frames to pivot independently thereby eliminating torsion stresses. The driving platform on four wheels has a driving position located on the side frame. This gives good all-round vision.

All control valves are positioned on the platform and include "Forward", "Reverse", "Steering" and two or four independent winch controls. The power unit consists of a Diesel Engine up to 150 BHP. It is equipped with fuel tank, battery, ammeter, oil pressure gauge, water temperature gauge and key switch. It drives a hydraulic power system consisting of oil reservoir, control valves and pumps for wheels, winch drives and steering rams. There is a hydro-mechanical drive to each steering wheel. Two or four hydraulic winches with "fail safe" brakes are capable of independent or synchronized operation for boat levelling, hoisting or lowering.

The marine hoist operates above a harbour basin of a width which depends on the inside width of the hoist. The basin may have walls built as heavy retaining walls or it may be created by use of finger piers of a width varying from 1.4 to 1.9 m minimum. It should be noted that the inside clearance of the hoist, and thus the width of the basin, varies between 5.180 m and 7.925 m. Although the length of the basin does not need to be stipulated, it can be built so as to correspond to the hoist length which varies from 13.1 to 22.85 m.

3. LIFTS

Recently many types of lifts have been designed and constructed. It seems sensible, however, to focus on the lift called "SYNCHRO-LIFT" since this is the one used most frequently in the world at the present time. It should be noted that for a developing country only a shipyard structure which allows both the building and the repairing of a ship should be recommended. This means that the SYNCHROLIFT, which fulfils all requirements in this field, should be the one considered.

Other recently produced lifts are:

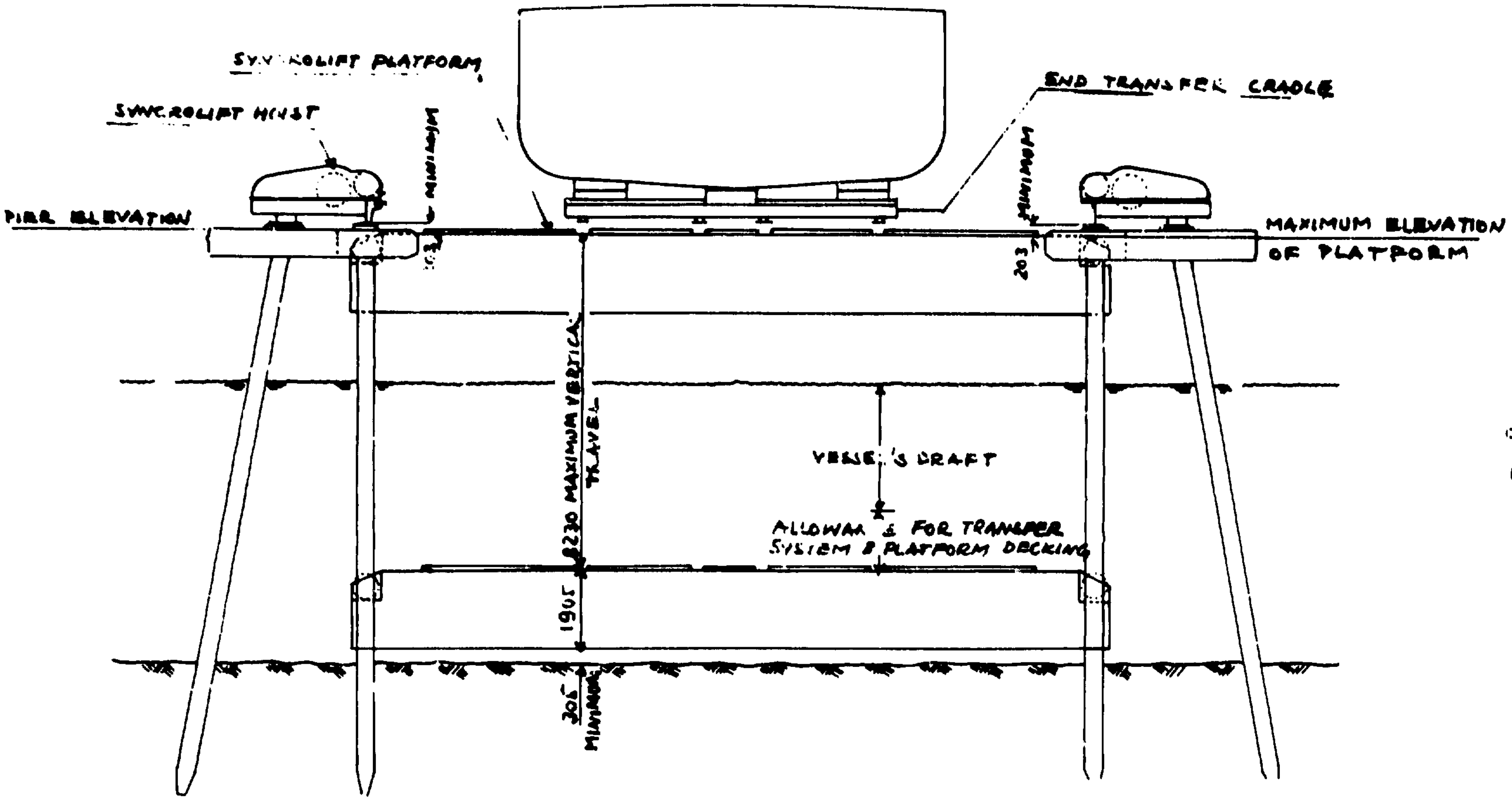
1. "HYDRANAUTICS" with a net rated capacity from 1,100 to 7,700 tons.
2. "HYCU" with a net capacity from 15 to 5,000 tons.
3. "LIFT-DOCK" (Schiess Defries) with a net capacity of 2,940 tons.
4. "KRUPP HYDRAULIKLIFT" with a net capacity of 450 tons.

As has been said before the general principles are more or less the same. Where differences occur they mainly concern the power units which may be hydraulic, electrical or mechanical. This means that the detailed description of the "SYNCHROLIFT" produced by Pearlson Engineering Co. Inc., Miami, USA, should correspond with the principles of other types of lifts.

"SYNCHROLIFT" (Fig. 4, 5, 6, 7) is a large elevator which can be lowered into the water, where a vessel is positioned over it. The elevator and vessel are then lifted vertically to the ground level of the shipyard. There are three principal components: a decked, structural steel platform; a number of synchronized motor powered wire rope hoists to raise and lower the platform; and a central electrical motor control center to operate the system.

Ships are drydocked on the "SYNCHROLIFT" platform using conventional procedures for setting the keel blocks and placing the bilge blocks. "SYNCHROLIFT" platforms consist of a series of steel main transverse lifting beams lifted by a hoist at each end. The ship's keel support is provided by placing intermediate transverse beams between the main beams. These intermediate beams are supported by longitudinal members.

The lifting hoists are supported on fixed pier structures (Fig. 4) which are normally constructed of concrete and standard



Rys.4. Cross section of "SYNCROLIFT"

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marine piling.

The synchronized electrical motors used to drive the hoists are designed to operate up to a maximum required capacity at a fixed rate of speed, regardless of load variations imposed by the distribution of the weigth of the vessel. All the motors are controlled from one central point. In the event of malfunction of any one motor, the entire system is automatically stopped.

"SYNCHROLIFT" can be expanded in length with little change to the initial equipment by the simple addition of extra platform sections and hoists. Additional controls can be included initially so that the control centre will not have to be modified when hoists are added.

A transfer system can be added to a basic "SYNCHROLIFT" shiplift by providing railroad or crane-type rails on the platform and on the adjacent land area. The rails are arranged so that a transfer cradle, with a ship on it, can be rolled to the land area when the platform is at the yard elevation. The onshore transfer system can be designed to permit movement in both directions.

Each hoist assembly consists of an electric motor with a marine--type integral brake, gearing, wire rope drum, ratchet and pawl back-stop, sheaves, miscellaneous accessories, and cover. All are assembled on a steel base ready for installation. The accessories for each hoist consist of one limit switch assembly, limit switch actuator, and the platform sheave assemblies. The hoist drum drives a multiple part wire rope system by reeving wire rope trough sheaves mounted on the hoist, and sheaves mounted in a housing.

The cable drum is grooved and provides for the maximum amount of travel with a single layer on the drum. One layer of wire rope will be on the drum when the platform is fully raised.

The hoist has two separate and distinct braking systems. The motor has an integral magnetic disc brake which releases when power is applied and engages by spring action when power is disconnected.

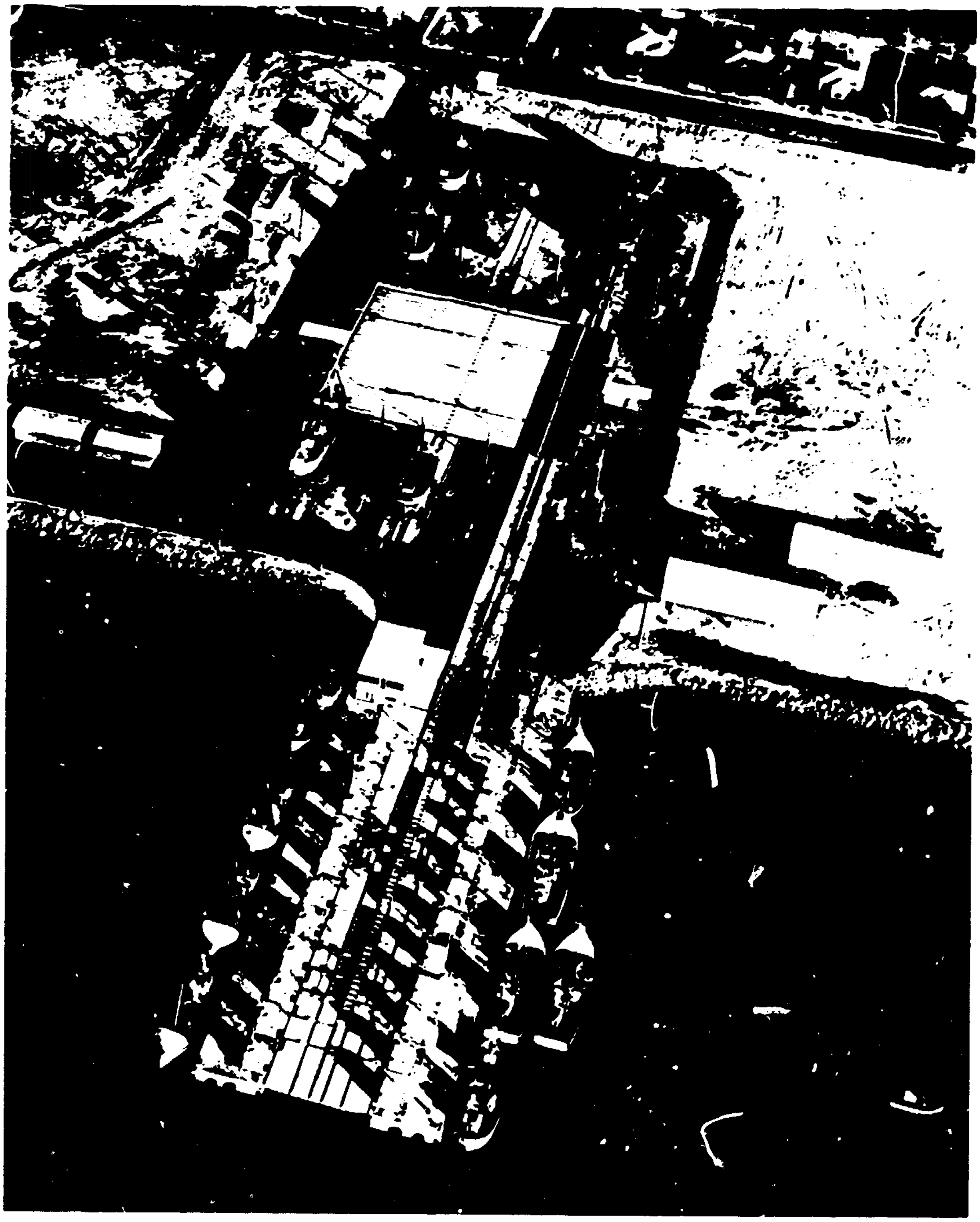
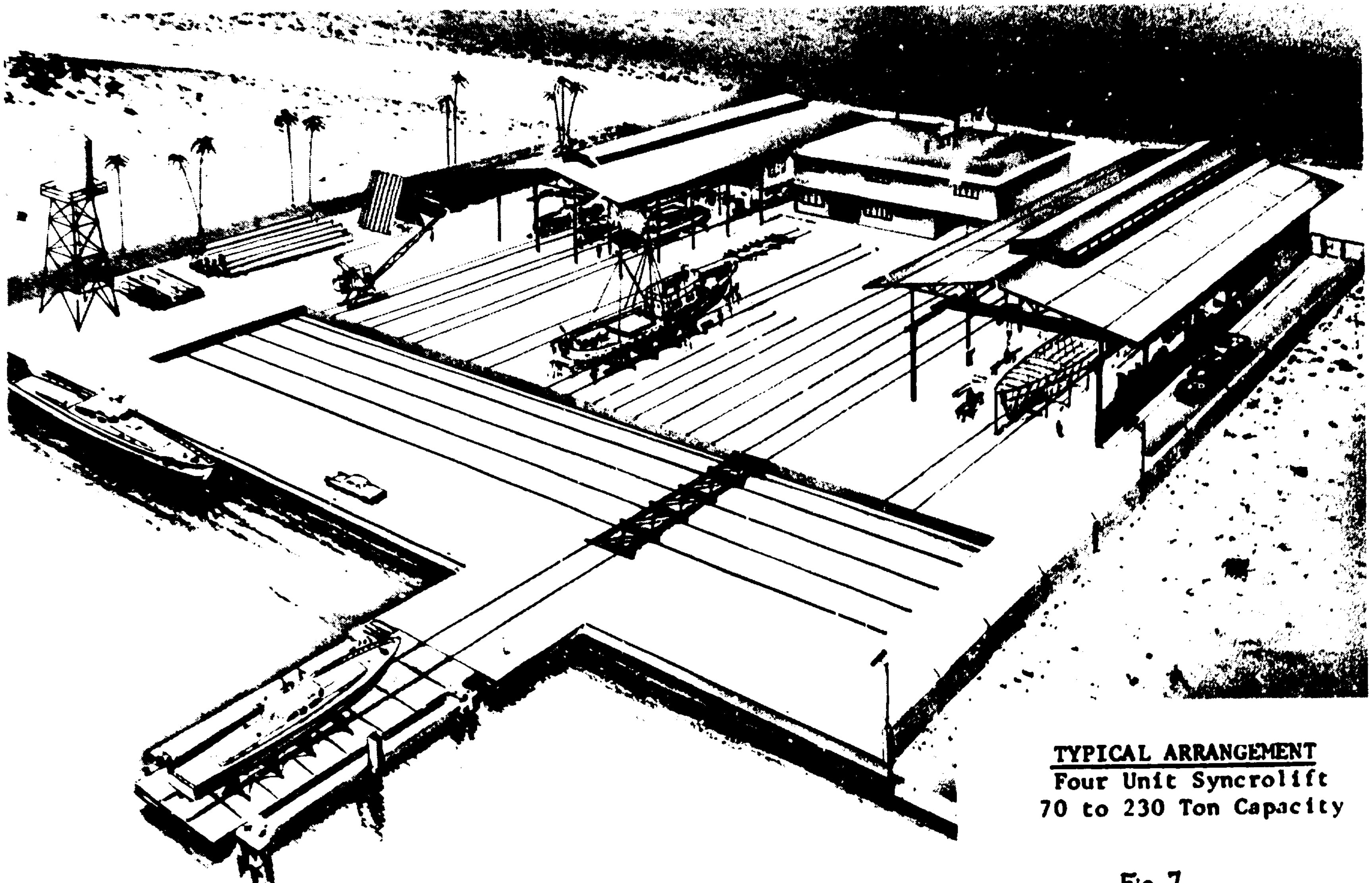


Fig.5.General view of a "SYNCROLIFT"

TYPICAL ARRANGEMENT
Multiple Unit Syncrolift
To 20,000 Ton Capacity Fig.6



TYPICAL ARRANGEMENT
Four Unit Syncrolift
70 to 230 Ton Capacity

Fig. 7.

The cable drum has a ratchet and pawl-type backstop. When the platform is being operated in the downward direction all pawls are automaticlly withdrawn from the ratchets. Under all other conditions the pawls are held in an engaged position by springs in the cylinders. The ratchet-pawl system also allows removal of the motor-brake unit and intermediate gears with full load on the hoist. An interlock in the control system prevents the platform from being operated in the downward direction when any pawl is in place. The brakes are of a watertight, marine construction and are mounted directly onto the motor frame and keyed to the motor shaft.

A control center operates the "SYNCHROLIFT" with a minimum number of settings. There is an ammeter for each hoist which indicates the relative load carried by each hoist during the operation of the "SYNCHROLIFT". Safety provisions are incorporated to automatically stop all motors instantaneously if any one motor exceeds the designed capacity of the "SYNCHROLIFT". In this event the platform can only be operated in the downward direction. Provision is also made to automatically stop all motors when the platformreaches the upper or lower limits of travel.

The control centre is free standing with a floor mounted cabinet. The starters are controlled from a single console using pushbutton and selector controls. All motors are protected against overload. The controls are arranged for simultaneous synchronized operation of all motors and for individual operation for maintenance purposes.

Power supply to the "SYNCHROLIFT" is 3 phase, 3 wire. Frequency may be 50 or 60 cycles. Preferred voltages are as follows:

Total KVA 50 or less	220, 380, 440, 550
Total KVA over 50	380, 440, 550.

The number of hoists is varied to provide the required dry-docking capacity. The minimum number is 4 and the hoist sizes are 91 t, 183 t and 244 t.

The standard 8 unit synchrolifts refer to the following sizes:

Hoist size	Platform size	Normal capacity	Maximum capacity	Load	Available travel
91 t	42.0x12.0 m	345 t	518 t	12.1 t/m	7,6 m
183 t	57.0x16.0 m	635 t	955 t	16.6 t/m	11,0 m
244 t	67.0x18.0 m	833 t	1,250 t	18.6 t/m	11,0 m

This allows different sizes of lifts to be chosen depending upon the required ship size. To demonstrate this point, dimensions and capacities of some other realized lifts are presented below.

Lifts require a minimum amount of space and can be constructed off-shore where its access piers may be utilized as wet dock space. Vessels are drydocked on an even keel at yard elevation with no obstructions impeding the work area.

Platform size	Nominal capacity, t	Maximum capacity, t
22.9 x 7.32 m	71	96
25.9 x 9.76 m	152	198
30.5 x 9.76 m	229	305
44.5 x 12.81 m	559	914
57.3 x 16.47 m	711	1,219
64.7 x 18.30 m	874	1,473
72.0 x 20.13 m	1,219	2,083
74.4 x 20.74 m	1,422	2,388
79.3 x 21.96 m	2,184	3,251
97.5 x 20.00 m	2,424	3,634
102.5 x 22.00 m	2,678	4,018
91.5 x 22.57 m	3,048	4,674
93.6 x 30.50 m	3,530	4,540
117.0 x 22.00 m	3,736	5,604
104.9 x 25.00 m	3,810	5,609

106.7 x 25.00 m	4,200	5,735
134.0 x 25.00 m	4,400	6,900
108.6 x 25.00 m	4,445	6,604
106.0 x 18.00 m	4,494	6,741
125.0 x 27.00 m	4,916	7,375
130.0 x 25.00 m	5,815	8,723
140.2 x 27.00 m	5,962	8,943
152.5 x 25.00 m	6,248	9,347
150.0 x 26.00 m	6,580	9,870
167.1 x 26.23 m	6,807	10,160
171.6 x 30.00 m	8,326	12,490
184.8 x 32.00 m	11,000	16,000

For a rough estimation of costs a "SYNCHROLIFT" system designed to handle 250 t vessels with a platform 30 x 10 m wide would cost US $500,000 ready to operate. The materials and services that the company supplies would be about US $260,000 of the total amount.

4. SLIPWAYS (MARINE RAILWAYS)

Slipways (Fig. 8 to 17) consist of inclined ways of timber, stone or concrete, running up from a sufficient depth of water to the requisite height above high water level, upon which a series of rails is fixed. On these rails suitable carriages run to support the vessel, and are hauled up or lowered by means of winding gear.

Slipways are either of the end-on or broadside pattern, according to whether the vessel is hauled clear of the water in the direction of its length or normal to this direction.

A much more elaborate carriage is required for an end-on slipway than for a broadside slipway if it is necessary that the vessel be maintained in a level position. On the other hand, if the vessel can be hauled up in an inclined position, much longer haulage will be required. An end-on slipway, on the other hand, requires considerably less quay space than a broadside slipway,

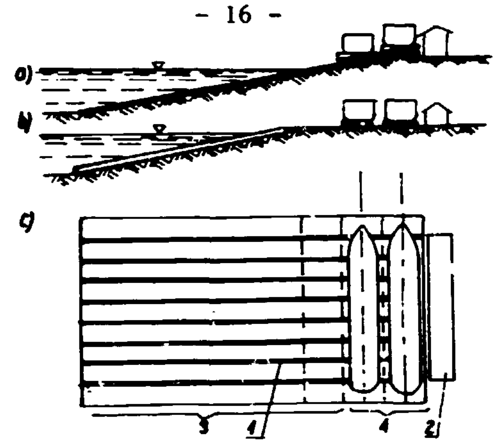


Fig. 8

Broadside slipway arrangements: a/cross-section of single slope, b/cross-section of double slope slipway, c/plan of slipway for both kinds of slopes, 1-rails, 2-machine room, 3-operation, 4-repair or building berths

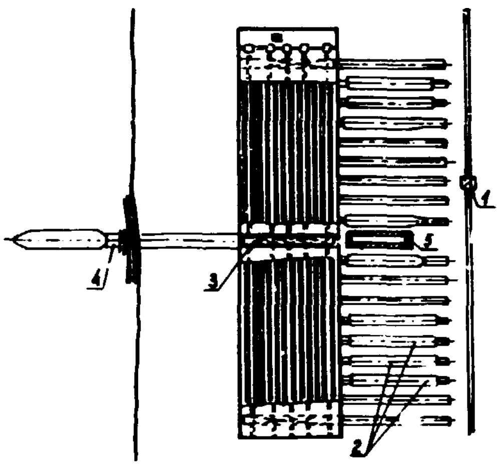


Fig. 9

Longitudinal slipway with a transfer system: 1-movable winches, 2-upper cradles, 3-transfer carriage, 4-slipway, 5-machine room

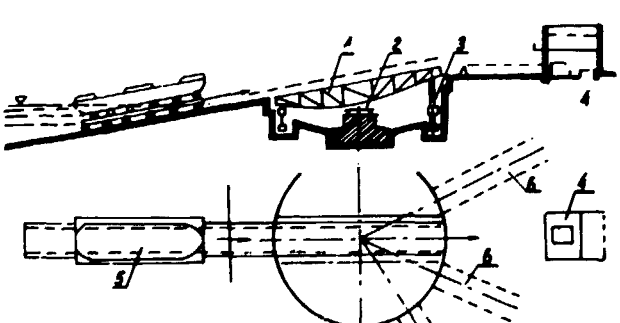


Fig. 10

Longitudinal slipway with a turn-table: 1-turn-table beam, 2-middle ring, 3-cradles with hydraulic jack, 4-machine room, 5-cradle, 6-repair or building berths

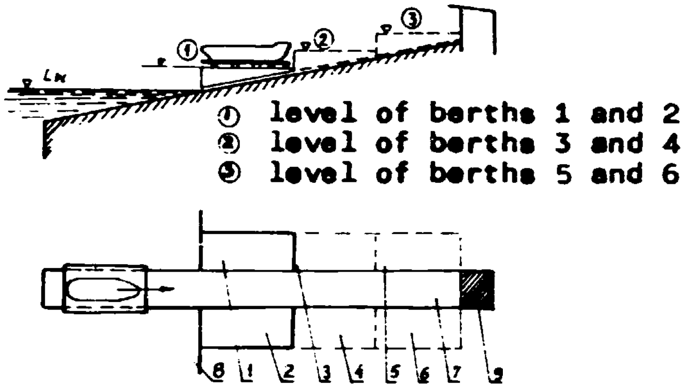


Fig. 11

Longitudinal /end-on/ slipway with side repair or building berths 1 to 6 - repair or building berths, 7-operation area, 8-harbour basin, 9-machine room

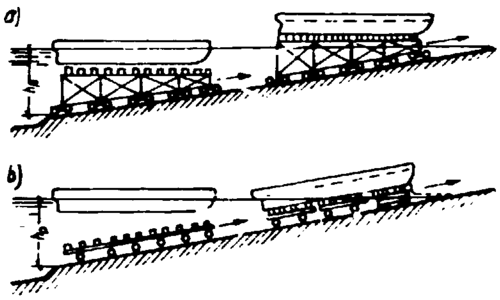


Fig. 12

Types of longitudinal /end-on/ slipways: a/with wedge /triangle/ cradle, b/with rectangle cradle

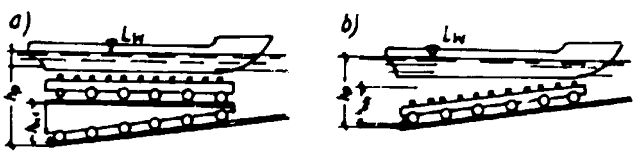


Fig. 13

The depth of the sill for a longitudinal /end-on/ slipway: a/ with triangle /wedge/ cradle, b/ with rectangle cradle

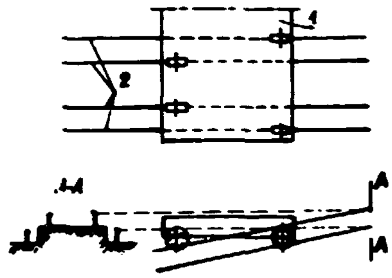


Fig. 14

Rail arrangement for a double slope slipway: 1-cradle, 2-rails

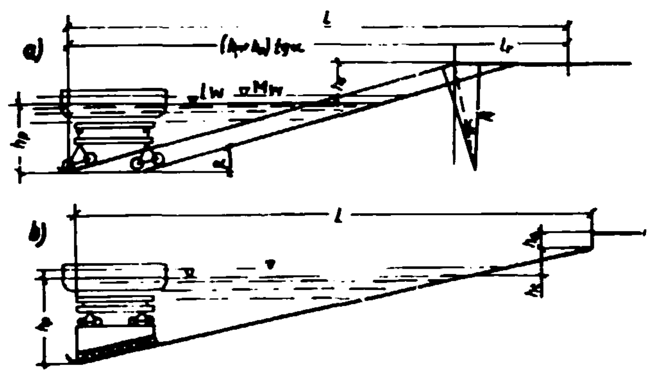


Fig. 15

Typical arrangements of bradside slipways: a/broadside slipway with double slope, rectangular cradle, two levels rails, b/ broadside slipway with one slope and upper rectangular cradle, lower wedge cradle

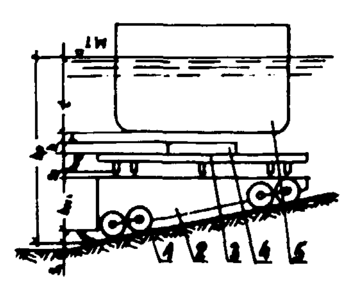
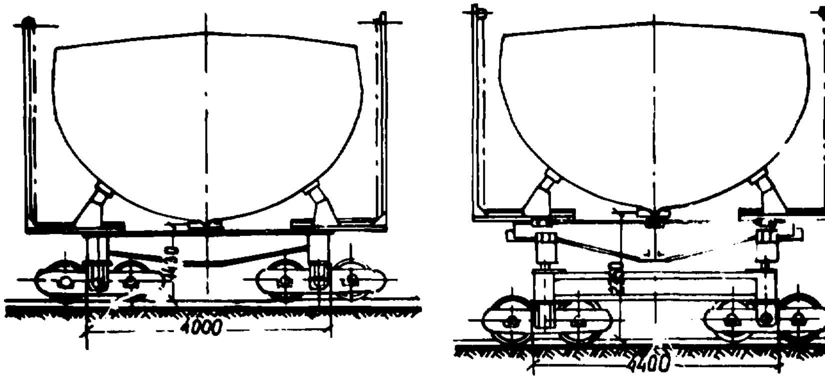
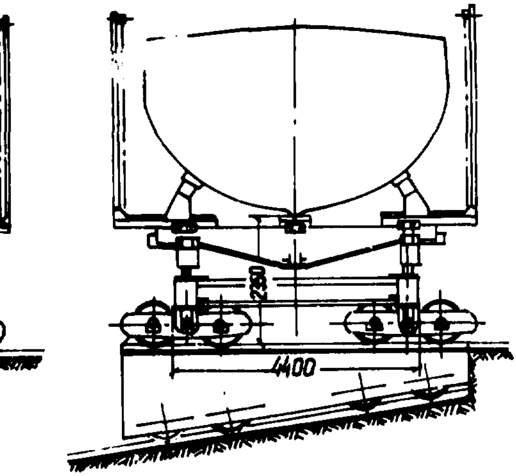


Fig. 16

The depth of the sill of a broadside slipway: 1-slipway rail, 2-lower cradle, 3-upper cradle, 4-keel-block, 5-ship hull



Rys.17. Slipway cradles


2350
4400

which may be an important consideration. The end-on pattern requires a space equal to only about three times the beam of the ship being dealt with, whereas the broadside pattern requires about 10 % more than the length of the ship.

A transfer system can be added to a basic slipway by providing railroads on the adjacent land area. The rails are arranged so that a transfer cradle, with a ship on it, can be rolled to the land area when the slipway cradle is at the yard elevation. The onshore transfer system, similar to the one proposed for lifts, can be designed in such a way that movement in both directions is permitted.

The cradles are of steel and built as one, two or three level cradles. This allows the ship to be transferred from the inclined operation area to the transfer area and repair or building berths. Moveable bilge blocks are provided on the cradle to support the ship.

The hauling gear usually consists of powerful winches worked by electricity which wind up the cradles by wire ropes.

Broadside slipways are suitable in narrow rivers where there is no room for the length of structure required for an end-on slipway. In a broadside slipway there are a number of sets of rails parallel to each other and a number of cradles. The hauling arrangements must be synchronized so that all the cradles rise or descend at the same rate. The cradles may be from 3 to 6 m apart according to the weight of the vessel to be supported.

Slipways require good foundations of uniform bearing power, since any disparity may cause damage to the vessel on the slip, and may also render the slipway unworkable.

In most cases, as the lower end of a slipway is under water a cofferdam is necessary for its construction. On the other hand, as the weight to be supported on the cradles over the underwater portion of the slipway diminishes as the ways get deeper until finally the ship is afloat, such heavy foundations are not needed in the lower part compared to thoserequired where the full weight of the cradles and ship must be supported. Recently the structure of the railways (beams or frames) has been of prefabricated, prestressed concrete units which are placed under water on a specially prepared bed. In the case of insufficient bearing capacity of the soil the frames may be supported on piles driven to the necessary depth and finished with pile caps constructed in underwater concrete. The proper solution depends on the type of slipway and the size and weight of vessel to be supported.

The inclination of slipways varies from 1:15 to 1:30. The power required to work them depends not only on the inclination but also on the state of lubrication, the presence of mud on the ways, and the speed of working, although the latter consideration must necessarily be kept low. The friction in slipway varies within a wide range, and it is towards the elimination of as much as possible of this friction that the efforts of designers should be directed. In situations where mud is freely thrown down by the water and the slipways are not often used accumulations of mud may substantially increase the power required therefore a considerable reserve of power is advisable.

In comparison with the lifts presented in chapter 3 it should be noted that slipways must have ways or tracks extended from the shore to where the water is deep enough for drydocking the vessel. The drydocking takes place in the harbour, (actually 150 to 240 m from shore), where there is exposure to currents, wind and other natural weather elements. Foundation requirements are high and the underwater maintenance of tracks, pilings, rollers and hauling gear create problems inasmuch as these parts are not visible. Constant surveillance by divers is needed to ensure proper operation. Periodic surveys are required to verify the gradient and allingment of the ways. To replace worn rails or plates on the track requires long shutdown periods. When the vessel is pulled up the inclined ways it comes to rest at the shipyard still on an incline unless more levels and wedge cradles are used.

Once this is done the tracks, their foundation, the rollers and the rope or chain gear must be extended underwater to obtain the required depth for drydocking the vessel.

As has already been stated, the size of the slipway is dependant upon the weight of the vessel. Vessels up to 1,000 tons weight are drydocked by using slipways. This means that these structures are mainly used for small ships.

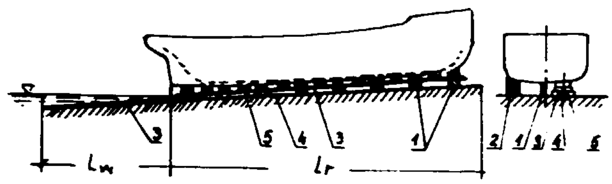
5. SHIPWAYS

Shipways (Fig. 18 to 22) may be used only for building new ships and thus are recommended only in building shipyards or as the building part of a building and repair shipyard. They are very simple structures and may be made in areas lacking equipment and placed directly on shore. This is very important for shipyards which may be built, for example, for erection of timber vessels of small size.

Shipways consist of inclined launching ways of timber running up from a sufficient depth of water to the requisite height above high water level upon which the building of the vessel takes place. The launching ways may be placed directly on a crushed stone (macadam) bed, or as a concrete slab laid directly on the macadam bed or supported on piles of timber or concrete.

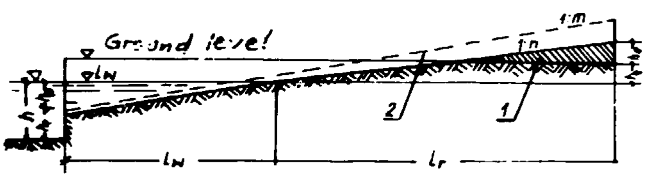
Shipways are either of the end-on or broadside pattern, according to whether the vessel is launched in the direction of its length or normal to this direction. It should be noted that for large vessels the longitudinal shipway should be closed by side-walls and shipway gates thus limiting the total length of the shipway and its height above ground level.

The ship is built on keelblocks. When the ship is ready for launching the sliding ways (bilge ways) are placed on the launching ways whilst a layer of grease is introduced between them to lessen the friction thus allowing for a smooth launching.



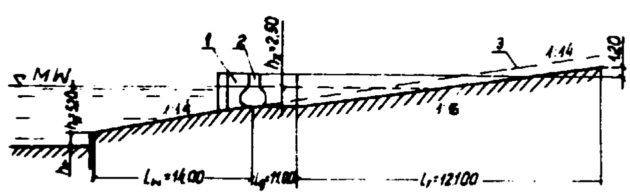
Rys. 18

The ship on a longitudinal shipway: 1-keel blocks, 2-side supports, 3-launching ways, 4-sliding ways /bilge ways/, 5-beams and wedges of sliding ways



Rys. 19

Dimensions of a longi tudinal shipway: 1-trestle 2-launching ways



Rys. 20

Dimensions of a closed longitudinal shipway: 1-shipway head, 2-gate, 3-launching way

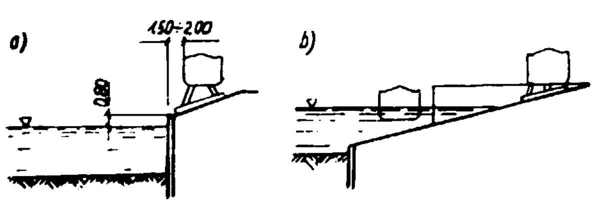


Fig. 21

Broadside shipway: a/with the sill above the water level, b/with the sill under the water level

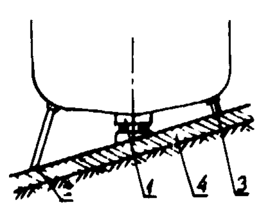


Fig. 22

Supports of the ship on a broadside shipway: 1-keel block, 2-seat, 3-side support, 4-shipway

Between the sliding ways and the hull wedges of timber are introduced which allow the keelblocks to be taken away when the vessel is heaved. This procedure is very simple, particularly if the ship weighs very little.

Usually one ship may be built on one shipway. It is possible, however, to use special carriages which allow transfer of sections from the assembly area to the shipway where they will be connected. In all cases, however, the transposition of the hull from the keelblocks to the launching ways is necessary.

The broadside shipways, which may be constructed in narrow rivers or harbour basins where there is no room for longitudinal shipways, have more than two launching ways e.g. 6 to 15. The launching ways may be from 3 to 6 m apart according to the length of vessel to be built and launched.

The inclination of shipways varies: a) longitudinal shipway: for small ships from 1:8 to 1:16, and for large ships from 1:14 to 1:30, b) broadside shipway from 1:5 to 1:8. The depth to which the launching ways are placed under the water depends on the inclination of the shipways and on the draught of the vessel during launching (the draught of the bow for longitudinal shipway and the maximum draught of the ship for broadside shipways). The minimum depth on the sill for a longitudinal shipway is usually 2 to 4 m whilst the depth at the sill should be about 2 m larger. The sill of the broadside shipway may be placed under or above the water level. In the first instance, the vessel will jump its water during launching, whilst in the second instance the launching will be similar to that of the longitudinal shipway. The depth at the sill is usually larger mainly because the structure made as a wall may also be used as a quay wall for mooring of ships.

The shipways should be equipped with stoppers which keep the ship on the launching ways until the moment when launching is intended. These stoppers, made of timber (carpenter stopper), or steel (mechanical stopper) are connected to the shipway and released by a hammer or mechanical device.

The length of the shipway above the water level is equal to the length of the supported ship. The length of the underwater part of the open longitudinal shipway depends on the depth of sill and inclination of the launching ways. This depth is the function of the draught of the bow during launching (e.g. for a draught of 2 m, inclination 1:20, the length should be 40 m). The determination of the shipway's geometrical parameters is very easy when the dimensions of the ship under consideration are given. In the case of a closed longitudinal shipway the length of the shipway is equal to the largest ship which is to be built on it.

The solution to the structure of the shipway depends on the soil conditions and the size of the ship. It can consist of two timber beams connected by transverse beams laid down on prepared substrata or supported by timber piles. For larger vessels the timber launching ways will be supported on concrete beams or slabs placed directly on to soil or on to piled foundation. The construction may take place behind a cofferdam (earth embankment) or underwater using divers. This is particularly relevent to timber structures which may be prefabricated, towed and set down on the shore.

6. CONCLUSIONS

The above general description of hoist lifts, slipways and shipways shows that for the building and repairing of small ships a set of structures exist which can be easily erected, taking into consideration the local conditions. When choosing a solution one should take into account the soil conditions, the available materials: timber, steel, concrete, (cast in-place, precast, prestressed), the available building equipment, (driving rigs, batching plants etc.), the available labour forces, (skilled labour), and the proposed shipbuilding activities, (building of timber, steel, concrete and ferrocement ships, repair of these ships). Having all this data available means that a construction may be recommended bearing in mind the above statements. At this point it may be advisable to contact a specialist in shipyard design and construction to avoid mistakes occuring in the determination of the data to be used as a basis for recommending the shipyard structure.