

## CHAPTER 93

### NEW DESIGNS FOR BEACH PROTECTION STRUCTURES

by

G.D.Khaskhachikh, Candidate of Science

G.A.Tsaturiyani, Candidate of Science

Ya.S.Shulgin, Engineer.

All-Union Research Institute of Transport Construction  
Igarskaya proezd, 2, Moscow I-329, USSR.

Along some length of the Black Sea coast line there are beach protection structures largely represented by groins and traverses in conjunction with wave resisting embankment walls. The groins are built of 30 to 100 t concrete blocks and set on a rubble-mound foundation levelled by sea divers.

In the course of building and exploitation of these structures, a number of disadvantages have been revealed. These are:

- The groin structure is affected by the waves that scour the rubble-mound foundation at the bottom and thereby disturb it. Failures occur more frequently at the head (seaward) part of the groin;

- The rubble-mound is concerned with having to perform a great deal of heavy and harmful to health diving job, such as underwater excavation, filling and levelling the stone material, etc.;

- The rubble-mound cost and labour involved are estimated to be high.

An example of deformation of such a groins is shown in figure 1.

Investigations were carried out in order to develop more reliable and industrialized designs of groin and transverse for use in soils subjected to scouring by waves. This resulted in achieving some new concepts of groin design which were then realised in construction on the Adler site of the Black Sea coast. The site was situated on a huge accumulation promontory formed by sand-shingle deposits. Reaching the shore, there were the sea waves up to 5-6 m. Due to a deficiency of sediments in that area an erosion process had already started involving the shore slopes, beaches and the sea bottom near the shore. The stabilization required for this section of the shore was being achieved by building a system of beach-protection structures, such a groins, stepped-slope sea-walls, submerged breakwaters, and by making artificial beaches. This system of beach protection has proved to be highly efficient in stabilizing the shores. Beside the conventional structures set on the rubble-mound foundation, two groins of a new design set on reinforced concrete hollow cylindrical piles were used there.

The experimental construction was aimed at field examination of the erection procedure for these structures, as well as to define their reliability in the course of application.

The first of the two test groins, shown in figure 2, is comprised of to 4 x 5-6 m, 2-4.5 m high concrete blocks weighing up to 100 tons.

Each block has a central hole 1.7m in diameter for a prestressed concrete hollow cylindrical pile 1.6m in diameter to be driven through it by vibrodriver. There are also semicircular slots on the butts for 20-t concrete keys. 1.6m in diameter to be inserted in them. These slots can as well be used for driving the piles. The head portion of the groin consist of two blocks fixed in place by



Fig. 1. Deformation of the conventional groin.

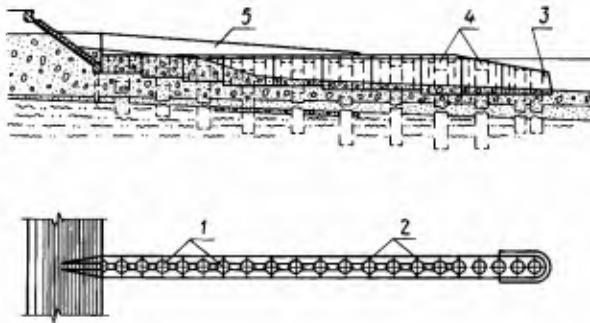


Fig. 2. Scheme of the concrete block groin set on cylindrical hollow pile foundation.  
 1- concrete blocks; 2- concrete keys;  
 3- head block; 4- cylindrical hollow piles;  
 5- cast-in-place concrete.

three hollow cylindrical piles. On the whole, the 60-m long groin is comprised of ten blocks, nine keys, and ten 8-10m length piles which are driven to the depth of 5 to 6 meters. The concrete blocks function as a reliable conductor in driving the piles, and as a means of protection for the latter from the sea-water abrasion.

Connection of the groin with the sloping wall was performed with cast-in-place concrete, also used in forming the levelling plate and profile crest.

The erection procedure for the groins consist of the following steps:

- pit excavation using a floating crane with a grab;
- installation of prismatic blocks;
- installation of the keys;
- installation and vibrodriving the hollow cylindrical piles;
- placing the cast-in-place concrete.

The groin under construction is shown in figure 3, and the same groin fully completed is shown in figure 4.

The second test groin is a reinforced concrete structure composed of slabs that fit into the slots of the concrete bearing blocks. These slabs are also supported by the hollow cylindrical piles driven through the holes in the blocks (see fig. 5).

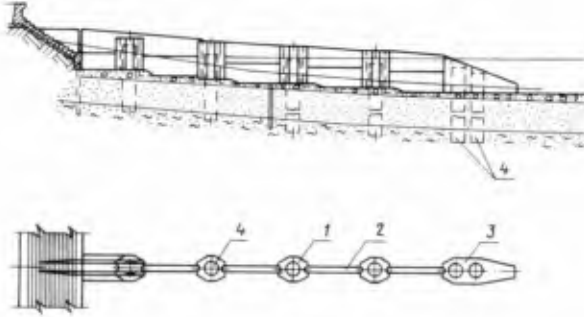
The 60-m length groin structure consist of four intermediate 60-t bearing blocks; a 65-t head portion; six hollow cylindrical piles; and ten 4-7m length, 0.6m thick concrete slabs weighing from 11 to 26 tons. The slabs are placed in two courses by height. The thin-walled groin structure is more acceptable from the economic point in view, though special means are needed to protect its slabs from abrasion by shingle deposits. For this purpose the high-strength concrete with a polimer-concrete covering is used, as <sup>well as</sup> the cast-in-place concreting for all of the other members of the structure. The erection procedure for this groin is principally the same as that for the former. A general view of the groin under construction is shown in Fig.6



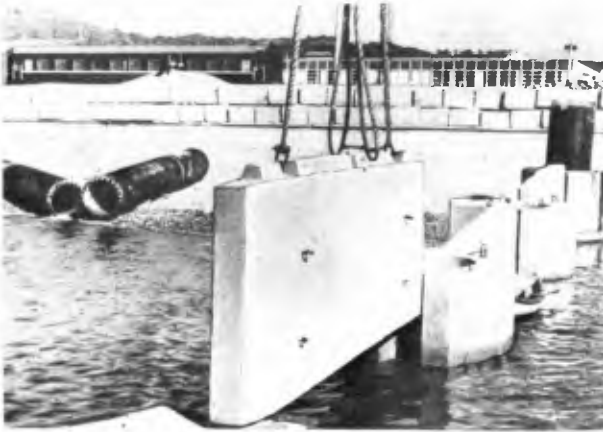
Fig. 3. Groin made of concrete blocks under construction.



Fig. 4. Groin made of concrete blocks is fully completed.



**Fig. 5.** Scheme of the groin made of reinforced concrete slabs.  
 1- bearing blocks; 2- reinforced concrete slabs; 3- head block; 4- cylindrical hollow piles.



**Fig. 6.** Groin made of reinforced concrete slabs under construction.

For all of the blocks and screening slabs in these test structures, the footing was installed below the active layer of deposits. In order to improve the block-pile connection, the piles were driven 1.5m further down below the block surface.

During the construction period and successive two years of exploitation, the new groins were subjected to repeated attacks of heavy and long storms with the waves up to 5-6 meters, but according to detailed examinations of these structures no damage has been recorded.

The test groin investigations have enabled designing a combined groin structure for shores with shingle deposits prevailing. The on-shore portion of such a groin is composed of prismatic blocks while the head portion is of thin-walled slabs.

Such a design is more suitable for the groin operation  

---

under these conditions.

