PORT AND OCEAN ENGINEERING UNDER ARCTIC CONDITIONS
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THE FISHERY HARBOUR IN ICE

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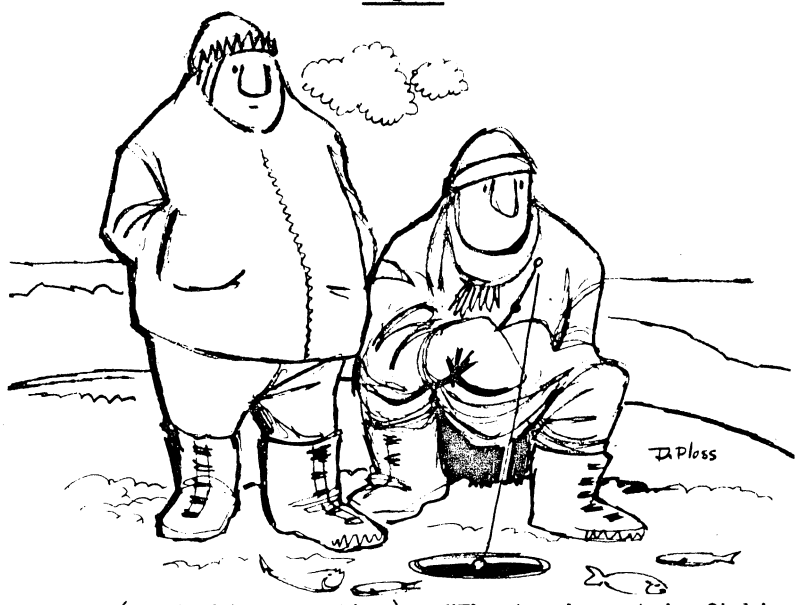
INTRODUCTION

The planning of a fishery harbour in Arctic conditions, which may include long or short periods with ice cover, is not a very different operation from the planning of a fishery harbour in more temperate or tropical climates. Many problems or difficulties taken in their stride by commercial port development engineers become insurmountable barriers to the fishery harbour engineer. The addition of a further hazard or a group of hazards will certainly make his life a little more difficult as, for instance, the worry it may cause him (Fig.1) in determining the size of the "hole" it will be necessary to keep clear of ice - but most engineers thrive on difficulty.

Fig. 1



Port Engineer (on fishing vacation): "The tough part in fishing my pond is chopping a hole big enough for the boats!"

(With acknowledgement and apologies for change in caption to Farm Pond Harvest magazine, 372 South East Ave., Kankakee, Ill.60901, USA)

FAO INTEREST IN ARCTIC CONDITIONS

You may question why the Food and Agriculture Organization of the United Nations (FAO) is interested in the Arctic region with its highly organized fishery industries, when fishery development efforts are usually concentrated on the developing nations of the tropical and sub-tropical zones. It is, however, very interested in the future development of the southern areas of Chile and Argentina with fjords and bays very like those of the Norwegian and Alaskan coastlines. From these southern oceans will come much of the future stocks of cold water fish species, e.g. hake and the small but abundant krill. A second reason is that it has been found by experience that even the most developed fishery nations have had their problems and can be classified, as far as their fishery harbour planning and development is concerned, in the undeveloped category. To illustrate this, one of the first requests for information on the subject received by the writer when he joined FAO was from the United States of America.

PRESENT-DAY COLD REGION OPERATIONS

Since a high proportion of the better quality human-consumption fish resources of the globe are to be found in the colder ocean waters, one understands why so much attention is at present being paid to their exploitation by many of the leading nations. Much of these resources is, however, being sought by the larger fishing fleets of countries located in the more temperate zones where port operations are relatively unaffected by Arctic conditions and crews of vessels alone rough it out in their search for a product with a high market value.

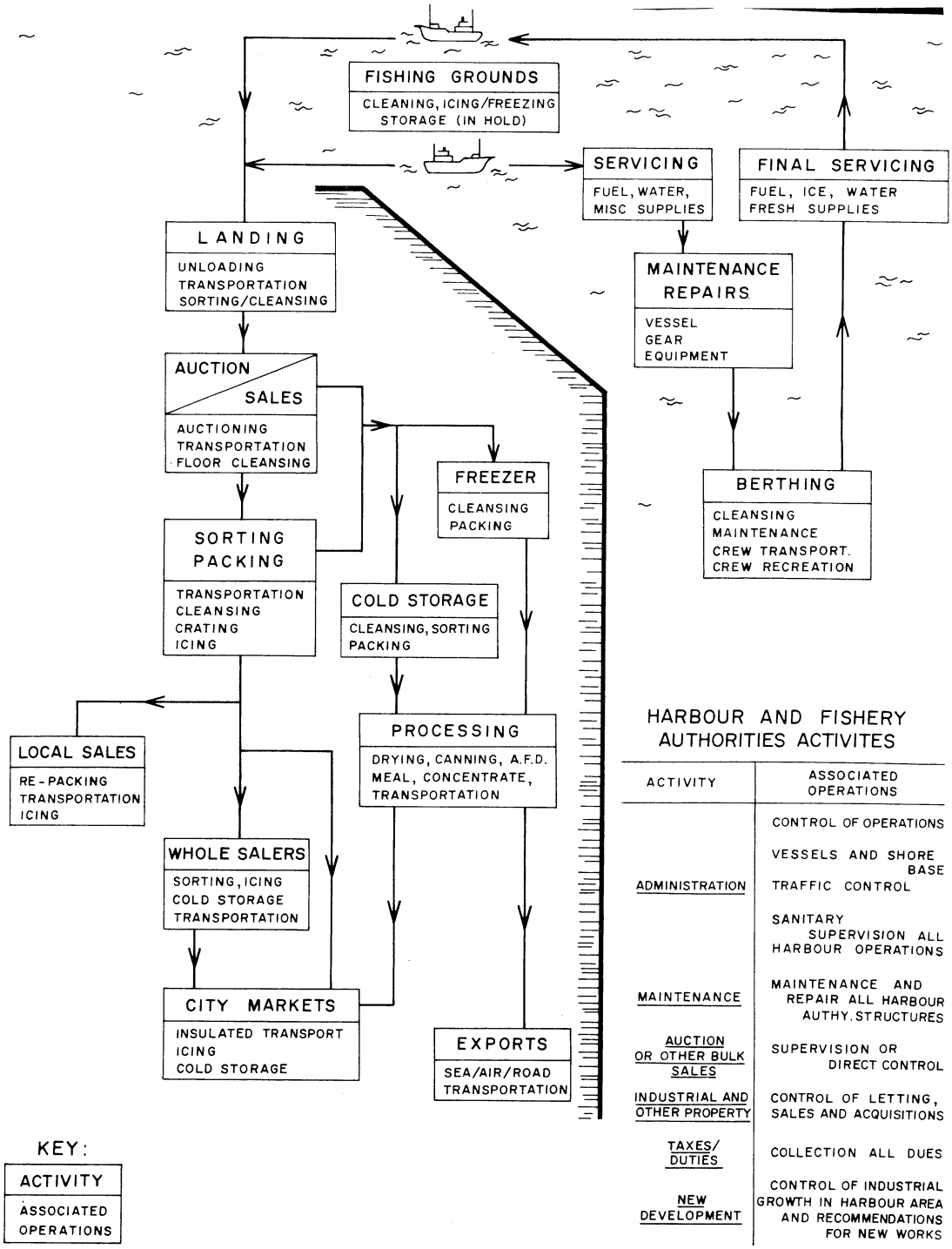
Recent changes, or proposed changes, in the national sea limits and, more specifically, in the fishery limits may in future years reduce this type of operation considerably. Countries adjoining the colder seas will be more attracted towards harvesting their own resources. Larger vessels, better gear and fishery aids will call for more elaborate facilities and provisions and thus the demand for better planned and organized ports will follow. The problems of ice and Arctic conditions now known to the few will, therefore, become known to larger groups of engineers and may result in a very different type of development to that now existing.

DEVELOPMENT OF THE CONCEPT OF THE FISHERY HARBOUR

Earlier forms of planning have frequently been limited to the provision of basins with minimum landing facilities and little thought has been given to providing the necessary services and facilities for the fleets, their crews and the associated processing and myriads of other industries. In other cases, the ports were constructed as railheads to enable fish to be landed and whisked away as quickly as possible to the centres of high population density. In many of these cases as, for instance, in Bremerhaven or in Grimsby an awareness has grown over the years of the complexity of the provisions and facilities that are necessary to keep a fishery port effectively operational and economically viable. Conditions accepted as normal a generation or two ago have gone out with the pigtail and the antimacassar. If they were revived today they would denude the industry overnight of most of its workers or else would result in a food product which would be incapable of meeting the present day stringent quality and sanitary standards. It is therefore very necessary for the harbour planner and designer to examine carefully the operations required in any particular facility and provide for them in the most efficient manner, with due regard to modern management systems and controls. For those who have little experience of the fishery industry, Fig.2 indicates some of the activities of the integrated fishery harbour complex.

Fig. 2

THE FISHERY HARBOUR: Chain of activities



From "The Planning and preparatory work for a fishery harbour development project", W.J. Guckian in Fishing Ports and Markets. London, 1970. Fishing News (Books) Ltd., by arrangement with the Food and Agriculture Organization of the United Nations.

It will be seen that the services and facilities provided can be listed as follows:

Services to vessels:

(i) Protected basins and approach channels of adequate dimensions and depth

(ii) Unloading quays and their operational equipments

(iii) Separate unloading facilities for supplies destined for fish-meal plants

(iv) Berthing and gear outfitting quays

(v) Provisioning and servicing quays and their supply systems (fuel, ice, water, fresh food supplies etc.)

(vi) Gear repair quays

(vii) Vessel repair slipway, boatyard, workshops and jetties

(viii) Vessel construction yards - sometimes associated with repair yards

Services to gear and equipment:

(i) New gear storage and ship chandlers

(ii) Mechanical, electric and electronic repair workshops

(iii) Fishing gear maintenance area (nets, ropes etc.)

Services to crews and port personnel:

(i) First aid and hospital evacuation arrangements

(ii) Amenities, canteens and rest room accommodations etc.

(iii) Sanitary arrangements to cover harbour area

Product handling, distribution and disposal:

(i) Unloading operation and transfer of products to display and market halls

(ii) Provision of display, sorting market and halls

(iii) Means of product distribution within and from the port area

(iv) Administration services

(v) Cleansing services

Product processing:

(i) Freezing

(ii) Cold storage

(iii) Chill room storage

(iv) Canning

(v) Curing by any of several methods, smoking, salting drying etc.

(vi) Fish meal and oil manufacture

(vii) Pet food and other fish extract industries

General port services:

(i) Port operation management

(ii) Port maintenance, new works planning and supervision including plant, workshops etc.

(iii) General port services, including potable water supply, electricity, power and lighting, fire-fighting services, telephone systems, port security, customs control offices, traffic flow control, and the provision and supervision of adequate parking facilities for all harbour users and visitors including tourists.

One can readily identify many elements in this complex of activities where the engineer would be confronted with hazards and problems when Arcitc and ice conditions prevail.

SPECIFIC PROBLEMS ENCOUNTERED IN ARCTIC CONDITIONS

Many of the engineer problems encountered by the fishery port planner, whether in ice or in warmer climates, are similar to those of our colleagues in the commercial port and in coastal engineering but many are also peculiar to the fishery industry. A principal one is that it is the norm for the work to be carried out to a totally inadequate budget with little or no provision for normal maintenance tasks and no thought for major curative works. It can be realized that here, also, might lie the most serious hazard of all in the prevailing Arctic conditions.

Most of the other hazards can be grouped in the following phases of the harbour development:

(i) planning and construction phase
(ii) provision of port and shore services
(iii) operational phase
(iv) other miscellaneous aspects

This paper can merely list the various headings and give a brief suggestion as to their implications.

Planning and construction phase

(a) Estuarine ports. Many fishery ports are located some distance upstream in river channels. Reduction of fresh-water flow and the presence of fresh-water ice can cause considerable differences to the silting pattern both within and outside the estuary - some changes may be adverse while some advantage may be taken of others.

(b) Open-coast ports. These invariably require an artificial breakwater protective system which can be affected in several ways. Icing of the coastal fringes can cause major change in the wave spectrum, currents (whether tidal or other) may deviate considerable from their normal pattern, wind velocities and direction may also fluctuate. These factors may lead to all or any of:

(i) reduction of littoral transport of material in certain places while increasing it in others
(ii) damage to the breakwater structure by ice pile-up and to the port buildings and facilities by toppling over the breakwater parapets
(iii) the inability to keep to a scheduled maintenance dredging programme resulting in interruption in port operations.

(c) Harbour basin and approach channel. Ice conditions may call for a different port layout pattern of basin and approach channel to that determined as the most economical.

(d) Construction work and materials. Careful choice of materials and methods of work must be made. Heating of aggregates and in-situ structures may be called for.

(e) Dredging. This operation may have to be suspended over long periods of time and, since it may form a considerable portion of the fishery harbour project, the result may be an unacceptable increase in project capital costs.

(f) Time lost. Operations on cold dark days will cost considerably more, whether because of time lost due to the elements or because of the necessary amenities to be provided to enable work to continue in more acceptable conditions.

(g) Rock drilling of sea bed under water. This is one of the few operations which may gain from frozen conditions. Under-water rock drilling and blastings call for steady platforms as well as reasonable mobility. Thick ice cover provides both of these characteristics in good measure. It is understood that a large channel-deepening operation at the port of Lulea some years ago benefited from this type of operation.

(h) Sand slide. A very frightening hazard is the sand slide in fjords. It would seem that this may also apply in the Chilean fjords, where damage by earthquake slides is also very prevalent.

(i) Artificial freezing. In more temperate climates frequently very expensive techniques are used to artificially freeze the ground so that excavations can be conducted in safety. Perhaps in Arctic conditions this can be done more cheaply in natural conditions, making full use of the permafrost zones.

Provision of port and shore services

(a) Ice supplies. Depending on the vessel size and type, its insulation characteristics and the length of fishing trip, the amount of ice taken on board can be reduced or dispensed with. This can be measured as a great saving as compared with tropical ports where, for instance, in one port ice demand is up to five or six times the weight of fish caught. Artificially provided chill or cold storage for short-term transfer purposes may also be dispensed with.

(b) Oil and water services. Oil and water services may be difficult to provide and may require special means of keeping them continuously in service, including the steam heating of the pipework. Some floor and deck cleansing services might be provided by means of salt water services.

(c) Product handling operations. The catching operation is always the most hazardous in the fishery industry. It can be made almost intolerable by Arctic conditions. Fishery ports catering for the needs of crews working in these conditions must be provided with every amenity and comfort including first aid and hospitalization services.

A high order of mechanization is necessary to speed up the unloading and vessel servicing operations.

Landing quays and their attendant display, sales and sorting rooms must generally be larger than normal acceptable standards to prevent unnecessary vessel unloading delays through lack of quay and hall facilities available to them.

As far as possible, for the benefit of crews and port workers, all continuing operations should be provided with heated coverage from the cold weather conditions.

Operational aspects

(a) Ice breaking. If the fishing grounds are clear of ice cover, it cannot be tolerated that the fishery vessels be permitted to lie iced up in port for long periods. Few fishery ports, apart from the major ones, can however afford the luxury of a more or less continuous use of icebreakers unless the operations are heavily subsidized by government funds. Siting close to a commercial port where cost-sharing can be accepted on occasions might be another solution. The location of the fishery port within the commercial port area should, however, be resisted.

(b) Snow and ice clearing on land areas of the harbour. The nature of the traffic flow in a properly administered fishery harbour calls for much movement of the product within the port area either by hand porterage or by mechanized methods. It is, therefore, essential that snow or ice is not permitted to interrupt these movements. The extra burden on the port operational costs of this and the previous ice breaking activities may not be tolerable to the port budget or, if passed on to the consumer, may grossly affect the price structure of the industry.

Miscellaneous aspects

(a) Vessel repair yards. Repair yards, an essential provision in or adjacent to fishery harbours, may need to be considerably larger than the normal requirement where vessel repair bays may total 5 to 10% of fleet numbers. Should the fishing operation cease for a short period due to icing up of port or fishing grounds, most vessels will then demand hull maintenance and incidental repairs carried out at this time. Space availability on shore will determine the extent of increase but a figure of 20% of fleet numbers may be a very reasonable demand for repair bays. This may further require an additional slipway or boatlift to cater adequately for the increased throughput.

(b) Means of providing emergency vessel repair bays - since the high demand of the previous item coincides in the Arctic with ice cover. This might be used to provide an external "ice rink" type repair area for the repair of smaller (under 20 m) craft and could be introduced on a seasonal basis. A special steel-shod cradle or sleigh might be designed for movement of the vessel over the ice surface.

CONCLUSION

Each fishery nation of the Arctic region has solved many of its problems in its own independent way. Some may be the best solutions, others may possibly be improved on. It is essential, especially in the future when more of the larger, sophisticated vessels enter the industry, that more cooperation in the tackling of common problems should be practised to ensure the optimum benefit for all members of the fishery industry in these arduous near-polar regions.