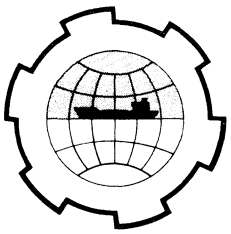
PORT AND OCEAN ENGINEERING UNDER ARCTIC CONDITIONS
TECHNICAL UNIVERSITY OF NORWAY



FISHING PORTS IN NORWAY, SOME ASPECTS OF THE PLANNING OF PROCESSING PLANTS AND SHORE FACILITIES.

Hans Tveitsme,
Civil Engineer

Directorate of
Fisheries

Bergen, Norway

1. INTRODUCTION.

Fishing is a rather complex trade. It requires many different techniques and the utilization of natural resources which involve special problems. Developments in quite different fields concern the fishing industry. The general background is a constant need for increased efficiency in order to make the fishing industry as profitable as other industries. Its products have to compete with other food products both in quality and price; it must be as attractive as other trades to cover its labour needs.

Changes that are taking place both in fisheries themselves and in other fields which influence the fisheries should be taken into account when planning fishing ports and processing plants.

2. DETERMINING FACTORS IN RECENT DEVELOPMENTS.

The following are some of the factors which have been influential in the development of fishing ports and processing plants.

Fishing vessels have become bigger, their gear and equipment more expensive. This seems to be a general trend even in typical coastal or "fjord" fisheries where one traditionally uses smaller boats. The size and complexity of the biggest fishing vessels has grown considerably, both for certain coastal fisheries and for fishing in the open sea. Handling of the catch on board has changed; many of the biggest vessels have installed refrigerated sea water tanks or equipment for freezing at sea; adequate icing immediately after the catch is taken in is now common even for the smaller boats. More expensive boats and equipment call for

greater intensity in fishing and increase the need for quick unloading and outfitting for the next trip.

In the processing industry there has been a rapid development with generally increased productivity as a goal along with the introduction of new products and new processing methods. Many fish processing plants have been converted into highly mechanized modern industrial units. There has been a marked change towards the production of frozen fillets, fish sticks and other refined products, along with the manufacture of such by-products as fish meal and fish oil. However, smaller plants for more conventional or simplified production must still remain.

For all types of processing plants there has been an ever growing demand for higher efficiency, more hygiene in production and higher quality of products. Various measures are taken to even out the supply of fish, it is still admitted that this industry will remain to some degree seasonal and therefore should have relatively high production capacity.

Mechanizing internal transport with the introduction of modern handling equipment has greatly influenced the layout of processing plants. So also has the development of external transport. Road transport by big trailers has taken over a considerable part of the transport of products from the plants. However, transport by sea is still most important, and it also has been subject to changes, bigger and faster ships, use of pallet ships, the need for quicker handling and loading during the day or night, whenever the ships call at one of the many ports along the coast.

Changes in the use of labour are associated with a general trend to reduce labour costs by mechanizing as well as by a shortage of labour; hence one has to save manpower as far as possible. From an industrial hygienic and safety point of view there is now an absolute demand for improvements in the fishing industry, where conditions in these respects often have been unsatisfactory. More stress is to be laid upon welfare for the workers.

The growing demand for measures against pollution also concerns the fishing industry and its disposal of waste.

An aim of the fishing industry in Norway is to be an important part of the economic life in coastal districts and to support the efforts for continued habitation there. The structure of the

processing industry is highly influenced by these considerations.

3. ACTUAL ASPECTS IN DESIGN AND CONSTRUCTION.

These various factors in the development of fisheries and related fields in turn create technical requirements and problems with regard to fishing ports and their facilities. Here some aspects will be pointed out which now seem to have become essential to conception and design. It may be convenient to refer separate to the various steps in the planning process as outlined below.

3.1. The Planning of Fishing Ports and Fish Processing Plants on a National or Regional Basis.

The fishing industry that has grown up in Norway since ancient times has always been exceedingly decentralized with a large number of fishing stations and fishing ports. It is obvious that the main reasons for this are such decisive natural factors as the geographical conditions and the occurrence of fish. There would be obvious advantages, from a technical and economic viewpoint, if activities mainly could be consentrated in a few ports where large and rational plants both for processing and service could be developed, as in many other fishing countries. Recent technical developments in the fishing fleet and in the processing industry also support this viewpoint. Some consentration in landing and processing has also taken place during the recent decades, and the size of the individual plant has grown. It is still characteristic of Norway to-day that there are a large number of fishing ports and processing plants of varying, but mostly modest size.

The fact that fisheries to-day play an important role in the context of our provincial development policy is a weighty argument for the maintenance of a certain decentralization of the fishing industry, and thus a certain geographical dispersal of fishing ports and landing places. It is generally considered that a fairly continous chain of settlements along the coast cannot be maintained unless the many small communities can base their existence on the fishing industry.

It is true that there has in recent years been a marked drift of population away from the most isolated coastal districts, with the result that operations in some small ports have been reduced or given up, whereas the importance of more centrally-situated ports

in the vicinity has increased. A sort of "concentration on the fringe" has developed. This trend is to some extent supported by the authorities. It is assumed that the process will continue, and that a number of outlying districts will be depopulated and many of the so-called "out-ports" closed down. However, this will of necessity take some time, and it is uncertain how quickly, and how far, this trend will proceed. In the meantime, various measures of a more provisional nature may be necessary to keep the plants in these ports on an adequate level. It has been suggested, for instance, that mobile freezing plants be introduced for certain small ports in outlying districts, in view of the fact that it is uncertain how long they can be kept in operation.

Although a far more concentrated development of the fishing industry would be desirable, from the technical viewpoint, it seems to be the present aim to create a network of viable fishing ports, at not too great distances apart along the coast. Of course, all the ports in such a future pattern would not be of equal importance. Not all ports, for instance, would be able to take the largest fishing vessels or export ships. Local conditions may, however, require that a small port be maintained as an active fishing port, and even that it be to a certain extent provided with modern facilities. Attempts are being made to evolve forms of co-operation between small ports and a larger central port. Various alternatives may be considered: the transport of fish landed at small reception plants in the "out-ports" to industrial plants in central ports for further processing is a well known solution. On the other hand the small ports prefer to do as much as possible of the processing themselves. Various forms of semi-finished product or simplified production are then possible, first and foremost the more simple production of salted and dried fish. There is also the possibility that these ports could take part in more sophisticated processes. The "double-freezing method", for instance, might be applicable in this connection, the fish being round-frozen at the reception plants in the "out-ports" and then taken to a central port for thawing and further processing.

The authorities will have to take all these considerations into account in deciding questions which influence the development of fishing ports, whether by financial support or by other means. On the one hand, it is probably advisable, from the technical and economic viewpoint, to concentrate activities in the more central ports, which would provide a basis for rational industrial units,

on the other hand, the foundation of employment must not be swept away from the smaller ports and the communities they support, communities which often the authorities are anxious to see maintained.

The problem of labour also comes into the picture in another way. The fishing industry itself is interested in the reserve of labour distributed along the coastal districts, often in the vicinity of small ports. It is not always easy to find labour for this industry, which remains to some degree seasonal in spite of all efforts to even out the supply of raw material, and which also in other respects may be less attractive than other industries. Examples have been seen of processing plants being established in new areas because of the availability of labour. In this connection it must be noted that Norway still has many natural harbours where large processing plants could be placed without the necessity of extensive harbour works.

3.2. The Layout of the Individual Port.

In the planning of individual ports the heavy increase in the size of vessels is of prime importance. In the case of most ports it is desirable that the largest possible fishing vessels can be accommodated, and for the more important ports it is essential to keep up with developments in the fishing fleet, and in the ships used for the export of the finished products, which are also increasing in size. The trend in the processing industry has been towards plants that make heavier demands with regard to site area. All in all, it is obvious that planning must include greater harbour depths, more space for maneuvering, room for the construction of more wharf capacity, and more land area along the basin.

Until fairly recently a dimensioning depth of 14' to 16' was considered satisfactory for an ordinary medium-sized fishing port, whereas present plans should count on a dimensioning depth of 20' to 22', and considerably more in the case of export ports. The range of the tide varies considerably along the coast of Norway, from an almost non-existent range on the south coast to a theoretical difference between highest and lowest water of more than 3.5 m in North Norway. Weather conditions will increase the real difference, and in ports on the coast of Finnmark the quay level should be approx. 5m above the lowest low-water mark. However, this especially low level occurs only a few times a year,

and it may be a question whether such extreme conditions always should be taken into account. No general standpoint can be taken - it must be a matter of judgement in each separate circumstance. It is of course a considerable advantage for the large fishing vessel that she can lay to at the landing stage with a full load at any time during a hectic fishing season, without having to think of the tides. On the other hand, the last half-metre of depth may be unduly costly.

Another feature of planning to-day is the division of ports into function areas. Especially a division is of current interest between unloading and production areas on the one hand, and service, fitting-out and berthing on the other. Contemporarily, there is an increasing demand for berths along the quay for all, or most, of the fishing boats served by the port. For many of the larger ports abroad this is nothing new, but conditions have developed differently in Norway. We have no auction system, almost all the catch being delivered direct to the individual processing plant. A fixed business connection usually develops between a plant and certain vessels, and it is then natural for the plant to provide these vessels with space adjacent to the plant for gear, baiting, etc. Plant quays have also been used as berths at times when landing was not taking place. However, most of the vessels were obliged to moor in the harbour, partly because it would be relatively expensive for a small port to construct sufficient quay frontage for the widely varying number of vessels it may serve. The development of processing plants on the one hand, and the requirements with regard to service for fishing vessels and the welfare of fishermen on the other, have, however, necessitated a revaluation of the conditions once accepted as normal, and to-day a division into the above-mentioned function areas is more and more considered necessary, and so is quay berth for all fishing vessels served by the port. In some districts trawler firms have been established to provide several processing plants within the area with additional raw material in times of shortage, and the necessity has thus arisen for landing terminals from which catches can be distributed to the individual plants. This represents a new and more particular function area in the ports concerned.

The concern with which all forms of pollution are viewed to-day has brought with it new problems for fishing ports. It has earlier

been the usual practice to dump offal from fish processing into the harbour. In Norway, where there is usually a considerable circulation of water in the harbour basin, and where the depth of water outside the harbour is usually great, this type of offal disposal often seemed suitable and did not appear to involve any particular disadvantages. It is obvious, however, that under certain conditions such disadvantages would occur, and in view of the stricter attitude taken to-day with regard to pollution in general, there will certainly be further restrictions on the dumping of offal. It will then be up to the individual processing plant to find other means of disposal, or measures for the whole port might be carried out, for instance, waste pipes that would run along the plants and dump the offal outside the harbour, or transport to designated dumping spots, etc.

As to the water supply topographical and climatic conditions make it relatively costly to bring adequate water supplies to many of our ports. For this reason seawater has been used to a considerable extent, and can certainly continue to be used for some purposes. However, due to the constantly more stringent hygienic requirements, seawater must either be taken further from the shore, where the water is clean, or else fresh water alone must be used. The latter solution is now usual as new water works has been built in many fishing ports in the recent years. Suitable sources of water are usually available, but often at such a distance from the port that pipelines are expensive, partly because in our climate they must be laid at a frost-proof depth, up to 2 meters, sometimes through solid rock.

There is in some cases a considerable surplus of water in the source used, the pipes might then be protected to a more moderate degree against frost, and the water allowed to flow constantly at a certain minimum rate of flow, for instance, from a remote source to a distribution reservoir at the consumption point. The specific consumption of water at processing plants has increased heavily in recent years. It is possible, however, that a certain amount of water is wasted, and it might well be useful to establish the rates of usage that would be proper in different operating conditions.

3.3. Design and Construction of Individual Plants. A major trend to-day in the planning of individual plants is the demand for more space, both indoor and outdoor. Sites must not only have a longer

shore line for quays, but also a greater land area for buildings and for open transport and handling areas. Ample space for future extension is desirable.

The length of quay must be adapted to the new and larger vessels, and must also meet the present demand for rapid access to the quay and quick unloading. It may, for instance, be necessary to provide berths at the same time for an export vessel, for one or more of the largest fishing vessels, trawlers or large purse seiners, and for a number of smaller fishing craft. In the case of a straight shoreline quay at a medium sized plant of the socalled "all-round" type, a frontage of from 150 to 200 m might then be necessary. Otherwise, of course, the design of the quay will depend to a very great extent on local conditions. In Norway the pier system is not much employed for fish processing plants, except for discharging at larger fish oil plants, but advantage is often taken of local conditions in designing angled or saw-tooth formed quays which provide berths for the same number of boats, with a shorter length of quay. The depth of water at the quayside must correspond to the before mentioned minimum depth in the harbour. It is to-day considered desirable to have at least one berth with a depth of approx. 20' at most plants of any importance. In places where the range of the tide is greatest the distance from the bottom to quay level will then be from 10 to 12 metres. However, it will usually be acceptable, for reasons of economy, to have some berths with lesser depths, as there normally will be a number of smaller vessels to be unloaded. In addition, quays must now be built with a greater free width than was earlier customary, in order to allow for various new types of discharge and grading equipment, and to provide access for modern transport, etc. Quays of lesser width are nevertheless still used for the reception of ungutted fish, the fish being discharged straight into the gutting hall through openings in the walls.

Another feature in many Norwegian plants is the processing of fish, which are kept alive in large "net bags" at the quayside, from where it is taken up, bled, and sent straight to the filleting machines. A suitable space must then be allocated at the edge of the quay area, protected from the ordinary traffic.

Pertaining to the use of refrigerated seawater tanks for transport of the catches ashore, which applies especially to the large purse seiners fishing for herring and mackerel, it is for various

reasons considered that it would be expedient to transfer some or all of these catches to corresponding tanks on shore. Various solutions to this problem are now being considered, for instance movable tanks standing on the quay as part of the ordinary discharge and grading equipment, or more permanent tanks built into the quay or the buildings.

The need for ice has increased heavily, both for use in the plants and, even more, for supply to fishing vessels. Equipment for delivery of ice should be as fully automatic as possible, with ample capacity. Ice often has to be delivered outside ordinary working hours, for instance on Sunday evening when several boats are leaving for the fishing grounds at the same time after spending the weekend in port. What is then required is equipment that can deliver ice quickly, with the least possible use of labour. In Norway the icemaking plant is usually part of the freezing plants. In line with the present trend to separate service function from processing plant, it is now becoming more common for separate ice plants to be built by the service and fitting-out quays for the supply of ice to vessels.

There are several factors behind the need for more indoor space in fish processing plants: more sophisticated production, in which the product goes through a greater number of processes, the possibility of carrying on various types of production in the same plant, the need to handle large quantities in a short time when fish is available - these are some of the key words. Reception departments must be spacious, with large chilled storage areas for intake and temporary storage of raw fish which are now handled by fork trucks at all plants of any importance. New production equipment is constantly being introduced to the production departments, and the premises should be large enough to permit new types of production and the equipment necessary.

Larger and more differentiated production also requires larger and better planned storage rooms for finished products. Another alternative may be to transfer the products to central warehouses, i.e. freezing stores, in the large export ports. In many cases this would appear to be a solution definitely worthy of consideration. However, the individual processing plants are often rather cautious in this connection, they are afraid of finding themselves obliged to cut down production during a period

when supply of fish is plentiful because there is insufficient storage space for finished goods.

Where the area surrounding the plant is concerned, it is the access to land transport which is the main new feature in the picture. To-day it is often necessary to provide access for the transport of finished products by trailer. This affects not only the outdoor area requirements, but also the planning of the plant. Ample parking facilities are also required, as the expansion of the road network in the coastal districts has meant that many workers and fishermen drive to the plants in their own cars. Outdoor areas are also required for stacking of certain types of equipment, empty boxes etc.

Fish processing plants and related buildings are often to-day built on one floor, following the general tendency for industrial buildings. This again means that a larger site is required. Frequently, however, the size of the site available, or other considerations, mean that multi-storey buildings must be built. The large roof surfaces and long free spans make snow load an important factor in construction. In many coastal districts heavy snowfalls are often combined with weather conditions that bring snow, wind, rain and extreme cold in quick succession, leading to loads which are difficult to predict and an additional risk of leakage problems at skylights, etc. Snow load values are of course given in the official table of standards, but these must nevertheless be evaluated to some extent in the individual case, especially in the particular conditions prevailing in certain coastal districts. It is partly due to these conditions that skylights are so little used in our fish processing plants. However, modern building materials and the use of electrical heating wires, etc., are of course capable of considerably reducing the danger of leakage, and skylights will certainly be used when natural lighting cannot be obtained by other means. Apart from the structural problems it involves, snow is often a considerable hindrance for traffic and work on quays and open places, especially in the light of the large outdoor areas now required. There are various methods by which snow could be kept at bay, for instance, heating the surface by electrical heating wires, utilizing the condenser heat from large freezing plants, the use of seawater, etc. An obvious solution is to roof in the outdoor

areas, and this is frequently done by constructing broad screens, which project from the building and cover the quays.

The increased requirements with regard to hygienic standards and to product quality find expression in various ways in the planning of processing plants. First and foremost, every corner of the plant must be easy to keep clean. Work rooms must have light and easily-washed surfaces, and all equipment must be readily accessible for inspection and cleaning.

Another central point in the planning of both processing and service plants concerns the industrial hygiene and the welfare of both fishermen and workers. In earlier days it was usual for fish reception, and much of the processing, to take place on the quay, and in other uncovered areas. Later sheds were built, but until recently many places of work were draughty and unattractive, only the premises where more sophisticated processing methods were carried out being heated. It is now a requirement from an industrial hygienic viewpoint that all work with fish be done in premises that are free from draughts, and heated. The question of how this can best be reconciled with the other consideration that arise in the case of fish production must be carefully weighed. The demand for better industrial hygiene, and for welfare measures, also comes to the fore in other respects, for instance, in the planning of welfare departments, and in protection against the noise of the various processing machinery, of which filleting machines are a current example.

The new features in planning and construction that have been mentioned here have, by and large, one thing in common - they mean more expensive plants. The economic factor then comes into planning work as an independent element of decisive importance. Plants must not be so expensive that economic operation is impossible, and although considerable investments of public money are made in various forms for the development of fishing ports and processing plants, such investments are restricted by the funds available, and they must also be subject to economic considerations.

4. CONCLUDING REMARKS

Attention has been drawn here to some of the major factors in the development of the fisheries, and to related circumstances of decisive importance which bring new elements into the planning of

ports and plants. Many other factors come into the picture, and the elements mentioned are of greater or lesser importance in the different ports.

A fishing port, with its plants and installations, must, on the whole, be planned individually, especially in Norway, where conditions vary considerably from one end of the country to the other.