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# VOLUME 3

# TECHNICAL SPECIFICATIONS

CB006.2.12.062 – 07 - Construction works to strengthen the banks and the bed of the Sandanskа Bistritsa river in the village of Lilyanovo, Municipality of Sandanski

1. Introduction

The Sandanska Bistritsa is a river in Municipality of Sandanski. The river is 33 km long and originates of the south-western slopes of the Pirin mountain. Its drainage basin covers a territory of 139 km².

There are three settlements along the river - town Sandanski and two villages, Lilyanovo and Stozha. Therefore, it is vital to have the river banks safe and fortified. During the late spring and in winter, the river is high and dangerous, especially in the sector which goes through both villages. As a result, in the event of heavy rain and flash floods, there is a significant possibility of flooding of houses, private properties and agricultural land. In 2010 the river had gone out of its riverbed and flooded the nearby areas and houses of the residents of the villages of Lilyanovo and Stozha.

The purpose of the current works contract is to carry out the envisaged infrastructure activities and works on a specific section of the Sandanska Bistritsa riverbed, located in the villages of Lilyanovo and Stozha, including construction of corrective walls, construction of water catchment, gabions, as well as other works related to cleaning and deepening of the river bed, shaping of slopes, forestation, etc.

The project for clearing of the bed and reinforcement of the banks of the river Sandanska Bistritsa in the area of Lilyanovo village is situated in EKTTE (unified classifier of urban territories) No. 43699, Municipality of Sandanski. The project is intended a protection measure for part of the village against high water level in Sandanska Bistritsa River. The cadastral basic details for engineering purposes were retrieved from the map of restituted property and the cadastral regulation plan of Lilyanovo village, supplemented by direct geodetic survey. Register with coordinates was prepared in the 1970 system for the walls. In the area of the above sites, there are not cultural or historical heritage sites or protected sites.

The objective of this project is to specify actions required to ensure fire safety during preventive clearing and reinforcement of the banks and the riverbed of Sandanska Bistritsa River in the section at v. Lilyanovo, Sandanski municipality. The project is intended to provide the required flow of the river in the section upstream and downstream of the bridge via corrective concrete walls shaping the cross-sectional profile of the river, 12 m wide. **The construction site is 1st /first/ category as per art. 137, par. 1, point 1, letter «g» of the Spatial Planning Law (SPL).** The walls have different lengths depending on the terrain and identical cross section and foundation depth, H=1,5, base of gravel and large boulders.

The first section of the riverbed has obstructions of the flow and potential hazard of bank erosion downstream the little bridge at the HMS No.51540 point. Only the left side bank is subjected to erosion and it is planned its reinforcement using a line of gabions 2x1x1 m, 37 m long.

The second section endangered by erosion is 400 m away from the bridge downstream, 20 m long; it is planned its reinforcement using gabions 2x1x1 m.

The third section endangered by erosion is also situated on the right side bank, 53 m long.

1. Hydrological data

The hydrologic parameters of the S. Bistritsa River have been determined for the area of HMS No.51540 at the start of the section intended for emergency clearing and banks reinforcement.

This development demonstrates details for the water catchment area and general parameters of river flow with details included for minimum water quantity and high water level, being of key importance of the design calculations of the corrective walls.

At the subject point of the river flow has been obstructed by the previously built, to years ago, Sandanska Bistritsa cascade with 3-off water power plants with rated flow 4.0 m3/sec. and water take off for water supply to Sandanski municipality –of max 150 l/sec.

The orohydrographical components of the water catchment basins and the details for surface water runoff for a medium to dry year at the point of HMS No.51540 for Sandanska Bistritsa River have been shown below:

|  |  |  |
| --- | --- | --- |
|  | Natural pattern | Disturbed pattern |
| - Water catchment basin area | 118.6 sq.km | 118.6 sq.km |
| - Surface runoff module | 22.7 l/sec/km2 | 10.5 l/sec/km2 |
| - Average annual water amount for a medium dry year | 2,7m3/sec | 1,24m3/sec |
| -Water amount for a medium dry year | 85 mio.m3 | 39 mio.m3 |
| -average annual water quantity for a 85% dry year | 1.90 m3/sec | 0,7 m3/sec |
| -water amount for a 85% dry year | 60 mio.m3 | 22 mio.m3 |
| -high water level with 5% reserve | 67 m3/sec | 67 m3/sec |

1. Conclusions from the hydraulic survey

**Basic data:**

* High water level @ 5% reserve Q=67 m3/sec.
* High water level @ 1% reserve Q=102 m3/sec.
* Water catchment width -> 12.00 m
* Bottom inclination -> i=7, 5%o.
* Roughness coefficient of gravel bottom π=0.0225

**Design calculation formula**

* Chézy’s formula -> Q= F.c.√R.i [m/sec]
* F=12.0 x 1.4 = 16.8 m2 cross sectional area, for water flow height H=1, 4 m
* R = F/p = 16.8/14.8 = 1.13 m -> hydraulic radius in meters
* P = 12.0 + 2 x 1.4 =14.8 m wet perimeter for water flow height H=1, 4 m
* Readings as per Pavlovski **:** c =45.1
* Q = 16.8 x 45.6 x V1.13 x 0.0075 = 65 m3/sec. – secured for high water level and reserve assumed as 40 cm for the walls over the high water level – wall height H = 1.4 +0.4 = 1.8 m.

**Hydrological information from studies**

The subject region from hydrographic point of view falls within the basins of the left-side tributaries of the Struma River in its lower run. The water catchment of S. Bistritsa River starts from Northern Pirin, with some lakes contributing, and the river run-off in summer months is higher. Such increased aquifer activity in the mountain part of the basin is determined by significant amount of precipitation, and significant run-off effects of the latter, especially in the higher parts, due to steep slopes and limited evaporation rate under lower temperatures.

The pattern of superficial run-off can be explained via data collected at the HMS point No.51540 at v. Lilyanovo.

**Parameters of average multi-annual run-off**

In the subject point of the river, run-off has been disturbed by the construction of Sandanska Bistritsa Cascade built 40 years ago with 3-off water power plants, with design flow rate of 4.0 m3/sec and water intake for water supply for Sandanski of max. 150 l/sec.

Determination of high water level is based on empirical formulae of Alekssev, Sokolovski et al.

High water level has been determined with 5% reserve as per the design norms for this wall class – IV, H=15 m max.

The orohydrographic components of the water catchment basins and data for surface run-off for a medium dry and a dry year at the HMS No.51540 point for S. Bistritsa have been demonstrated below:

|  |  |  |
| --- | --- | --- |
|  | Natural pattern | Disturbed pattern |
| * Area of the water catchment basin | 118,6 sq.m | 118,6 sq.m |
| * Surface run-off module | 22,7 l/sec/km2 | 10,5 l/sec/km2 |
| * Average annual amount of water for a medium dry year | 2,7 m3/sec | 1,24 m3/sec |
| * Water mass for a medium dry year | 85 mio.m3 | 39 mio.m3 |
| * Average annual water amount for a 85% dry year | 1,90 m3/sec | 0,7 m3/sec |
| * Water mass for 85% dry year | 60 mio.m3 | 22 mio.m3 |
| * High water level, 5% reserve | 67 m3/sec | 1. 3/sec |

**Yearly distribution of runoff by month**

Yearly distribution of runoff means natural laws of variation within a single hydrological year. Annual distribution of river runoff is irregular, just these three months – March, April and May, contribute approx. 50% of annual runoff to S. Bistritsa. Runoff distribution is based on data lines at HMS No.51540 of S. Bistritsa River. The runoff pattern valid for the period of study there is maximum peak in March and April, and a minimum for August and September.

**Maximum water amount**

High water level has been determined with a reserve of 5%, a norm used for design calculations for this wall class IV, H= 15 max.

Maximum water amount constitutes a significant part of this development. It is a characteristic component of runoff pattern. Knowledge of origin and nature of high water level is highly important.

Typical for the subject region is the fact that, high water level in most cases follow the distribution pattern of precipitation. Equally important for the formation of high water level are orohydrographic features of the water catchment basin of S. Bistritsa river. Typical for the said mountainous feature is high peaks and extended duration of occurrence of high water level.

1. Design solution

**3.1 Description of the site**

Due to deposition of large boulders and drift, the left aperture of the bridge at S. Bistritsa River upstream v. Lilyanovo has been completely obstructed and the river flow has headed only through the right side aperture; high water level caused overflow through the bridge in December 2010, and in the vent of a subsequent flood the bridge will be destroyed. To ensure passability of the river in this section, upstream and downstream of the bridge, we have planned construction of corrective walls of concrete to shape the cross sectional profile of the river, width 12 m. Following the inspection onsite to establish the condition of the riverbed using geodesic survey of the riverbed, we have found four different challenging sections and measures have been suggested to improve the condition of the riverbed and the banks via corrective walls and gabion facilities.

The most endangered section of the banks upstream and downstream of the bridge will be provided with corrective walls; works will include clearing of the obstructed pass of the bridge to ensure flow of high water.

The walls will have different lengths according to the terrain, and with identical cross section and foundation depth, H=1,5 m with a base of gravel mixed with large boulders.

Wall No.1 – left side bank (in the direction of flow) – 35 m long

Wall No.2 – right side bank (in the direction of flow) – 47 m long

Wall No.3 – right side bank (in the direction of flow) – 45 m long

Deposits at the left bridge support will be removed, as well as those under the road slab.

The walls have been designed for ground pressure, excluding live load, due to the fact that there is no existing road, and construction of a new road is not intended, since there are other access roads to the river. As per the provisions of article 41 of the rules for support walls, H= 4,0 m max, seismic design calculations are not required.

The first section of the riverbed has obstructions of the flow and potential hazard of bank erosion downstream the little bridge at the HMS No.51540 point. Only the left side bank is subjected to erosion and we have planned its reinforcement using a line of gabions 2x1x1 m, 37 m long.

The second section endangered by erosion is 400 m away from the bridge downstream, 20 m long; we have planned its reinforcement using gabions 2x1x1 m.

The third section endangered by erosion is also situated on the right side bank, 53 m long, to be reinforced with gabions, 2x1x1 m.

Following inspection of the riverbed and the banks, we found other minor depositions and partially eroded locations, banks covered with small bushes and single trees that can cause new depositions.

1. Construction activities and other requirements

The construction site shall be placed within the subject section within the existing flooded area of the river and excluding agrarian land.

The estimated period for **the completion of work is 6 months,** to be completed in several stages, with no clear-cut milestone in between, due to works performed at several locations.

**Stage 1** – Clearing of bushes at the base of the corrective dykes, preparing for construction. Delivery of wagons and WC to the site.

**Stage 2** – Dyke construction, with temporary redirection of the river from the construction point.

**Stage 3** – Construction of walls and gabions.

**Stage 4** – Finishing works, vertical planning and preparation of the section for commissioning.

Apart from the earth and preparatory construction activities the construction of walls and gabions will be essential for ensuring the objectives of the project. The dimensions of the corrective walls have been determined based on hydraulic and static calculations considering specific loads. A cross sectional profile was adopted for the concrete support wall with base rein bars for the plinth joint. Hydraulic calculations were employed to determine the riverbed cross section: B=12,0 m and H wall= 1,8 m

The walls differ in length according to the terrain, however they have identical cross section and foundation depth H=1,5 m – on top of gravel base, mixed with large boulders.

* Wall No.1 – left side bank /in the direction of flow/ - 35 m long
* Wall No.2 – right side bank /in the direction of flow/ - 47 m long
* Wall No.3 – right side bank /in the direction of flow/ - 45 m long

The walls have been designed for ground compression force excluding live loads, since there is no new road adjacent to it, and no construction of new roads is intended due to the existing access roads to the river. As per the regulations and provisions of article 41 of the Rules for support walls, H= 4,0 m max, no seismicity design calculations are required.

The static calculations indicate the basic information used to design the walls. The relevant wall dimensions have been shown in the formwork arrangement plan. The base of the wall is B=1,10 m wide, with foundation of gravel and aggregate base following removal of water from the excavation , without substrate concrete. The walls will be made in lamella pattern of 20 m with construction joints in between. The base shall be accepted by the Engineer as a mandatory requirement.

The construction of corrective walls can be subdivided by the following types of works:

* Construction of temporary deviator dyke from the foundation excavations
* Removal of water from the base
* Foundation framework
* Concrete works for foundations
* Formwork, reinforcing steel and formwork removal for the walls
* Backfill behind the walls

Water catchment will be constructed using:

* Concrete grade B20W04 (C16/20)
* Steel AI No.12 – structural and Φ8 distributional

Gabions will be constructed on the levelled riverbed, with depression of 30 cm. on top of the gabions a concrete cover of 20 cm will be made to extend the life of the mesh and to protect the rein bars against robbery of bars from the gabion skeleton.

* 1. **Use of constriction machinery**

The following machinery will be used on the site: bulldozer, excavator, front loader, mobile crane, concrete pump truck, concrete transport truck, dump track, and other heavy machinery if necessary.

Machinery allowed to work onsite shall be provided with technical dossier and shall be in full conformity with the project requirements for construction works.

Operators of construction machinery driven by electric motors shall be qualified and shall hold certificates qualification group II for safety.

All machinery can only be operated by authorized operators, following instruction of the specific conditions of work.

**Other necessary mechanization and tools are:**

**Standard construction tools (optional)**

* Hand tools - shovels, rakes, hammers and nails, model knives, wooden planks;
* Power tools - drills, saws, hammers;
* Concrete plasters - trowels, sealants;
* Hand tools - levels, tripods, levers, laser signalization, receivers, props, twine.
  1. **Temporary construction facilities.**

The site is located in the vicinity of v. Lilyanovo. There is no need of construction of buildings for accommodation of workers or a temporary warehousing facility. Works will be mainly performed using construction machinery, 10 to 12 workers will be required for concrete works and formwork .

2-off wagons will be placed, 1 for construction personnel and 1 for the technical manager; these will be provided with temporary source of power supply and water via branch lines from the relevant systems of v. Porominovo. A WC will be provided onsite for the wagons. The necessary construction materials, mainly formwork will be stored onsite temporarily and therefore construction of temporary warehousing facilities will not be required.

* 1. **Preparatory works.**

The contractor shall perform the following preparatory works:

* Advise the operators of underground and aboveground communications in the subject area;
* Identify the site to be used for transfer of surplus soil and waste materials via a permit to be issued by the municipality for a dedicated disposal site.
  1. **Access roads.**

During the construction phase, the existing asphalt road from v. Lilyanovo to the site will be used, with a branch from the latter to the wagon site, 120 m long. Onsite roads will be built initially with the routes passing along the walls to ensure access to the riverbed along the full length of the corrective wall section.

* 1. **Methods of work for the main construction works.**

The contractor shall undertake the actions as provided for by occupational safety, hygiene and fire safety, and organization of construction works as per the permit for use and the regulations, as well as the requirements of this project. Specific machinery, equipment and work force as required for the project will be specified by the contractor, depending on work phase, season, time schedules , etc. terms, as specified by the employer.

**The following types of works will be performed on the site:**

* Earthworks and backfilling
* Formwork, reinforcing steel and concrete works
* Gabion positioning
* Water removal
* Re-cultivation and planting of trees for affected terrains

A working design project is an integral part of the technical specification and should be fully considered. Wherever the technical specification and the working design include brands and types the tenderers should consider that they can offer any equivalent material/item.

* 1. **Control of works**

The Contracting Authority will provide a consultant who will supervise construction with investment functions, according to Law on Spatial Planning and other legal acts. The Contracting Authority and / or Supervisor/ and or Investor control services’ expert may at any time inspect the work, control technology performance and issue instructions to remove the defects, according to the specified technology and method of implementation. If found serious defects, errors and low quality performance, the Contracting Authority shall notify the Contractor that breached the contract and should stop to work. The Contractor shall always provide access to the construction site of the authorized representatives of the Contracting Authority, the Supervisor and the Investor control services’ expert.

* 1. **Requirements regarding the provision of safe and healthy working conditions.**

During the execution of construction works Contractor shall comply with the requirements of Ordinance № 2 of 2004 on minimum requirements for health and safety in the course of construction works, as well as all other applicable regulations and standards for safety and hygiene, industrial and fire safety during construction and operation of such sites, and also to ensure the safety of all persons who are on site. The Contractor shall comply with the approved Plan for safety and health for construction.

* 1. **Requirements related to handling and storage of materials and plants**

All materials to be incorporated in the work shall be handled and stored in a manner, which prevents injury of any kind whatsoever. The construction waste is required to be disposed of in the approved by the Contracting Authority's site, as stipulated in the Construction permit and relevant documentation.