CHAPTER 106

SOME ASPECTS OF COASTAL ENGINEERING RESEARCH WORKS IN CHINA

by

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China has a long coastline. Only for the continental part of China, the length of coastline amounts to 18,000 km and, when including the coastline of more than 6,400 islands, an overall length of more than 32,000 km may be counted. As far as the geographical features are concerned, China is characterized by the prevalence of plateaux in the west, such as plateaux of Tibet and Sinkiang regions and plateaux of Yunnan and Kweichow provinces. There are nearly a hundred rivers, the most prominent of which are: the Yangtze River, the Yellow River, the Pearl River etc., flowing from west to east into the Pacific, and carrying about 2,000 million tons of sediment each year to the sea. As a result, silty coasts prevail in the vicinity of estuaries while sandy coasts emerge from a distance away. Generally speaking, the depth of coastal waters is comparatively small, especially along the silty coasts, where the beach profile presents a very gentle slope, varying from 1/50 to 1/500, and in some extreme cases even to 1/2000. Hence the maintenance of water depth in coastal harbours and estuaries has become one of salient problems of coastal engineering in our country. A brief description of our research on the sedimentation of harbours along silty and sandy coasts as well as rivermouth regulation, wave protection, etc. is given as follows:

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(A) Research on siltation of harbours on silty coasts

To this the New Port of Tianjing may be taken as a typical example. This harbour was constructed on a mud flat, the material composing the beach is very fine, with mean particle diameter of 0.005 mm, and the beach slope is only 1/1000 to 1/2000. Heavy siltation took place in the water area of the harbour due to the combined action of waves, tidal currents and river discharge. Therefore, the study of reduction of harbour siltation becomes an urgent task. The key to solving such a problem lies in gaining a clear idea of the cause and process of siltation. For this reason we must get an insight into the physico-chemical properties of the sediment deposited in the harbour, have a thorough understanding of the behavior of sediment movement under the action of waves and currents, and investigate the inflow process of the sediment and estimate its rate of transport on the basis of the analysis of field measurements so as to devise the siltation reduction schemes. According to the requirements mentioned above systematic experimental studies of the sediment deposits in the port were performed and then siltation reduction schemes developed on the basis of the comprehensive analysis of field observation data and scale model studies as well. These projects have been carried out in succession over the past decade. At present the water depth in the navigation channel has been increased to 9.0 m below mean L.W., and is safe for vessels of 15.000 tons to enter the port at any time, while general cargo carriers of 40,000 tons can enter at high water.

(B) Research on siltation of harbours on sandy coasts

Along sandy coasts runnels are generally formed on the beaches due to the breaking of waves, and littoral transport of sediment comes into being. Natural coasts are in a state of relative equilibrium when a material balance is reached after a long-term interaction between the dynamic forces of the sea and the coasts. The construction of port results in disturbing the original state of equilibrium and , consequently siltation takes place. Experiments with scale models were conducted with several

sandy coast harbours, indicating that the locations and shapes of runnels were basically similar to those in nature. Despite difference in harbour layouts, such as the use of detached breakwaters, jetties, or even open-type structures, the littoral drifts were more or less intercepted and deposition on the updrift side would occur. The sediment accumulation gradually extends seawards, leading to the formation of a new coastline. It is the depositional behavior of the sediments and the rate of siltation as well as the measures to reduce siltation that are stressed in our present studies.

(C) Research on estuary regulation

Alone the Chinese coast about 100 rivers empty into the sea. All the chief rivers, such as the Yangtze River, the Pearl River, the Chientang River, the Liao River etc., are navigable and highly important to the development of our national economy and therealization of four modernizations. A brief description of the regulation of some main estuaries is given as follows:

(1) Yangtze River Mouth

The Yangtze, More than 6,300 km long, is the first largest river in China. The Yangtze River Mouth, Serving as a vital passage for the foreign trade of six provinces and the gateway to the biggest port of China, the Shanghai port, is of great concern to the development of our national economy. The Estuary is bifurcated into the North Branch and the South Branch. The South Branch is again bifureated into the North Pass and the South Pass, and the latter in turn is divided into the North Channel and the South Channel. At present the South Channel is the main entrance channel. Because of the high river discharges and strong tidal currents, drastic channel changes take place,which has become a hindrance to navigation. For the purpose of improvement, large quantities of field observation data have been collected since 1958. Based on the analysis of the data, a relatively comprehensive knowledge of the characteristics of the channel process has been gained.

Diversified as the phenomena are, they can be classified as two problems. One is the susceptibility of the channels of the south branch to changes, and the other is the difficulties of maintaining adequate depths at the entrances of the navigation channels due to severe siltation. Now a tidal model with a horizontal scale of 1:1600 is available, its overall length is some 140 m and the maximum width is 34 m. A comprehensive experimental study is being performed for the planning of regulation works. The regulation works will be carried out in stages in combination with farmland reclamation.

(2) Chientang River Mouth

The Chientang River Mouth is famous for its strong tide. Low river discharge, strong tidal current and high sediment transport from the sea are the contributing factors in the formation of a huge sandbank inside the entrance. Owing to the fact that the river there is very wide and shallow, along with strong tidal currents and roaring bores, the main channel swings frequently between the two banks, and severe scour takes place once a new channel is formed. In conformity with these natural features our principle of regulation is such that at first we confine the tidal flow by reclaiming the foreshore of the river mouth, so as to reduce the inflow of water and sediment during the flood tide. It is hoped that by so doing the main channel will be stabilized and sandbank lowered. The final program consists of building tidal gates at the mouth of the river (in the vicinity of Jianshanhuang) to control the river discharge and tidal flow. A series of theoretical analysis and model studies have been performed for the above-mentioned programs. In the meantime, reclamation of the foreshores has been carried out in stages. Up to now 50,000 hectares of land has been reclaimed, and the river mouth has got its course initially stabilized.

(D) Research on wave protection works

Along the Chinese coast water depths and wave heights are comparatively small and most of the breakwaters are of rubble-mound type. Apart from model tests of rubble type breakwaters,

large numbers of experiments have been conducted to investigate the stability of artificial armor units sueh as tetrapod bloeks, Akmon blocks, tetrapod hollow bloeks, I-blocks, wing blocks,frog blocks etc., as well as breakwaters armoured with the artifieial units mentioned above. Some of the above types have already been adopted in engineering practice. In addition, wall type breakwaters of caisson and concrete block construction are also in use at many harbours. Recently not a few experimental studies have been performed with a view to further improving the stability of the breakwater, reducing its cross section and saving its engineering costs. For instanee, owing to the adoption of a sloping breast wall, we got ehamfered upright breakwater which, as eompared with the conventional wall type breakwater, bears a low horizontal wave pressure at high water and , what is more, the vertical wave pressure is increased, thus resulting in much improvement in the stability of the breakwater. This kind of breakwater is already in use in Tsingtao, Proving successful in withstanding the attack of severe waves. Recently the eonstruetion of deep water harbours has given a stimulus to the study of floating breakwaters.

The problem of the effect of typhoon waves on breakwaters and the damage resulting therefrom has aroused broad interest of all the coastal engineering cireles both at home and abroad since the attack of Typhoon No.3 on the Gulf of Pohai with associated heavy damage in 1972. Special technical discussions were held and, later, special studies made on the selection of the frequency of occurrence of design waves. Now a method, which conforms to the particulars of China, has been developed of selecting wave height and wave period corresponding to a certain frequency.

In the field of theoretieal investigation on waves, methods which conform to China's particulars, are developed for sea wave prediction, calculation of wind wave elements and so on. Our research work also includes some basic problems such as loss of wave energy due to turbulence and the like.

Furthermore, in the aspect of coast protection and seawalls, systematic studies of the height of wave run-up on sloping,

embankments have been conducted by laboratory tests along with analysis of field data. The results of investigation are already used in the design of seawalls.

Above is only a brief account of our research works on coastal engineering. As China has a long coastline, many problems remain to be solved. Despite all the above efforts we still lag behind what the development of our national economy demands of us. Now, it is for the first time that we, the Chinese delegation, take part in the activities of the International Conference on Coastal Engineering. We come here chiefly for the purpose of learning the advanced experiences from our friends, as well as carrying on academic exchanges, which, we think, would further promote the friendship and mutual understanding among us.