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PLANNING OF FISHERY HARBOURS

with special reference to the required quay lengths

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1. INTRODUCTION

Basically, the planning of fishery harbours does not differ from the planning of any other type of shipping harbour. However, for the same reasons that a bus terminal differs from a railway station, i.e., the different characteristics and behaviour of the units to be served, fishery harbours differ from the other types and therefore the planning of fishery harbours requires specialized knowledge. Especially when dealing with countries with a developing fisheries, a very broad knowledge is required, from resources and catch potential to marketing systems and consumer preferences, since decisions will have to be made on which type of fisheries to develop, into what it should be developed and, even if the need for harbours is clear, priorities will have to be established.

At present it is common practice to provide harbour facilities for fishing vessels which have been designed considering the vessel's performance only.

The same applied, until recently, to commercial ports but with the introduction of mammoth vessels awareness arose that the vessel and the harbour should be considered together and an optimal solution for the combination should be sought.

In countries with developed fisheries, a strong tradition and the unwillingness of fishermen to accept changes might create difficulties in introducing novelties but, in countries with developing fisheries, an opportunity exists to introduce the evaluation of the combined vessels and harbour and their adaptation to each other.

Moreover, in many developing countries the coastal conditions are such that the construction of fishery harbour facilities with deep water provisions can only be done at prohibitive cost, thus limiting the development of the fishery industry.

Especially in cases where littoral drift exists, the entrances to sheltered areas, e.g. river estuaries, are partially blocked by sand bars, permitting the passage of vessels with limited draft only.

Increasing the water depth in these cases requires not only high capital expenditure but frequently also creates high maintenance dredging costs.

The draft of the fishing vessels planned to use harbour facilities in these areas becomes a crucial point and should be given much attention.

It might be possible that the total operation of fishing vessels with less than optimum performance using relatively cheap harbour constructions proves to be more economical than optimum fishing vessels requiring expensive facilities with high maintenance costs.

2. FUNCTIONS OF FISHERY HARBOURS

In general, the role of a fishery harbour is to provide facilities to enable a proper exectuion of some of the activities which have to take place between the catching of the fish and its consumption.

What "proper" means in this context depends very much on the type of fisheries and the size of boats being used.

Where small beachable boats, landing small quantities of fish, are used, only modest facilities for cleaning, sorting, selling and storage of the fish may be required, in which case it might be better to speak of a "landing place". However, as the fishing vessels become bigger and the landed quantities increase, the need for quicker unloading operations, more selective product handling and improved distribution facilities arises, together with the need for more sophisticated maintenance and repair facilities, both for vessels and equipment.

The provision of shelter also becomes more important, not only to protect the vessels against the elements but also to enable a continuous operation on shore, especially when conditions outside permit fishing operations to be conducted. Which of the required facilities should be provided and/or operated by the port-operating organization depends on the organizational set-up which, in its turn, can be influenced by financial, economic, traditional and ideological considerations.

3. LOCATION OF FISHERY HARBOURS

In many cases the construction of fishery harbours has been determined by the need for shelter and unloading facilities for vessels in existing fisheries; the general location was, in these cases, predetermined and the exact location depended on the site conditions.

In countries with developing fisheries a greater measure of freedom exists in the choice of locations and an opportunity even exists to steer the development of the fisheries by providing harbour facilities at selected places. Prerequisites for a suitable site for the construction of a fishery harbour are in general:

- Fishing operations should exist already in the area, for reasons of required skill of boat operators and shore workers.
- The distance to the fishing grounds should not exceed a certain maximum, this maximum depending on the grade of sophistication of the fisheries envisaged, the fish species, the preservation methods to be used and the type of final product.
- The distance to the major consumer areas should be limited, depending on the type of processing of the products, the preservation and quality requirements and the consumer preferences.
- The physical conditions of the site should be such as to permit construction, operation and maintenance without excessive costs.
- Urban developments should exist in the area in order to facilitate the availability of labour and the provision of means of access and utility services.

The last point can, however, be overruled by general development plans and objectives.

If the provision of harbours is going to be used as a steering device for the development it is extremely important that the development objectives are clearly defined, which is frequently outside the harbour planner's sphere of influence.

Only very seldom does a coast offer a natural sheltered area, suitable for safe and quiet berthing, where a new fishery harbour can easily be developed at low costs and, where the coast offers such natural possibilities, they have usually already been utilized for many years as harbours.

Therefore a new artifical port is often the only possibility, involving high expenditure for breakwater protection, draining works for navigational channel, maintenance dredging etc.

In those cases where the costs for the marine works and also for further infrastructural works cannot be borne by the fishery industry an alternative might be left open in the combination with a nearby commercial harbour. The attractiveness of the combination of fishery harbours with commercial harbours lies in the possibility of sharing the costs for mutually required facilities or by charging them completely to the usually economically stronger commercial harbour.

Problems might arise from this combination, such as:

- ships' traffic problems;
- contamination of the fishery products, e.g. by ore dust;
- the smell of the fishery products might offend other harbour users;
- road and rail traffic problems;
- difficulties in reserving sufficient space for future fisheries development in the event of conflicting interests;
- possible delay in transport due to customs checking;
- insufficient representation of the interests of the fishery industry.

In order to avoid these conflicts it seems recommendable to separate the fishery and the non-fishery activities as much as possible, not only in locatio but also in operation and management, and further, close attention to such thin as traffic regulation and control, careful layout and arrangement planning, taking due account of prevailing wind directions, currents etc., as well as strict control of the design and operation of processing plants, together with long-term planning and a firm development policy, should, in most cases, be abl to reduce many of the problems of conflicts to acceptable limits.

4. ECONOMIC EVALUATION OF FISHERY HARBOURS

It is outside the scope of this paper to elaborate on this subject. It ca be said, however, that no single evaluation method exists which takes all aspec into account and which provides firm answers.

Therefore it is necessary to approach the problem in various ways, to appl various methods and to take into account all possible effects of the constructi of the harbour, including those that cannot be expressed in economic units. Th latter effects can be of great importance, especially in countries with developing fisheries, where objectives like income redistribution, employment creation, regional development etc. might play a decisive role.

Again, it can be said that these objectives should be very clear before ar adequate evaluation can be made.

5. TECHNICAL ASPECTS OF FISHERY HARBOUR PLANNING

5.1 General

When planning a fishery harbour the following characteristic points shoul be kept in mind:

- Fish, and especially wet fish, is a perishable product and therefore rapid u loading and handling should be made possible and vessels should have to wait as little as possible before unloading takes place.
- Fishing vessels are relatively small and require a high degree of protection not only to permit unloading operations but also to prevent damage when the vessels are tied up.
- Due to the uncertainty of catch rates and grounds fished, it is, in general, not possible to have advance knowledge of vessel arrival and departure times
- In most cases, fishing vessels lie idle for part of the time in the harbour, for crew recreation and other miscellaneous purposes.

Where in most non-fishery harbours it is common practice for all activiti such as unloading, reloading, provisioning and light repairs and maintenance t take place at the same berth, because of differing time and conflicting space quirements in fishery harbours it is advisable that separate quay facilities a provided for the various activities. Where the operation is on such a small scale that the efficiency of the operation is easy to maintain, or where highl

specialized vessels use the port facilities only to discharge their catch and to reprovision, the need for separate quay facilities may not be so pressing.

In all other cases, however, it appears to be advisable to provide at least separate unloading quays and, for reasons of smoothness of operation and surveyability, it might be advisable to carry the separation even further by also providing separate quayage for berthing, supplying and maintenance and repair.

The whole range of facilities which might be required in a fishery harbour goes from breakwaters through quays to processing plants and waste and sewage treatment.

In many cases, depending on the operational and organizational set-up of the fishery harbour, only a few of the facilities have to be planned in detail in the early stages. However, even if no detailed knowledge is required about certain other subjects, general knowledge about space requirements, location requirements, water and power demands, ice supply, maintenance and repair of vessels, gear and equipment etc., is required.

Of the facilities to be planned in detail in the early stages, quays are generally a major item as far as importance and cost are concerned.

In the following, therefore, the activities which take place alongside the quays and the quay requirements will be discussed.

5.2 Main groups of activities alongside the quays

The main groups of activities connected with vessel operation that can be distinguished in a fishery port are:

5.2.1 Unloading - For hygienic reasons, and in order to prevent a deterioration in quality, it is important that the unloading operation be carried out as quickly as possible and that the transport line from the vessel to the receiver be as short as possible. Therefore, it is advisable that free space be always available alongside the quay, as close to the receiver as possible.

5.2.2 Berthing - At the berthing space, the boats are often left alone, with or without a watchman, while the crew goes home. The fishing gear is maintained and/or repaired at this place and prepared for the next trip while routine maintenance and light repairs are also carried out. Furthermore, the provisioning for the crew will mostly be done here. It is strongly advisable that a land area in the vicinity of the berthing area is reserved for net drying, rope measuring etc. and that some buildings be provided for net mending, small repairs and the storage of gear and spare parts. Where not enough quayage is available but where an adequate anchorage area exists, it is still advisable to reserve some quayage and land area for berthing purposes in order to prevent the need for an excessive transport with small boats to and from the vessels.

5.2.3 Supplying - The most important articles to be supplied are food articles, fresh water, fuel oil and ice. While food articles and even fresh water can easily be supplied at the berthing area, fuel oil and ice supply may demand a separate quay in order to prevent pollution by spilled oil, to prevent contamina-

tion of the ice during transport or to avoid excessive traffic of trucks and barges through the port with the resulting loss of smoothness and surveyability of the port operation.

5.2.4 Vessel maintenance and repair - For some types of repair and maintenance and for some periodical controls, the vessels have to be taken out of the water. This creates the need for a lifting device of one type or another. Other types of repair and maintenance and some other controls can be done while the vessel is afloat. Due to the specialized character of the work and the need for cranes and other special equipment in some cases, it is strongly advised to provide special quayage for this purpose near the specialized workshops where the work has to be done or whereout the work will be done. When adequate repair facilities are available or can be made available at a convenient distance from the port, it will not be necessary to provide the full facilities in the port; however, some provisions for routine maintenance will still have to be provided, as was pointed out under section 5.2.2.

5.3 Considerations for the determination of required quay lengths

In the following, the requirements for the various activities, as described above, will be discussed, as well as the total quay requirements.

It is not possible to give calculation methods providing firm answers for all situations that may occur and, therefore, the following will be limited to an analysis of the problems and an indication of possible methods for solution only.

5.3.1 Unloading requirements - The following two considerations should be kept in mind:

- The quality of the landed product should not suffer from the lack of unloading facilities.
- The vessel operation should not be handicapped by too long waiting periods before unloading takes place.

The means of preservation of the catch on board, together with the system of sales of the catch, play an important role. For wet fish, both the quality deterioration while waiting and the profitability of the vessel operation will be of importance while for frozen fish the profitability of the vessel operation alone will be of major concern.

Depending on the circumstances, various criteria can be established for the determination of the required quay length, such as:

- For reasons of quality of landed products, there exists a maximum allowable waiting time before unloading takes place.
- In order to have the fish sold as quickly as possible, all incoming vessels have to be unloaded within a certain period of time.
- The balance between waiting time of the vessels and the idling time of the unloading facilities should be such that an economic optimum is reached.

The unloading operation can be described as a queuing problem and, in order to determine the required number of unloading places, the arrival pattern, the service mechanism, the queue-discipline and any interaction between the different parts of the system have to be known.

The arrival pattern differs per type of fishery: for one-day trip fishing the arrival pattern may be rather regular, for a fishery with freezer trawlers the arrival pattern may be random, but for most wet-fish fisheries the arrival pattern differs considerably from the two mentioned above.

The service mechanism depends very much on the type of unloading systems being used which, in their turn, depend on type of catch, preservation methods on board, type of final product and even layout of the vessels.

The queue-discipline will, in most cases, be of the "first come, first served" type; where, however, both frozen and wet fish are landed this system might sometimes be abandoned.

Interaction between the different parts of the system is possible in various ways, e.g. an extra auction might be held in the case of heavy landings, extra equipment and manpower might be put to work when the number of vessels waiting for unloading becomes too great and the arrival of vessels might be influenced by the market situation when this is known by means of radio contact.

If all elements are known then, in the rare cases where the mathematical expressions of the various parts of the system are suitable, an algebraic solution can be achieved. In other cases simulation techniques can be applied or probability calculations be made, giving a solution by accepting a certain percentage of unsatisfactory situations.

In many cases, however, and especially in countries with developing fisheries, the required information is not available and the whole calculation will have to be based on assumptions. In this case it might be more reasonable to effect the calculation by assuming a number of average figures and introducing an irregularity factor which also takes care of all unknowns and uncertainties. The situation is then determined by the following factors:

- Number of groups of fishing vessels, grouped by size and by type of fishery in which they are involved.
- Average number of vessels in a group unloading during one day in a chosen peak period.
- For vessels in each group, the quay length needed when unloading.
- Average quantity of catch unloaded per vessel in each group in the chosen peak period.
- Average unloading speed for each group, including the effect of preparation time before and after the actual unloading.
- Period of time available for unloading during one day.
- Irregularity factor, introduced by the need to work with averages and further dealing with all unknowns and uncertainties.

While this type of calculation includes the difficulty of determining the averages to be used, the main difficulty is the choice of the irregularity factor. Preferably, this factor should be calculated back from existing comparable situations which, however, in many cases is not possible.

5.3.2 Berthing requirements - The basic factors determining the required quay length for berthing purposes are:

- Number of vessels based at the harbour.
- Quay length required per vessel while berthing, which depends on the berthing arrangement.
- Time spent in port in relation to the time spent steaming and fishing.
- Influence of fishing seasons and peak periods on the fishing cycles.

Many other factors, however, should also be taken into consideration, such as:

- Number of boats fishing in other areas but using the harbour as a home port.
- Number of boats not based at the harbour but using it during certain periods.
- Tendency of boats to be all in the harbour on certain occasions (e.g. national holidays).
- The function of the harbour as a port of refuge under special circumstances.
- The pattern of fishing activities. In a case where all the boats go out on Monday and return on Saturday, it is clear that berthing for all the boats together has to be provided and that these provisions will be used for two days a week only. On the other hand, when the fishing activities consist of seven-day cycles, divided into five days out and two days in, a daily average of only 2/7 of the total number of boats will be in.
- Seasonal variations in the fishing activities. In order to determine the maximum demands it might be necessary to consider various seasons, each with different fishing activities.
- Availability of alternative berthing possibilities, like anchorage areas.
- Special weather conditions, such as hurricanes, which require special provisions.

With so many factors involved it is hardly possible to set up a calculation system valid for all types of situation.

If the probability distribution of the presence of boats in the harbour is known, probability calculus can be used to determine how frequently the situation is unsatisfactory, for which a criterion will first have to be established. If the behaviour pattern is sufficiently regular, average values can be used and an irregularity factor can be introduced to deal with all other factors, with the difficulty again of determining the value of this irregularity factor. Some flexibility can, however, be achieved by adjusting the berthing arrangement to

the given situation, e.g., when berthing two abreast is considered preferable, the acceptance of berthing three abreast on special occasions gives an increase in capacity of 50 per cent.

5.3.3 Supplying requirements – The determination of the quay length required for supplying depends on the types of supplies which are considered and the capacity of the installations but, basically, it follows the same pattern as the calculation of the unloading quays. However, more flexibility exists because, while it is an advantage to take ice on board at the latest possible moment, it is not of much consequence when fresh water and fuel oil are taken on board.

5.3.4 Requirements for vessel maintenance and repair – The types of facilities generally required are:

- A drydocking device to enable repair, maintenance and control of the underwater parts of the boats.
- Cranes to lift out engines in the case of serious engine repairs or to strip gear, equipment and deck machinery.
- A series of workshops such as mechanical, woodworking, electric, electronic etc.

The factors determining the required facilities are:

- Total number of boats to be served by the facilities.
- Composition of the fleet with regard to size, weight, shape, material and age of the vessels. While size, weight, shape and, to a certain extent, material of the vessels have their influence on the dimensions of the facilities, the age distribution has influence on the variation of the average length of the repair and control work.
- Duration of repair work, which is also influenced by the frequency and type of obligatory controls for insurance reasons.
- Influence of the seasonal variations of the fishing pattern. Where the fishing is mainly done in a period of nine months of the year, the vessels will all tend to get their repairs and maintenance done in the remaining three months, leaving the busy period as far as possible to deal with accidental damage repairs only.
- Meteorological influences: when painting has to be done in the open this will preferably be done in a dry season.
- Alternative possibilities: where ample space is available alongside berthing quays, the need for a special repair quay will not be so urgently felt. Also, with a high tidal range and when a smooth and clean sea bottom can be made available, certain types of boats might be beached when only a short-time job is anticipated, thus decreasing the need for sophisticated dry parking places.

The factors determining the required facilities are so dependent on the local habits and circumstances that it is not possible to establish general rules for the planning of the maintenance and repair facilities. For each case an optimum

occupation rate will have to be determined, taking into account the cost of idle time of the repair facilities, the cost and loss in earnings of the vessels waiting for repairs and the organizational set-up.

As was said before, it will not be necessary to provide the full facilities in a fishery harbour when adequate repair facilities are available, or can be made available, at a convenient distance from the harbour; however, some provisions for routine maintenance will still have to be provided.

A special problem arises when no specialized facilities are available nearby and the number of fishing vessels is not sufficient to justify the construction of full repair facilities. As far as possible, use should then be made of existing workshops but, even when this is possible, it might be necessary to provide a slipway which will probably not be profitable in itself but which might enable a fishery industry to continue operations at an otherwise suitable location.

If no facilities at all are available, the development of a particular site becomes a matter of choice of location and development policy. In the case of an insufficient number of fishing vessels to allow for a profitable operation of the repair facilities, the combination with vessel construction or other construction activities might provide a solution to arrive at a fuller utilization of the facilities.

5.3.5 Total quay requirements – In some cases the total required quay length is not equal to the sum of the quay lengths required for the four types of usage as described above but will be less when various activities can take place alongside the same quay. For example, in a day fishery, where the unloading quay is only used during a certain number of hours, this quay can be used for berthing during the remaining hours of the day. Also, if on special occasions the whole fleet is lying idle in the harbour, there is no reason why at least part of the other specialized quays could not be used for berthing purposes.

In view of the difficulties in determining the required quay lengths for the various purposes, it is important to make the layout and the arrangements flexible enough to permit adjustements in usage if the assumptions on which the calculations are based prove to be inaccurate.