CHAPTER 84

ENCLOSING SCHEME FOR BATHING-BEACH DEVELOPMENT

by

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ABSTRACT

This paper refers to bathing beaches. It presents a method for beach design which provides both coastal protection and protection for the bathing public. Reasons are pointed out as to why the open sea foreshores are, in many cases, not suitable for recreation.

The method uses an enclosing submerged breakwater coupled with short groins to provide a bathing beach with a safe swimming area and a controlled sand plaza. Economical in execution and maintenance, the method can be used for sandy or rocky coasts.

Fig. 1. Enclosed Sela Beach at Bat-Yam. General View. 400 m. long by 175 m. wide.

INTRODUCTION

The use of beaches for recreation has assumed tremendous proportions (Ref. 1) and, with growing frequencies of heat waves, it may be expected that sea bathing will continue to rise in demand.

Various coastal protection measures (Ref. 2) used in coastal engineering emphasize mainly the protection and creation of sandy plazas. The problems of sea bathing were left open. This paper is devoted foremost to the human aspect of coastal protection rather than to sedimentation or to structural problems.

Bathing in the open sea foreshore (where most bathing takes place) is in many cases a safety hazard, and swimming or other recreational activities are hardly possible. Besides the good swimmers, the surfers and those who enjoy jumping to the rhythm of breakers, there is a vast public of ordinary people, including families with children, the handicapped and the elderly, which require controlled sea conditions for bathing, swimming, rubber boating and just playing around in the water. This last group of people is often deterred from bathing in the sea by conditions and warnings of waves, currents, changing depths and rocky sea bottoms, pollution, reappearing sludges dumped in deep sea, sharks, jellyfish, fear of drifting out into the sea, strict lifeguard discipline, etc.

The Enclosing Scheme is aimed at developing a method by which bathing beaches will provide side by side enclosed and open sea coastal protected sections for the benefit of almost all groups of bathers. The following paragraphs describe the results of two built, enclosed beaches. They also describe general open sea conditions, emphasizing the need for beaches, public and private, to be properly utilized.

DESCRIPTIVE SUMMARY OF RESULTS

In general, the Scheme was meant to provide beaches with safe bathing areas, sand plazas and hinterlands protected against winter storms. In the Scheme, the submerged breakwater encloses a water area of reduced wave heights, cut off from open sea dangers. The short groins maintain the plaza sands and the seawall protects the hinterland at the back of the plaza. For rocky beaches, sand has to be brought in.

The Scheme was introduced at two locations of differing coastal characteristics along the Mediterranean shores of Israel. In 1969, an area about 400 m. long by 175 m. wide was enclosed at the sandy Sela Beach of Bat-Yam, at the central west coast of the country (Fig. 1). A rocky pocket beach about 75 m. long by 50 m. wide was enclosed, in 1974, at Achziv in the north of the country (Fig. 2). This enclosure is the first part of a planned future development and, being limited in size and water depth, it mainly serves families and children visiting the adjacent park.

Fig. 2. Enclosed Achziv Beach. General View. 75 m. long by 50 m. wide.

Sela is a very popular beach and from the time of its enclosure, seven years ago, soundings, field observations and water quality tests have been performed. The following summary of results and respective layout of the Scheme refer to Sela Beach, with occasional reference to Achziv Beach.

1. Layout. Fig. 3 presents the general layout of the Scheme and of the structural elements. The overall enclosed area is some 65,000 sq. m. (Achziv 4,000 sq. m.). The water area is about 40,000 sq. m., at present. The enclosure follows the lines of existing submerged beach rock. The reason for this was mainly economical. (In Achziv, too, advantage was taken of existing beach rock.) The submerged breakwater was based partially on sandy seabottom and partially on rocky bottom. The outer groins, on top of the beach rock, were designed to top the sides of the submerged breakwater. The location of the inner groins was influenced by the existence of the refreshment kiosk. The inner groins are not yet at their proposed full length. The sea wall follows the front line of the refreshment kiosk, leaving a limited hinterland up to the cliff. The plaza is some 25 m. wide at its narrowest, between the mean sea water line and the sea wall. The plaza is expected to be widened an additional 15 m. by lengthening the inner groins and by adding a groin at the southern sector.

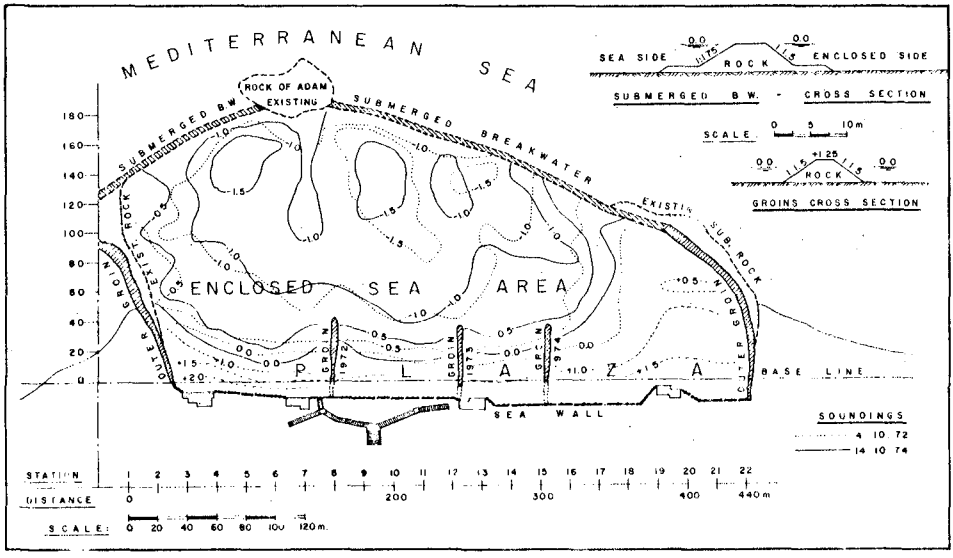

Fig. 3. Sela Beach. Layout of Enclosure, Structural Elements, Cross Sections and Soundings. Dated October 1972 and October 1974.

Long beaches can be developed step by step as was proposed for the whole beach length of Bat-Yam (Fig. 4).

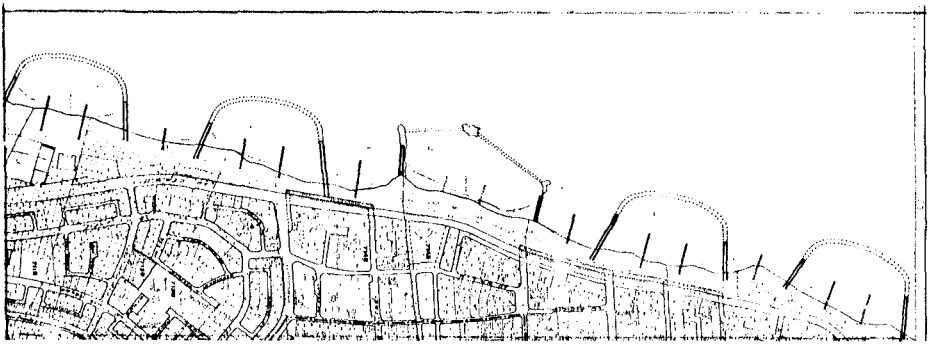

Fig. 4. Proposed Development for Bat-Yam Coast.

2. Waves and Currents. Wave heights in the enclosed area are considerably reduced, compared to outside wave heights. Those measured in the enclosed area were a maximum of 0.5 m., while estimated heights outside were around 1.5 m.

During most of the bathing season, bathing, swimming and rubber boating were safe inside, whereas they were hardly possible outside.

Waves sliding over the breakwater re-form in the area, some distance from the breakwater. The re-formed waves are of an oscillatory nature and swimming is pleasant. There are almost no currents. In certain wind conditions, relatively weak currents were occasionally reported between the breakwater and re-forming line.

During winter storms, wave heights in the area may reach up to 1 - 1.5 m. and currents of significant strength were reported by good swimmers.

The difference between wave and current conditions inside and outside are significant (Fig. 5). Bathing in the enclosed area is possible throughout the year, except during winter storms.

Fig. 5. Sela Beach. Difference in Agitation Between Inside and Outside the Enclosed Area. Limited Bathing Outside.

3. Water Depth and Sediment Movement. In most of the enclosed area, water depth is no more than 1.0 m. from mean sea level, i.e., about 1.5 m. from inside, still, high water level. In some areas, the water is deeper, up to 2.5 m. The shallow areas are usually preferred by the majority of the visitors. Figures 3 and 6 show soundings related to mean sea level, taken at beginnings and ends of bathing seasons. The depth lines seem to be relatively stable and the slopes gentle.

During and after construction of the breakwater and groins, sand movement took different forms. During the construction period,

sand drifted into the area and a tombolo was formed in the lee of the Rock of Adam. During the first two years after construction, the sand of the tombolo moved to the northern corner creating there a wide plaza. During the same period - prior to building the inner groins and prior to securing the southern outer groin against outflanking - the whole center and southern plaza areas were washed out, leaving beach rock exposed above and below sea level. Since the construction of the inner groins and the placing of sand between them, the plaza width became relatively stable, the beach rock became covered with sand, and seasonal sand movement takes place in the enclosed area. During the summer months, sand drifts from the plaza towards the breakwater creating shallow water areas near the breakwater, opposite the southern and central groins (Fig. 6).

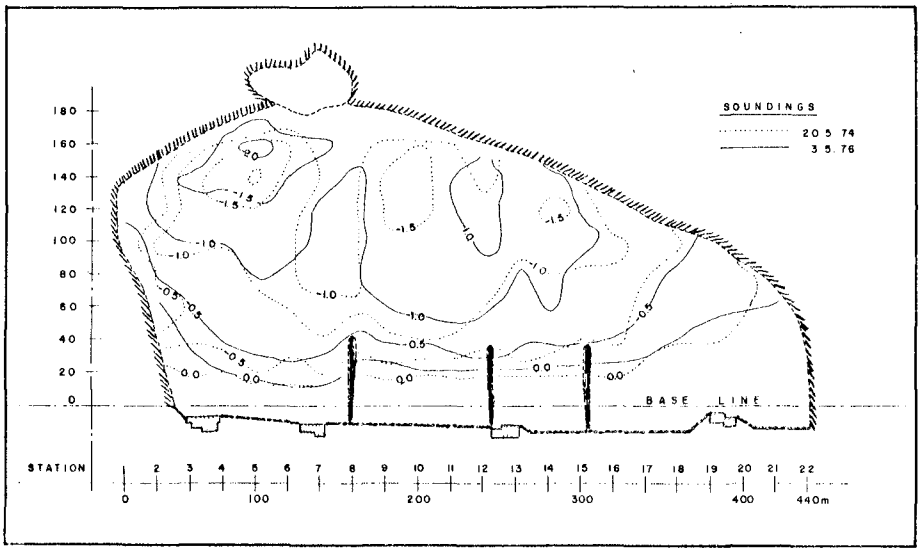

Fig. 6. Sela Beach. Soundings May 1974 and May 1976, (also see Fig. 3), Related to MSWL.

These shallow water areas may reach a height of -0.5 m. below mean sea level. The winter storms push the sand back, but it appears that not all of the sand goes back and not to its original plaza sections. During the last two years, some 2,500 cu. m. of sand remained in the water area. So far, no maintenance has been done in the water area, but it is expected that in years to come sand will have to be shifted from the water area back to the plaza. Shifting of sand in the plaza area takes place at the beginning of each bathing season for shaping up the area after winter storms. So far, since the building of the inner groins, there have been no noticeable changes in the overall balance of the sand in the enclosed area.

Outside the area, at the sides of the outer groins, accretion took place. This accretion undergoes seasonal changes within the general on- and off-shore movement of the sediments. The littoral drift appears to bypass the area around the breakwater.

4. Water Quality. Water quality inside is the same as outside and the enclosed area cleanses itself. The still water level is higher inside than outside, resulting in a constant out-flow of water.

A water temperature difference of 2°C, higher inside than outside, was measured during the bathing season.

During construction, contamination from the open sea penetrated into the enclosed area resulting in an odour in the northern part of the enclosure. This odour faded during the first bathing season after construction.

Afterwards, the following facts were reported: a) A pipeline, located some 150 m. to the south of the area, discharges fluid spoil of brown color. Even under southwesterly winds, a small part of this fluid was seen penetrating the area. The bulk of it was seen bypassing outside the breakwater; b) Before the beginning of the 1975 bathing season, the Bat-Yam beaches were accidentally flooded by untreated sewage. In July, the waters were retested and all the beaches, including the Sela, were found clean - fit for bathing; c) This 1976 season, the Sela Beach was declared open for bathing whereas the other two beaches to the south were closed due to contamination.

5. Recreation. The enclosed area provides sea bathing recreation also to a public which, in open sea conditions, could not bathe. It has been noticed at many locations that wide, sandy, open sea plazas are used to capacity by visitors, while actual sea bathing is very limited.

In the enclosed area, a considerable part of the visiting time is spent in the water and a wide range of recreational activities are available. Bathing, swimming and swimming lessons, rubber boating and shallow water diving are exercised inside; amateur fishing takes place from the breakwater to the outside.

Enterprise could still broaden the recreational activities of the water and hinterland areas. It should be emphasized that the enclosed area gives the impression and feeling of open sea bathing and not of a swimming pool. The sand plaza, sea water, sandy bottom, space, low waves, open horizon, onshore breeze, security and lenient attitude of the lifeguards provide sea bathing and recreation in a relaxed atmosphere. For the good swimmers, entrance to the open sea can be either through the open sections of the beach at both sides of the outer groins or, in order to avoid bypassing the dangerous foreshore, from specified places along the breakwater.

Most bathers prefer shallow water. In the enclosed beach, bathing is spread over wide areas, whereas outside it is limited to narrow strips and only as directed by the lifeguards (Fig. 7).

Fig. 7. Sela Beach. Bathing Mostly in Shallow Areas. Outside Bathing Limited to Narrow Strips. Inside Bathing Spread Over Wider Areas.

6. Design and Construction. Design of the enclosed Sela Beach started in 1968, and continued through the construction period and until the inner groins were built. At that time, wave data and personnel experience* with submerged breakwaters and enclosed sea areas were available from the building of Ashdod Port, about 30 km. to the south of Bat-Yam. Partial soundings of the Sela area were taken at the beginning of the design, and field observations in the area and along other bathing beaches were made through the whole design period. No laboratory tests were made because of lack of local data, time and the high cost in foreign currency in comparison to the overall cost of the structure.

The beach rocks at both ends of the area were thought to serve as parts of the enclosing structure, but a closer survey during construction indicated the necessity of full enclosure by means of dumped rock and the necessity of elevated outer groins at both ends.

The necessity of the inner groins became evident during the first winter of construction. The inner groins were built only after serious damage occurred to the inner plaza. Close observations were made as to sand movement prior to and after the building of the groins.

The submerged breakwater was built at a water depth of approx. 2.5 - 3 m. The nominal crest elevation was designed to be at mean sea level. In reality, some rocks are lower and some are up to +0.6 m. and more (Fig. 3). The armour rock, of 5 - 8 ton class, was designed for wave heights of 3.5 m. The placing of the rocks was carried out from both ends, simultaneously. The equipment operated from an overbuilt elevation of 1.5 - 2.0 m. above mean water. After enclosure was achieved, the overbuilt rock was removed and used as berms at both sides of the breakwater. The quantities of rock were about 100 tons per lineal meter of breakwater. The work was done during one summer season.

OPEN SEA CONDITIONS

Open sea bathing is in many cases a safety hazard and of limited recreational value. Along our Mediterranean coast, the foreshore is particularly dangerous and there most drownings occur.

1. The Foreshore. The foreshore is the area between the

*The author served as supervising engineer for design and construction of breakwaters at the Port of Ashdod

water line and the outer limit of the nearshore bar. The assumed conditions in the foreshore, as described, are based on observations during a bathing season prior to the construction at the Sela Beach.

During most days of the summer months, the eastern coast of the Mediterranean Sea is exposed to onshore winds resulting in waves 0.6 - 1.2 m. high and sometimes up to 2.0 m. high (Fig. 8).

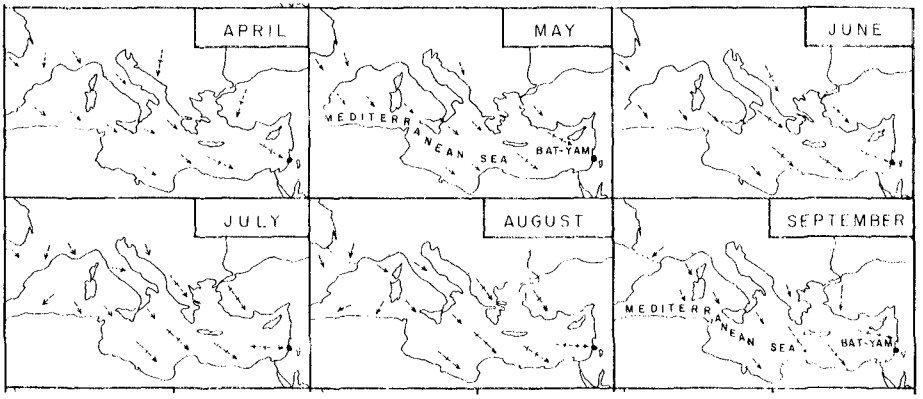

Fig. 8. Monthly Wind Conditions at Mediterranean Sea.

At the same time, a nearshore bar with a crest elevation of about 1.0 m. below sea level exists parallel to the coast.

The nearshore bar was sounded (Ref. 3)(Fig. 8a) and appears to be in fair agreement with the assumptions based on previous observations.

The waves break to the seaside or on top of the bar and almost the entire width of the foreshore is covered by surf. It appears that the area between the water line and the inner limit of the bar acts as a current velocity field in which flow takes place in all directions (Fig. 8b). Studies made in the past provide a wider range of information (Ref. 5 & 6).

Along the bar, there are breaks or rip-passes through which rip-currents are forced out into the sea. On top of the bar the water seemed to be air entrained, absorbing currents from both sides (Fig. 8c). The bar configuration, the rip-passes, current velocities and current directions seemed to be changing under changing wave conditions. In the area, drownings occurred as near as 5 m. from the water line and difficulties in returning

to shore were experienced by ordinary bathers, while rip-currents endangered even fairly good swimmers. Because of frequent drownings during bathing seasons, a law was enforced banning entrance into the sea except under supervision and as directed by lifeguards.

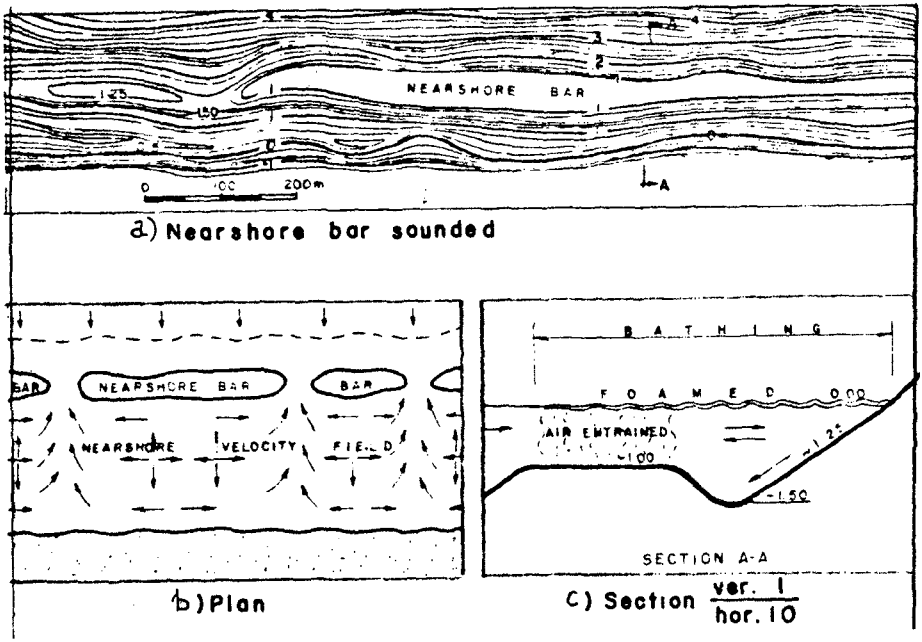

Fig. 8. Schematic Diagram of Nearshore Bar and of Nearshore Current Velocity Field.

2. Open Sea Bathing. Open sea bathing is in many cases confined to jumping to the rhythm of the breakers. The ordinary bathers' time in the water is short and at a very limited distance from the water line. The great responsibility resting with the lifeguards results in their enforcing stringent restrictions on the movements of the bathers, and bathing takes place in narrow areas perpendicular to the shore.

Swimming, rubber boating or other recreational activities are hardly possible during most days of the bathing season (Fig. 9). Visitors often spend their time on the plazas without going into the water, or they wade for short periods. In many cases, even wide beaches with lifeguards cannot be rated as bathing beaches.

Fig. 9. Open Sea Beach Near Achziv. August 1976.

SUMMARY

With the increasing demand for recreational beaches, beach design should include the problems of sea bathing and related recreational activities.

During its seven years of existence, the Enclosing Scheme proved that safe sea bathing and recreation for private and public beaches can be achieved and long sections of shore can be developed step by step with relative economy.

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