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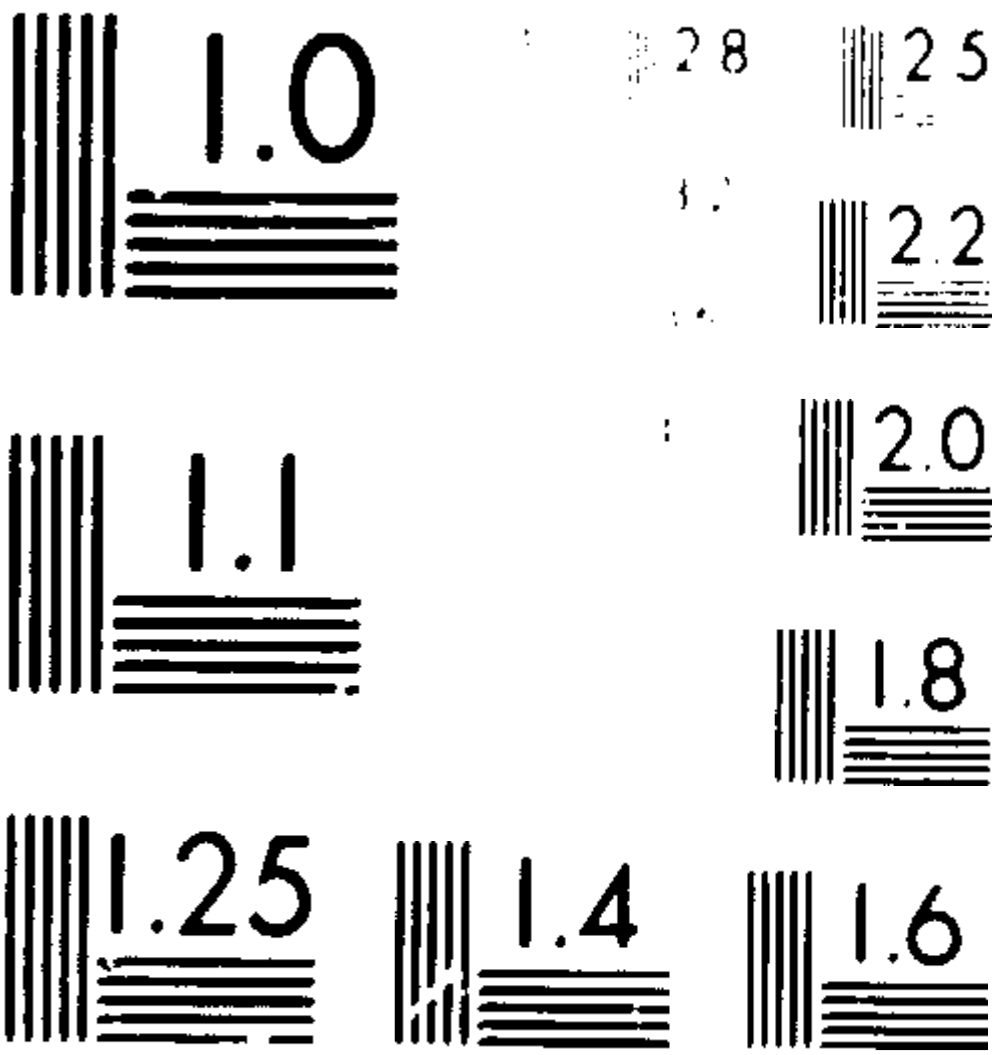
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CONSTRUCTION OF SHIPBUILDING AND SHIPREPAIR YARDS FOR SMALL-SCALE SHIPS*

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CONSTRUCTION OF SHIPBUILDING AND SHIPREPAIR YARDS FOR SMALL-SCALE SHIPS

I would like to start my lecture with a personal remark, namely, that when I wrote my book on the design and construction of dry docks I found that already in Havana, in Cuba, a dry dock had been constructed which is an example of a very modern structural solution in the soil and environmental conditions existing on this island. During the few days of my stay in Cuba I acquired also the knowledge on the development of special methods of shipbuilding in this country, namely, using ferro-cement. The above two facts make it very difficult to speak from this place about the construction of boatbuilding and boatrepair yards for small-scale vessels. I understand, however, that the participants of our workshop represent also experts which are from regions or countries having considerably lower stage of development of boatbuilding and boatrepair, maybe due to a small interest in this field in previous years. Therefore please allow me to make some remarks concerning the way which ought to be followed when establishing a boatyard for small size boats in a country which has considerably small experiences in this field.

I have prepared some papers which you may have obtained from the organizing committee. During my lecture I would like to refer to these papers.

To start the activity in boatbuilding one has to decide of course for which purpose the boats have to be used. Let's assume here, as it is mostly the case in the reality in the developing countries, that a boatyard for building, maintenance and repair of fishing boats will be mainly considered. At the beginning of course many questions are normally raised concerning mainly the large investment costs which seem to be connected with this activity. It has to be therefore stressed that the start of boatbuilding does not need to be immediately connected with planning of large expenses which of course depend mainly on the

size and type of the boatyard which is the function of the boat size, the yearly capacity or output, the type and amount of equipment in the yard and the material which has to be used for boat construction. A very important factor is of course the rate of mechanisation of all shipbuilding works which is connected with the purchase of certain equipment, for instance for wood working, etc. The above means of course that when one starts with a boatyard for fishing vessels based on local materials, local labour and on very low level of mechanisation, then he may reach very low investment costs, particularly at the beginning of the event. Let's start, however, to discuss shortly all the mechanical factors.

First the material and production technology problem might be considered. In the paper prepared for this workshop under the title "Materials and production technologies for small ships" a detail analysis of this problem is given. Ten probable materials and production technologies are distinguished from which for the developing countries are recommended, mainly boats made from ferro-cement. This recommendations concern particular countries which have no wood and have small import possibilities. The above conclusions may be drawn due to the following characteristics of the ferro-cement, namely:

Its basic raw materials -- sand, cement and reinforcing mesh -- are readily available in most countries.

It can be fabricated into almost any shape to meet the needs of the user; traditional designs can be reproduced and often improved. Properly fabricated, it is more durable than most woods and cheaper than imported steel.

The skills for ferro-cement construction are quickly acquired, and include many skills traditional in developing countries. In the case of boats a trained supervisor can achieve the requisite amount of quality control using fairly unskilled labour for the fabrication.

Ferro-cement construction does not need heavy plant and machinery.

Ferro-cement could be easily and rapidly repaired in the boatyard.

It may be stated that ferro-cement applications are relatively inexpensive due to the low cost of material. Major cost goes to unskilled labour which, however, is very cheap in developing countries. Also the volume of material required is comparatively small what reduces the transportation costs.

In some countries it may be also favorable to build boats from marine plywood mainly because the good boat building timber is rapidly increasing in costs and expensive new equipment can plunge the fisherman into debts and a trap of loan repayments. A special technology is here recommended in which the precut sections of marine plywood are wired together and then the joints are sealed with epoxy resin and covered with terylene tape. When the resin has set the wires are cut and the finish is applied. This method requires minimal carpenter skills and avoids the traditional boat builder's dependence on sectional timber, not readily available in many developing countries. It may be stated that the use of plywood reduces the cost below comparable locally made boats. Easily boats of the length up to 7-8 m may be build.

The use of timber for building of boats, particularly fishing boats, is still in some countries actual and may be further developed. In this case, however, a more improved technology should be applied, meaning among others the introduction of mechanical woodworking equipment, etc.

In any case, however, the erection of a boatyard requires to start with a technological design connected with a civil engineering project which may be not only the basis for all decisions concerning the boatyard into consideration, but also the basis of civil engineering works, purchase and installation of equipment, training of personnel, etc. In the paper under the title "Boat building and repair yard for wooden fishing boats", an example of a preliminary project of a small boatyard is presented which includes all necessary details concerning the boat-building and boat repair hall, the list of equipment, the number of employees, launching arrangements, etc.

In connection with the above some remarks may be in addition presented, namely:

First, the location of the yard. It may be here stated that for a small boatyard no special requirements in this field may be raised. It is, of course, very essential to situate the yard on a beach which is sheltered from waves whilst the soil conditions allow to use simple, direct founded structures. Concerning the necessary land area, it may be assumed that an area of about 5000 sqm is sufficient for each type of boatyard small vessels.

It is of course recommended to prepare an adequate surveying plan, as well as to make all levelling works and certain soil investigations, the last through some excavations to a depth of about 1.0 m from the assumed foundation base level. A special attention should be paid to the existing ground water levels. If possible, record from many years are here very valuable and most recommended.

Secondly the boatbuilding and boat repair hall. It should be here particularly stressed that the first factor in the choice of an adequate structural solution are the weather conditions i.e. the outside temperature, rainfall, wind force. These factors are sometimes not fully taken into consideration what means for instance that for tropical countries assembly halls are constructurec which contain heavy concrete block wall, fully closed inside spaces. etc. It may be proved that for this case a very light shed is fully sufficient, particularly, if the production is based on the use of very simple machines and equipment.

The third problem concerns the repair possibilities of the boatyard. The repair may concern the hull and the engine and all other installations, if any. The repair of the hull will be done using almost the same tools as for erection of the hull. However, the repair of installation and particularly of the engine may require machines as lathe, milling machines, boring machines, etc. Therefore, it should be decided at the very begining, if for instance, the engine will be dismantled and brought for repair to a specialized repair workshop and later after repair installed on the boat or if it will be totally repaired at the boatyard. It seems rational to use the first method of engine repair particularly that for small fishing boats also outboard motors may be used. Of course if the yard will in the future develop its activity an own mechanical workshop may be established equipped with proper machines, as for

example listed in the second mentioned paper. This requires, of course, very skilled labors and therefore it may be suggested to increase the boatyard activities gradually.

In connection with the boat engines, it may be stated that in the present period of a very intensive oil savings, the application of sails or wind energy for boats drive is fully recommended. Thus I have prepared also a separate paper on this subject under the title "Application of wind power for ships drive" which you may obtain from the organizing committee and in which are discussed not only the possibilities of the application of sails for different types of ships but also the types of sails and their way of operation.

The last question concerns the structures or arrangements for launching and docking of boats. In the next paper under the title "Shipyard structures for building and repairing of small ships" a detail analysis of different types of these arrangements is given, namely of derrick hoists, marine hoists, lifts, slipways and shipways. It is possible to choose between these structures, of course, taking into consideration the financial possibilities at the time of the yard erection. It may be however, stated that a very simple launching and docking systems containing cradles on tyred wheels which are moving on the slope of the beach paved, for instance, with a concrete slab is possible - such a cradle, described in the second mentioned paper, can be very easy assembled using very simple tools and at the site available materials.

A very essential point connected with the erection of a boatyard is the supply with electrical energy. fresh water etc. The best solution is of course to locate the yard in the vicinity of an electrical as well as water supply network. However, at the time being in the case of lack of these installations, a possibility exists to erect an own power station supplying the yard with electrical energy while the water may be obtained from deep wells or as rain water from especially erected reservoirs. This creates certain construction problems which, however, may be gradually overcame.

A very essential problem connected also with the protection of the environment create the sanitary arrangements, disposal of sewage and drainage of rain water. It is recommended to construct an own network connected to a septic tank cleaned in certain necessary periods.

It may be here suggested that in any individual case a kind of advice may be necessary which may be given either by an expert or an adequate design office. One has, however, to say, that the best results are obtained through discussion with local authorities taking into consideration local skill, local boat building tradition, local weather and environmental conditions, as well as local possibilities in the field of purchase of the final product. Of course, the best solution is to promote the whole event by the state and base on certain financial credits sufficient for erection of the yeard, and for start of full production. It may be, however, in many cases wise not to wait for the full financial support from the state but to start the erection of the boatyard with a certain help e.i. of international agencies and using the experiences of other countries which have already developed their own boat building and boat repair industry.

It would be very valuable if the worksnop which we have opened some minutes ago could be a valuable contribution to the method of fast and cheap development of boatbuilding and boat repair industry in the developing countries. If my papers and the few words which I have devoted to this subject may also be helpful in this field, I will be fully satisfied.
