

EARTHQUAKE RESISTANT COAST GUARD AND FLOOD PROTECTION FACILITY

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Abstract. The article is devoted to the design features, principles of operation and identification of shortcomings of well-known coastal protection structures designed to protect river banks from erosion and erosion, as well as from floods and floods, as well as the development of their earthquake-resistant design. It has been established that the known embankment structures have a number of disadvantages, and their ability to withstand earthquakes and floods is very low. In order to increase the efficiency of coast guard facilities and expand their functionality, a new coast guard complex was developed, different from its predecessors, and its design, operating principle and protective ability were explained. The proposed coastal protection device consists of bottom thresholds with a practical profile, a guide wall, a protective guide head, a reinforced concrete coating, a shock-absorbing intermediate layer, a sand-gravel preparatory layer, a heel and large river stones laid on the heel part. The device has the ability to work as a coast guard device, embankment protection and flood protection.

Keywords: coastal protection device, earthquake, flood, protection, design, principle of operation, functionality

Introduction. In rivers, mountain rivers with high flow rates, as well as a result of natural and anthropogenic impacts on the riverbed and slopes in their bends, bends and narrow sections, complications such as erosion of banks and channels, cliffs and flooding and destruction of adjacent territories, settlements, communication lines and other objects arise. At the same time, the collapse, erosion and erosion of slopes and riverbeds lead to premature filling and failure of reservoirs built on them, regulating and other hydraulic structures that bring silt and bottom. It reveals the need for the use and construction of coastal, coastal protection and flood control structures to eliminate these complications.

2. The object of the study is coastal protection and flood protection structures used on rivers.

3. Research methodology. Data were collected on hydraulic structures and drainage processes for the development of a coastal protection structure, the principles of construction and operation of similar structures were studied, their advantages and disadvantages were identified with the involvement of scientific analysis.

4. Analysis and discussions. In case of floods, floods and earthquakes, flushing of the river bank and bottom leads to an increase in the intake and weighing of particles, and ultimately to the filling of the reservoir located in the lower parts of the river with sediments and premature failure of structures at the waterworks.

On the other hand, the erosion of the banks of the river leads to a change in its natural flow, causing floods and floods during high water. For example, frequent floods and floods of rivers flowing in the Sheki-Zagatala zone of Azerbaijan have led to damage and destruction of settlements, communication lines, industrial facilities and other structures and structures, causing enormous damage to the economy and population of the country.

Therefore, it is important to strengthen the bottom and banks of rivers, especially mountainous and prone to floods, and to prevent erosion processes.

The analysis of literary sources shows that there are two ways to deal with the collapse, leaching and erosion of the banks and river bottoms (Волков 19681, Гришин 1955).

1. Reduction of the flow flushing speed and power due to displacement of the flow hose from the flushing zone;

2. Increase of stability and resistance to flow in the flushing zone.

The first method, i.e. removal of the drain (its mass) from the flushing zone, it is carried out with the help of longitudinal and transverse devices in the bend of the river (in this area, the river leaves the channel both during high water and during high water).

The second method, namely, increasing the stability and resistance of the channel in the arrival and flushing zone, is carried out with the help of protective jackets of the flushing zone and shore protection devices (Алперин 1973, Смирнова 2002).

In the first method, longitudinal structures include guide dams, reinforced concrete walls, special steel plates and spurs (Гришин 1962, Гришин 1979). At the entrance to the flushing zone, one end of the dam or the guide wall (this is called the channel) is put on 3-10 m on the river bank, and the other end (this is called the channel) freely goes into the river. A partition is installed in the remaining space between the dam or the guide wall and the river. The dam is made in a curved form in plan. The flow, changing its direction, leaves the flushing zone. At this time, a rotational movement of water (vortex) in the direction of the current occurs between the dam and the shore. Due to the change in the direction of the vortex and whirlpool, the water flow rate decreases. The washing of the shore disappears, and in the interval between the dam and the shore, the arches collapse. The partition connecting the shore and the dam increases the stability of this dam (or wall), and also accelerates the collapse of the drains. Depending on the characteristics and conditions of the rivers, guide embankments (shields) are used as longitudinal structures. Seedlings can be submerged to the bottom-stationary and floating above water-temporary and permanent.

The transversely located structures include hemispheres (semi-dams) and spurs. Labels or spurs are placed in the flushing area perpendicular to the flow axis or at a certain angle. Their root (one end) is put on the shore, and the other end remains in the river.

This is how hemispheres work. The stream shrinks due to semi-deserts and moves away from the shore. He approaches the shore again, and a whirlpool appears between the hemispheres. At this time, the energy of the flow is turned off, and the conclusions collapse between the hemispheres. Thus, the flushing of the shore disappears. To increase the distance between the hemispheres, they are placed in a direction inclined to the axis of the flow. The slope ranges from 5-15° per angle.

On some banks of rivers that have a fast current or interfere with their flow, along with the spread of the banks, their bottom is washed away. To prevent flushing, not too high lower thresholds are used. Bottom rapids divert runoff from the bottom of the river and reduce its speed. A vortex forms between the thresholds in the direction of the horizontal axis, and part of their bottom sediments settles in the zone between the thresholds. This eliminates the flushing of the river bottom. These devices are destroyed faster during earthquakes. Therefore, their seismic resistance should be increased.

One of the rivers whose bottom and banks are eroded and deformed is the Tarter River (Quliyev 2015). As a result of interventions in the riverbed in the village of Zyumurkhan of the Bardansky district, its natural stability has been completely lost. The same case was recorded in different areas of the Tartar River. Therefore, design and construction work was carried out to restore the stability of the river.

The mentioned, that is, the first method and the structures necessary for its implementation partially protect the bottom and the river bank. But these structures are considered more effective in regulating the flow processes in the river. However, the mentioned structures are dangerous for fleeting floods and do not give the expected effect on rivers with sharp turns, the consumption and level of which often fluctuate. Therefore, the second method is used, that is, ways to increase the stability and resistance of the riverbed in the flushing zone, and devices (structures) that perform them.

One of the simplest constructions when attaching a ramp is planting grass, grass and woody vegetation on the slope, combining fascine on the slope, shah-shavalin and stone with fascine (a set of branches or twigs) (Гришин 1955, Гришин 1979). This design is an outdated design and when they are used, it becomes impossible to mechanize the work.

One of the designs of the pitched fastening is the laying of stones consisting of one or two layers on the banks of rivers prone to landslides and leaching. This structure cannot withstand high water speeds, the effects of flood waves and quickly fails. To make up for this shortcoming, large-sized stones are poured onto the ground on the bottom and slope of the river and give it a slope. If there are not enough large stones, gravel-gravel material is poured onto the bottom and slope of the river and stone prisms are created on it. Such structures cannot withstand specific, high-speed mudstone flows and are destroyed during flood flows. When fixing river slopes, gabion mattresses and gabion braid are also used. In these constructions, gabion mattresses are laid directly on the bottom and slopes of the river. The gabion braid is sewn in a combined way. The bottom of the river is lined with gabion mattresses, and rectangular gabions are braided on top. In the remaining space (area) between the gabion spit and the slope, either soil is poured or gradually filled with river bottoms. Practice shows that this gabion fastener is also resistant to floods and landslides.

The river slopes are also bonded with asphalt concrete lining. An asphalt concrete layer 5-10 cm thick is laid in the slope leaching zone. Asphalt concrete coatings are made of two types. In factory conditions, pallets (plates) with an area of up to 15 m² are made and brought to the construction site by laying them with a crane in the right place. Asphalt concrete coating is made directly on the stand at the construction site. An asphalt concrete mat (covering) with an area of 50 m² is wound on a drum and placed on the shore by a crane. The tip of the coating at the water level is attached to the ground using anchor piles. The end, which remains under water, is weighted with a concrete beam. This design is considered cost-effective. However, this type of construction does not withstand the destructive effects of flooding. Such a fastening design can be used on rivers whose speed is relatively low.

A structure with a perforated reinforced concrete frame is considered to be a more effective structure in terms of strength and durability. This structure consists of reinforced concrete piles with a diameter of 150 mm and precast reinforced concrete perforated panels. Piles are driven at certain distances from each other, and perforated panels are placed between them from head to toe. Piles are used as supports to hold panels. This design is quite expensive to manufacture and build.

One of the fastening structures that can be erected at the bottom and above the water is a structure made of reinforced concrete supports and filled with stone inside. This design with holes from head to toe is characterized by mobility and durability. But it occupies most of the river. Ultimately, this leads to a decrease in the width of the river and an increase in the speed of the river flow. The latter leads to the erosion of the river bottom and leads to flooding of the floodplain.

Among the mentioned fastening structures, reinforced concrete coatings (monolithic or prefabricated) and elastic reinforced concrete gratings are considered the most reliable and durable. Reinforced concrete coatings are laid on top of the sand-gravel preparatory layer. They are manufactured in various designs, such as pallets, reinforced concrete chains, beams, grilles, etc.

In recent years, a number of coastal protection structures have been developed to strengthen the banks of rivers (Габібов 2012, Габібов 1991). Employees of the Azerbaijan Research Institute of Land Reclamation B.M.Akhmedov, I.A. Agayev, A.M. Muslimov have developed very original shore-protection or shore-protection devices and obtained patents of the Republic of Azerbaijan for these devices (Əhmədov 2007).

One of the coastal protective structures consists of concrete pallets, a tongue-and-groove tooth, a heel part and piles surrounded by a grid and filled with river stones inside (Əhmədov 2008). All the elements are firmly interconnected. To resist the eroding and destructive effect of flooding, both piles and a stone tongue-and-groove were used.

The second coastal protection structure is designed to strengthen and protect the banks of rivers from the destructive effects of flood and flood waters. The cup holder consists of concrete pallets, supporting parts of pallets and processed large-diameter car tires mounted on supports, two rows of processed small-diameter car tires firmly connected to each other and filled from the inside with river stones, as well as the heel part (Əhmədov 2007).

The study and analysis of the principle of operation, design features and conditions of use of known coastal protection structures and structures allows us to conclude that known structures and structures have a number of disadvantages.

1. The fields of application of known structures and structures are limited, and most of them cannot be used on mountain rivers.

2. They have poor resistance to earthquakes, floods and flood flows. For example, a significant part of the coastal, coastal protection and coastal protection structures built in the Sheki-Zagatala region of Azerbaijan could not withstand small earthquakes, floods and flood flows, and their individual sections collapsed and failed.

3. Well-known shore protection, shore protection and shore protection structures and structures do not participate in the regulation of the current and have a passive effect.

4. Known structures and structures have little or no effect on changing the internal structure of flood and flood flows flowing in rivers, reducing their speed and impact force, as well as on the flow processes.

5. The overall dimensions of most of the known structures were quite large, narrowing the riverbed in the areas where they were built, causing compression of the stream and an increase in its speed. This also leads to the flushing of the river bottom. At the same time, the narrowing of the river creates a real basis for the occurrence of floods, preventing the release of flood waters.

The above-mentioned emphasizes the need to create a more reliable, durable, efficient and suitable for use on rivers with different characteristics of coastal protective structures. With this in mind, a coastal protection device was developed, which differs from its predecessors in design and principle of operation.

4.1 The new Coast Guard.

The proposed installation consists of a bottom threshold, a guide wall, a protective guide head, a reinforced concrete lining, a sand-gravel preparatory layer, a heel part and river stones laid on the heel part (Fig.1).

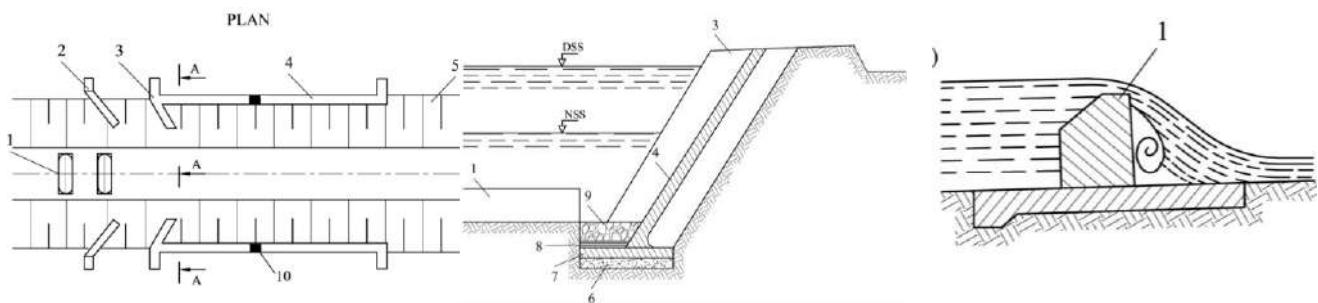


Figure 1. Coast Guard and flood protection: a-cross section of the bottom threshold; 1-bottom threshold; 2-guide wall (spur); 3-protective guide head; 4-reinforced concrete lining; 5-river bank; 6-sand-gravel preparatory layer; 7-heel part; 8-clay layer; 9-river stones; 10-shock-absorbing intermediate layer; DSS-flood water level; NSS-normal water level.

At the entrance to the coastal protection structure - two bottom thresholds are placed at the bottom of the river to turn off the speed and energy of the flood current and retain part of the bottom runoff. On the left and right sides of the central part of the bottom thresholds, submerged guide walls (spurs) are built on the slope in order to direct the flow direction to the center of the river and partially eliminate the erosion of the banks, as well as to muffle the kinetic energy of the flow in the channel. The guide walls are also designed for the subsidence of part of the supply material between the protective guide head. The entrance part of the reinforced concrete lining at the beginning (in front) of the section of the river subjected to overflowing and flushing is dressed on the one hand to the shore, and on the other-at a certain angle to the central axis of the river to direct the flow to the center of the river, damping the energy of the flood flow, protection from the destructive effects of

the supply products of the protective lining and prevention of seepage, which in case of an earthquake, it penetrates into the back side of the cladding and weakens the stability of the structure in the form of a protruding protective guide head. In order to increase the stability of the device, prevent it from washing and flying, deforming and slipping, the heel of the visor is made in the form of a retaining wall seat. The height of the protective guide head (Wall) is assumed to be 0.5-0.1 m higher than the difference between the flood water level (DSS) and the normal water level (NSS). This height can direct both floods and normal flows. To prevent the displacement of the lining during an earthquake, shock-absorbing intermediate layers are placed between the brackets of reinforced concrete linings.

To prevent leaching and seepage of the lower and heel parts of the unit, a layer of clay and river pebbles is laid on top of the heel (seat).

This is how the proposed stand works.

Flood and flood streams bring with them a large amount of materials (mud, stones, sand, gravel, pieces of rocks, tree stumps and branches, etc.), which enters the zone of constant flushing and flooding of the river at high speed. At this time, bottom thresholds and submerged guide walls located in front of the coastal protection structure resist the current, partially extinguishing its speed and kinetic energy. A certain part of the terminals settles in front of the lower threshold and between the guide wall and the protective guide hood. Due to the protective and guiding pressure, the velocity of the weakened flow decreases somewhat, and the flow rod together with the terminals moves along the central part of the installation, deviating from the shore. The contact of the protective lining with the flow terminals is greatly weakened, and its friction and impact on the terminals disappear. This ensures the protection of the cladding.

Practice shows that all coastal protection structures and structures fail prematurely due to erosion and wear of their bottom, mainly the construction part. But as a result of changes in the flow rate, power and structure in the proposed installation and due to river stones laid on top of the heel part, the process of washing the bottom and the construction part of the installation does not occur.

In case of an earthquake, a layer of clay laid at the base of the protective lining and shock-absorbing intermediate layers placed between the facing brackets soften the earthquake transmitted to the object and prevent it from collapsing.

The proposed coastal protection structure works according to the principle described above, even during the absence of floods, floods and landslides on the river, while the threat of collapse, erosion, erosion and deformation of the banks is completely eliminated. At the same time, since the combined installation regulates the flow structure, the probability of flooding does not arise, thereby eliminating the threat of flooding of settlements, agricultural land, construction and industrial facilities, communication lines and other facilities.

Conclusions. In contrast to the well-known structures and structures, the coastal protection structure can be used both in areas of increased seismicity and in rivers with inclined slopes, as well as in channels of rigid and rectangular shape. The structure can be built on both sides of the river-on the right and left banks, as well as on the river bank, which is more prone to spills and washouts. The proposed installation is able to work more efficiently on sharp turns of the river.

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