Lot no. 1 - KLEK

Technical specification of works

VOLUME 3.1. ARCHITECTURAL WORKS ON TECHNICAL BUILDING

TECHNICAL DESCRIPTION

Upon the developer's request the Main design for reparation of facilities has been developed within the hydro-complexes of Klek, cadastral lots no 643/2 c.m. Klek.

The developer has obtained the Decision on the approval of the execution of works No 143-351-13/2018, ROP-PSUGZ-32319-ISAWHA-3/2018 of 31 January 2018 and Preliminary designs related to repairing, developed by the company Hidroprojekt Zrenjanin doo in February 2016.

TECHNICAL BUILDING

The facility comprises only a ground floor. Under a part of the ground floor there is a basement. Its shape is rectangular and the dimensions are 14.47m x 11.22m. The structure of the basement is vaulted. Above the ground floor there is a ceiling construction made of roof trusses, planks, cane and plaster. It is a gable roof with the double hangers system with ties above the joist hangers above the roof trusses. The roof cover consists of interlocking roof tiles.

Functions

The spot elevation of the ground floor is distanced 125cm from the surrounding terrain so that the ground floor is accessible through the external staircase. The clear height of the rooms is around 370cm. There is a side entrance to the facility to the east and a front entrance to the north.

The structure contains one larger premise, an office, a male and female sanitary block and accompanying rooms. The conference room is organized around the big spot of the monitor screen placed on the southern wall of the conference hall where there are also two chairs for the lecturers. The space for the participants is arranged in the rows. For the purpose of organizing a different kind of lectures, additional folding tables are also planned that will be stored in the basement. Wardrobe on the north wall of the conference hall is planned for the placement of the clothes. The darkening of the hall is provided by the inner wooden folding curtains.

The free walls between the windows and doors are designed for the installation of exhibiting of the museum pieces so that special lighting is provided for these walls.

The gathering and preparation of a lecturer is in the office, where the space for an interpreter who has direct contact through the window with a conference room is allocated. In addition to visual contact, a computer network with headphones and speakers are also provided. Office space also serves for the door keeper's stay at the regular use of the building as well as for the usual administration.

The kitchen is provided as a kitchenette for the preparation of the usual beverages and as a distribution kitchen in case of serving meals when the food is brought by the catering.

Sanitary blocks are retained in the existing positions, but completely redesigned. REC is placed in a separate premise - a storage room.

Roof repairing covers the disassembly of the roof cover which consists of interlocking roof tiles and roof laths along all elements of the roof edge and gutters. All the damaged and rotten parts of the roof construction are disassembled. This refers to the principal rafters as well as to tie beams which were shortened before and which should be replaced. The chimneys are to be demolished and reconstructed on the same brick position.

All damaged and disassembled parts of the roof construction are to be made of the coniferous timber of II quality class. Undamaged rafters which are disassembled due to the tie beams replacement technology are reused. New visible wooden elements are profiled according to the existing profiling. Overall roof structure and wooden deck frame are to be coated with an insect and fungus protection agent according to the manufacturer's instructions 2-3 times. The rafters are levelled and covered by 2.5 cm thick plunks, over which steam-permeable and water-permeable foil is placed and fastened with 5x5 cm sticks in the direction of rafters. Depending on the choice of interlocking roof tiles the lathes are nailed down of 5x3cm upon the instruction. There are unbalanced snow loadings integrated in the roof construction. Tin roof edges and gutters are constructed of steel galvanized sheet metal.

Complete construction of the floor is planned, with the creation of space for the construction of a new, thick structure with hydro and thermal insulation. An internal excavation of the outer walls of the conference hall up to a level of the field in the width of min 60 cm and the creation of a workbench for walls cutting is a part of

this operational item. Cutting these walls from capillary moisture should be done at a level of about 20 cm from the ground so that there remain 14 rows of facade brick on the building socle. Below the water insulation the dilapidated wall of min 50cm height is to be demolished and replaced by reinforced concrete, which will in this case enter min 30cm below the ground. Reinforced concrete is to be drawn in from the outer side of the wall 5cm for adaptation of the socle. XPS plates with the thickness of 4cm, with final processing of mass called kulirplast will be applied on the plinth by glueing.

The entire cutting operation is to be performed in sections at max. 1.00m in order to avoid collapsing of the wall. The continuity of reinforced concrete is to be achieved by leaving the appropriate anchor plate nuts. Water insulation of water repellent glass wool strips of 4mm thickness, with adequate coatings. Welded overlaps are of 10 cm at least. This also refers to welded overlap and joint with vertical insulation of the wall so that the width of the water repellent strip increases 10 cm into the inner space in relation to the thickness of the upper part of the wall. The grout area above the water insulation on the facade side must be injected with cement emulsion under pressure, due to the establishment of static stability and taking care of the aesthetics of facade brick. All the dilapidate bricks must be replaced with adequate and similar. There are no aesthetic requirements in the inside area and more attention is to be paid to the wall's firmness at wall underpinning.

Vertical water insulation of the plinth wall is to be done by glueing repellent glass wool strips of 4mm thickness onto the firm and flat surface of the inside area of the wall. Before applying the water insulation onto the wall, the wall must be cleaned and levelled by partial concrete removal, by building an extension or by plastering, depending on the humps on the wall. Protect the vertical water insulation with the shiner brick leaning on the new reinforced concrete.

Horizontal water insulation of the inner walls is done cutting at the level of 20cm below the level of the constructed floor. This is also performed in sections. Below the water insulation a concrete padstone should be constructed about 10 cm above the reinforced concrete for making available a flat surface for water insulation. The width of the water repellent strip is to be increased 10 cm due to the overlap with the water insulation of the floor.

The floor structure is made of a layer of gravel, reinforced concrete slabs and water insulation over a plate which is at -20cm level. The continuity of water insulation with the 10 cm overlap and welding with vertical water insulation of the plinth wall and inner walls.

Cutting or any water insulation of these walls above the basement will not be performed at this situation stage except for water insulation of the floors and inner walls at -20 cm level.

Thermal insulation is to be installed in the floor from EPS plates 10cm thick, of 30kg / m3 min density, PVC foil is to be set and cement screeds 6cm thick, Shults steel reinforcement frames with overlaps or synthetic fibres. In the contact between the screed and the wall, a section from EPS plates 1cm thick (floating floor) is to be installed.

The final floor is made of ceramic and granite tiles in glue. The plinth of 10cm height is performed on the wall.

Water insulation of the basement will be performed on the well cleaned and prepared walls on the inner side of walls with mass that penetrates into walls from the manufacturers Bauplus, Texal or similar ones upon the manufacturer's instructions.

Crumbly mortar on interior and exterior walls cracks, and grouts are to be cleaned to the depth of 2cm. Mortar should be stripped off and at mere chase cutting for electrical wiring and the installation of water supply and sewerage. By plastering the straight transition between the old and new mortar is to be achieved. There is a partial drifting of these surfaces.

The treatment of interior walls and partially of the ceiling is done in semi-dispersible colours of light shades.

In the sanitary blocks there are beautiful ceramic tiles high up to 210 cm and in the kitchenette, behind the kitchen elements there are tiles up to 150 cm high.

The ceiling of plaster performed by casting plaster of cane is to be disassembled on the whole facility. All the layers between the ceiling joist are demolished. The new ceiling of two layers of 12.5mm thick plasterboard plates is performed on the substructure of CD / UD profile. Thermal insulation made of mineral wool, 20cm thick with steam protection from below and water vapor permeable waterproof foil is placed between the ceiling joists.

In the conference room, the ceiling of 60x60cm in height made of mineral panels of “armstrong” type or similar one is to be lowered. Lighting fixtures are installed in the ceiling. The necessary electrical installations are performed in the cavity of the ceiling. In the other rooms, a new suspended ceiling composed of 12.5mm thick plasterboard on the metal sub-structure of the CD / UD profile is lowered. The necessary electrical installations are performed in the cavity of the ceiling. The ceiling profiles are secured to the ceiling at the places of the existing ceiling joists. Lighting bodies in these rooms are superstructural.

The windows are double, wooden, alike the existing ones, with all the leaves opening inside and the windows are installed for half of a brick towards the inside from the outer surface of the facade. Glazing of the outer window leaves performed by double thermal insulation with glass of Ug≤1.30W / m2K, and internal single glass of 4mm thickness. Alike the existing ones on the inside there are foldable solid wood shutters constructed and assembled. Installation should be carried out with stainless steel joints and sealed with polyurethane foam.

The interior doors are solid wooden, profiled. The detailed reparation and bringing into a functional state is necessary to perform. The old paint is to be stripped of by shingles and burning with hot air. Surface treatment is to be performed by drilling and sanding to the smooth fine surface. Nonfunctional fittings are to be replaced by adequate or similar ones, which in particular refers to the door handles. Broken glass is to be replaced with adequate one, also possibly rotten parts of wood are to be replaced too.

Electrical Installations

Elimination of all the shortcomings in the existing internal electrical and strong power supply is planned, so that the new electrical installation is to be practically performed in Notes 4 and 5.

Plumbing and drainage

The complete replacement of the existing installation is planned along with monitoring of the architectural solution of the layout of sanitary facilities. For installations routing the old route is to be used at the greatest extent.

Procurement and installation of water pipes made of crosslinked polyethylene with all required fittings within the piping network. The sewage installation is made of polypropylene sewage pipes.

All new sanitary equipment is specified in the Bill of Quantities.

Heating

The structure is not heated because it is not used in the winter period, so pursuant to Article 7, paragraph 1, point 8 of the Rulebook on the conditions, content and method of issuing Certificate of energy properties (Official Gazette of RS No. 69/2012) for this structure it is not necessary to obtain an energy passport and, therefore, the developing of the Energy Efficiency Study, according to the Energy Efficiency of Buildings (Official Gazette of RS No. 61/2011).

For an occasional use of the facility in the transitional period late autumn and early spring, the electric panel radiators are installed on the parapets. For heating the door keeper's office in winter time would be heated with a tiled stove.

Ventilation

All rooms have windows and, therefore, natural ventilation apart from sanitary blocks. Ventilation of these rooms is artificial, designed so that PVC pipes Ø110mm and with built-in fans perform the function of ventilation.

Facility equipment

The structure is fully equipped with furniture provided by the domestic furniture manufacturer, specified in Bill of Quantities of equipment and furniture.

VOLUME 3.2 TECHNICAL DESCRIPTION OF CONSTRUCTION WORKS ON THE SHIP LOCK

3.2.1. CURRENT STATE

The hydrotechnical complex of the canal lock in Klek was constructed between 1910 and 1912, consisting of the upper chamber of the canal lock and the structures of the technical building, workshop and auxiliary facilities.
In the 1960s, the lower (downstream) chamber of the canal lock was added, which made this canal lock the only two-stage lock in the canals within the DTD hydraulic engineering system.
At the end of the 1960s, navigation through the canal was suspended which reduced the maintenance activities on the canal and the associated hydrotechnical structures, resulting in the current poor state of the structures.

Klek canal lock and floodgate are located on the Navigable Begej canal near the village of Klek, on the chainage km 0+740, immediately upstream from the point where the Navigable Begej discharges into the Banatska Palanka-Novi Bečej canal.
The upper chamber of the canal lock is 10 m wide and 99 m long in total (including gates and lock pounds), with 5.8 m high walls. The crown of the wall is at the elevation of 78.70 m.a.s.l., while the bottom of the chamber is at the elevation of 72.90 m.a.s.l. The walls are made of stone, subsequently lined with a layer of concrete with reinforcing mesh. The layer of concrete has mostly degraded or has completely fallen off.
The lower chamber of the canal lock is 10 m wide and 79 m long in total, with 6.50 m high walls. The crown of the wall is at the elevation of 78.00 m.a.s.l., while the bottom of the chamber is at the elevation of 71.50 m.a.s.l. The bottom slab, walls and cantilevered pathways at the top of the chamber walls are made of reinforced concrete. There is minor local damage to the concrete at the visible parts of the chamber walls, and also concrete surface degradation of a lower level.
The difference of elevations between the walls of the upper and lower chamber, amounting to 70 cm, is bridged with concrete stairs that are in quite good condition. Concrete pathways on the walls of both chambers have partly cracked, while the concrete pathway on the pier has largely degraded. Concrete cloth - pillars of the pier have suffered surface damage, without degraded concrete sections.
Abutments of the bridge crossing the Navigable Begej canal are made of brick which is damaged in some segments, especially under the bridge structure. The intermediate pier is located on the right wall of the canal lock and it is made of brick and stone, subsequently lined with concrete which has fallen off at some places, while at others, it has detached from the original pier structure.
Linings of the canal slopes upstream from the floodgate are made of stone, while in their downstream segment, they are made of concrete.

PHOTOGRAPHS OF THE CURRENT STATE

Damaged wall of the upper chamber of the canal lock

Damaged wall of the lower chamber of the canal lock

Damaged intermediate pier

Damaged abutment

Damaged pathway on the wall of the canal lock

Damaged last two spans of the pier

Appearance of the pier

Pier pathway

Floodgate sill model

Damaged concrete lining of the canal

3.2.2. SCOPE OF WORKS

Repair of the canal lock includes the following groups of works:

1. PREPARATORY WORKS
2. DISASSEMBLY AND DEMOLITION WORKS
3. EARTHWORKS INCLUDING CONSTRUCTION OF ACCESS ROADS AND HANDLING PLATFORMS
4. CONCRETE WORKS
5. MASONRY WORKS
6. REINFORCING STEEL WORKS
7. INSULATION WORKS
8. CARPENTRY
9. METALWORK
10. OTHER WORKS
11. PREPARATION OF THE DESIGN OF THE CONSTRUCTED FACILITY

The following are the functional parts of the canal lock where repair works are planned to be carried out:

- UPPER CHAMBER OF THE CANAL LOCK
- LOWER CHAMBER OF THE CANAL LOCK
- PATHWAYS ON THE CANAL LOCK WALLS
- PIER (upstream access dock for conducting ships into the canal lock chamber)
- PIERS OF THE BRIDGE ACROSS THE BEGEJ
- BANK REVETMENTS
- FLOODGATE SILL MODEL
- FENCE AND GATES OF THE COMPLEX

3.2.3. DESCRIPTION OF WORKS

1. PREPARATORY WORKS

In order to carry out canal lock chamber repair works, it is necessary to undertake onshore works including:

- Installation of stop logs in front of the upstream and behind the downstream canal lock gates
- Water pumping from the canal lock chambers
- Cleaning the chamber bottom of deposits and sludge

In order to execute the pier and bank revetment repair works, a lower water level of the Begej is recommended (min. elevation 74.40 m.a.s.l.). At this water level and in case there is no water in the canal lock chambers, the sliding safety factor amounts to 0.95, which means that the facility is not safe from sliding. In order to meet the sliding safety requirement, the groundwater level in the soil behind the bank wall of the chambers should be at the elevation of 73.40 m.a.s.l. (or lower).
Accordingly, the design for repair works includes construction of drainage wells along the bank wall of the upper and lower chambers. It is planned to construct 8 wells, with a 225 mm diameter and 20 m long. The wells should be spaced 25 m apart and positioned 5 m from the bank wall of the chambers. It is assumed that water will be pumped over a period of 90 days, i.e. the period assumed to be required to execute the repair works on both chambers.
For the purpose of monitoring the groundwater level, it is planned to install 2 piezometers along the bank (left) wall of the canal lock.

NOTE: Stability calculations have been performed for the lower chamber made of reinforced concrete which was built in the 1960s and which is provided with the project documentation. The upper chamber of the lock is made of stone; it was constructed between 1910 and 1912 and it is not provided with the project documentation.
In order to perform the repair works on the Begej floodgate, the design also includes cleaning of the river bed in the area of the floodgate (in the length of 100 m and width of 30 m of the Begej, assuming that the sludge layer is 0.50 m).
It is planned to use scaffolding to carry out the works to repair the walls of the canal lock chambers and the piers of the bridge across the Begej. The works to repair the pier, depending on the water level of the Begej, are to be carried out either from a vessel or from scaffolding.

2. DISASSEMBLY AND DEMOLITION WORKS

The design for repair works includes disassembly of the following elements:

- Wooden fender beams in the canal lock chambers and on the pillars of the pier
- The fence and gates of the entire complex

Demolition works include the following:

- Stripping off of reinforced concrete wall lining of the upper chamber (reinforced with a mesh)
- Demolition of damaged concrete pathway sections on the walls of both canal lock chambers
- Stripping off of reinforced concrete lining of the intermediate pier of the bridge across the Begej (the pier is located on the right wall of the canal lock)
- Demolition of upper brick layers on the walls of the abutments of the bridge across the Begej
- Demolition, i.e. removal of the last two spans of the pier which have been displaced from the designed position and separated from the pier structure
- Demolition of the concrete slab of the pier threads
- Demolition, i.e. stripping off of the cement screed on the stairs on the right bank slope
- Demolition of the brick fence wall of the complex made of brick laid as shiners between concrete posts

3. EARTHWORKS INCLUDING CONSTRUCTION OF ACCESS ROADS AND HANDLING PLATFORMS

Planned earthworks include manual excavation of soil during repair of access pavements.
In terms of access roads, the design includes construction of three intersecting access roads, 80 m long and 3 m wide. The access roads are to connect the existing route leading to the complex of the hydrotechnical node of Klek with the left bank of the canal lock, at three locations: at the upstream, mid and downstream gates of the canal lock. At these three locations, it is planned to also construct handling platforms (two end platforms measuring 20x12 m, and an intermediate platform measuring 15x14 m).
The access road structure consists of the following: 30 cm of sand, 20 cm of crushed stone aggregate 0-63 mm and 10 cm of crushed stone aggregate 0-31.5 mm; total thickness 60 cm.
The handling platform structure consists of the following: 40 cm of sand, 25 cm of crushed stone aggregate 0-63 mm and 10 cm of crushed stone aggregate 0-31.5 mm; total thickness 75 cm.
The site where access roads and handling platforms are to be constructed is occupied by green space, thus the design includes three cutting and stump removal. While performing site layout survey in the field, ensure that the routes of access roads and handling platform locations are positioned so as to require minimum tree cutting.

4. CONCRETE WORKS

The design for repair works includes the following concrete works:

- Concreting of pathways on the canal lock walls

- Concreting of access pavements
- Concreting of reinforced concrete lining of the intermediate pier of the bridge across the Begej (the pier is located on the right wall of the canal lock)
- Concreting of stairs on the right bank slope
- Concreting of the floodgate sill model on the right bank (in front of the workshop, next to the spare floodgate frames)

5. MASONRY WORKS

Before masonry works to repair the chambers and bridge piers, it is necessary to pressure wash the surfaces, using an HD device.
After the cleaning, the following works are to be carried out:

- Replacement of damaged stone sections of the upper chamber
- Jointing of stone walls of the upper chamber
- Repair of concrete walls and the bottom slab of the lower chamber using restoration mortar
- Application of a penetrating sealer to concrete walls and the bottom slab of the lower chamber
- Laying of face brick layers on the pillars of the bridge across the Begej
- Jointing of face brick layers on the piers of the bridge across the Begej
- Repair of minor damage to concrete pathways on the canal lock chamber walls using restoration mortar
- Sealing of fractures on concrete pathways on the canal lock chamber walls
- Repair of the pillars of the pier using restoration mortar
- Grouting of joints on the concrete revetment of the Begej bank
- Construction of a cement screed on the stairs on the bank revetment slopes
- Construction and installation of the fence and gates made of galvanized steel pipes and plasticized mesh, 2 m high, around the entire complex

6. REINFORCING STEEL WORKS

The design includes construction of a reinforced concrete lining on the intermediate pier of the bridge across the Begej (the pier is located on the right wall of the canal lock). The lining is to be reinforced using steel reinforcing mesh Q-503, while the steel reinforcing mesh at the corners is to be connected using reinforcing steel Ø10, B500B.

7. INSULATION WORKS

The design includes application of a transparent hydrophobic coating to the walls of both chambers and the piers of the bridge across the Begej. The coating can be applied by spraying, in two layers.

8. CARPENTRY

The design includes installation of new wooden fenders on the walls of the canal lock chambers and the pillars of the pier. The fenders should be made of dry pine timber 30x30/400 cm in the canal lock chambers and 20x20/350 cm on the pillars of the pier.

9. METALWORK

Metalwork includes:

- Manufacturing and installation of pathway supports on the pier, made of steel sections U100
- Manufacturing and installation of pathway treads on the pier, made of hot-dip galvanized grid treads (platforms)
- Repair of the steel fence on the wall of the canal lock and the pier
- Repair of step irons (fixed ladders) in the canal lock chambers

- Repair of manhole covers, metal edge protection and other metal elements
- Threshold lining at the canal lock chamber gate
- Lock gate upper bearing recess
- Recess with gate side support
- Lining of the vertical edge at gate recess
- Stop log threshold
- Lining of the stop log recess

10. OTHER WORKS

Other works include the previously mentioned installation of 2 piezometers for monitoring the groundwater level, and also repair of the stone cladding of the bank revetment.

11. PREPARATION OF THE DESIGN OF THE CONSTRUCTED FACILITY

Having completed the works, the Contractor is to prepare the Design of the Constructed Facility in case that, during the performance of works, there were changes compared to the design solution provided in the Performing Design.

NOTES:

- The use of most of the repair materials is limited by the base and ambient temperature requirements, specified by the Manufacturer, ranging from +5ºC to +30ºC. Accordingly, the Designer recommends that the repair works be carried out in the period when the expected temperature corresponds with the specified one so as to avoid performing works of lower quality.
- The works to repair the canal lock gates, mechanical equipment and floodgate are included in the mechanical engineering section of the Performing Design (Book 6).

The works to repair the facilities within the hydrotechnical node of Klek (technical building, workshop and shed) are included in the architectural engineering section of the Performing Design (Book 1)

VOLUME 3.3 TECHNICAL DESCRIPTION OF ELECTRICAL WORKS

ON REHABLITATION OF HC KLEK

3.3.1. GENERAL PROVISIONS

Pursuant to the ToR, and based on the bases and data from the construction and mechanical designs, the following parts of the complex are developed under this design of electrical installations for the **Rehabilitation of Klek hydroengineering complex:**

Ancillary facilities:

- Technical building;
- Lighting of hydraulic power system;
- Marking of waterways;
- STS power facility.

The following electrical installations are described:

- Measuring point cabinets (MPC), main distribution cabinets (MDC) and distribution cabinets (DC) of sub-distribution for the supply of consumers;
- Interior installations of general electrical lightning;
- Exterior installations of electrical lightning and light signals of hydraulic power system;
- Installations of "panic" lighting on main communications and exits;
- Installation of mono-phase and tree-phase Schuko sockets;
- Installation of earthing, potential equilization and lightning protection of buildings.

The technical solutions envisaged by this design are in compliance with the valid SRPS, IEC and ISO standards, other applicable technical regulations for this area and good engineering practice.

3.3.2. DESCRIPTION OF CURRENT CONDITION OF POWER INSTALLATIONS OF THE HYDRO-TECHNICAL COMPLEX

3.3.2.1. Technical building

The building was built at the beginning of the twentieth century. It remained unchanged until present, except that electrification of the building was carried out in the mid-1970s. The power supply of the consumers in the facility is provided through two metering-distribution cabinets, MDCs, equipped with fuses, faulty current protection switches and measuring groups for metering of power consumption, situated on the facade of the facility. The metering-distribution cabinets MDC-1 and MDC-2 are supplied through self-supporting cable harnesses from the pole-mounted substation STS 10/0.4 kV/kV, 50kVA, from the low voltage distribution cabinet, through the three-phase roof carrier on the residential building. The electrical installation of the building was maintained only in the part of the building that was used as an office, and only within the scope of regular maintenance. It is necessary to replace the complete cable distribution and adjust the installation to the actual needs of the users in the building. Electrical installation equipment is partly broken, worn out, and its complete replacement is necessary. Existing lights in the building are of poor lighting characteristics, defective, unsafe and need to be completely replaced. There is a classical lightning installation on the facility in the form of a Faraday cage, with two down lead conductors and metering points, that is out of function.

3.3.2.2. Lighting of hydraulic power system

The hydraulic power system lighting is carried out on the right side of the river Begej bank, with one lighting pole between the facilities on the hydraulic power system and the ship lock, with twelve light poles equipped with lamps with sodium high pressure lightbulbs. The supply cables of light poles, downstream from STS – 9 pieces, were replaced in 2015 with PP00 4x4mm² cables.

3.3.2.3. Marking of waterways

Marking of waterways has not been installed.

3.3.3. NEWLY DESIGNED INSTALLATIONS

3.3.3.1.Technical building

Building power supply

The basic power supply of the building will be provided from the public electric distribution network of medium voltage (20/10kV/kV), from the pole-mounted substation 20/10/0.4 kV/kV/kV, with the power of 50kVA.

Main distribution cabinet MDC is supplied through the cabinet of the metering point, situated on the facade of the residential facility. The metering point cabinet is supplied from LV cabinet with STS power cable of PP00 4x16mm² type.

The measurement of the power consumption is provided by existing, three-phase active electronic metering device that shall be located in a new standard metering-distribution cabinet.

Distribution cabinets

The main distribution cabinet MDC (power supply from MPC) is located in the building and it supplies all consumers in the building.

The cabinet housings are made of polyester, in IP54 protection.

Electrical installations of interior lighting

The present design of the administrative building reconstruction of the hydroengineering complex in Klek foresees the dismantling and replacement of existing worn-out lamps and installation switches with new ones.

The lighting of individual rooms is envisaged by means of adequate installation of lighting points with above-fitted fluorescent lamps. In the ancillary rooms, lamps with bulbs with wire filaments and fluo compact are envisaged.

Lighting installation is performed by cables of type N2XH 2,3,4 ×1.5mm², in the wall and ceiling, under mortar.

Activation of the lighting is by means of a single-pole installation switch of “in wall” type.

For panic lighting of escape routes and exits, the lamps with their own source of power supply (Ni-Cd batteries), automatic charging and automatic switch-on in the event of a power outage shall be foreseen. These lamps are above fitted with a 1×8W bulb, autonomy 3h, similar to the type BPN P 108, IP40, Buck.The installation of panic lighting provides passage of communications to the exit from the building, in case of a need for evacuation and voltage failure, and they should be provided with stickers with direction markings to the nearest exit and exit signs.

Electrical installations of sockets and plugs

The present design of the administrative building reconstruction of the hydroengineering complex in Klek foresees the dismantling and replacement of existing worn-out lamps installation sockets with new ones. The sockets have been selected and fitted according to the conditions of the site where they are being mounted.

Electrical distribution for the purpose of installation of mono-phase sockets is foreseen by means of cables of type N2XH 3×2.5mm², placed in the wall, under the mortar.

Electrical distribution for the purpose of installation of three-phase five-pole sockets is foreseen by means of cables of type N2XH 5×2.5mm², placed in the wall, under the mortar.

The sockets are installed at a height of 0.5m from the floor level.

Lightning protection of facilities

The existing lightning installation of the administrative building will be disassembled during the reconstruction of the roof covering, roof structure and facade, and the design foresees its complete replacement.

The new lightning installation has been implemented in accordance with PTN 11/96 and valid SRPS standards for this type of works. In order to protect the buildings from lightning, a protection levels has been selected in advance according to SRPS IEC 1024-1-1, and for the adopted level of protection, a lightning protection installation consisting of an earthing system, a system of down lead conductors and a reception system has been designed.

Earthing system:

A standard lightning installation has been designed for the building with the following characteristics: for accepting the lightning electricity discharge, a ground ring made of galvanized steel strip Fe-Zn 25×4mm steel strip, which is laid in a trench, at a distance of 1.5 m from the building and at a depth of 0.8 m is foreseen. This type of earth electrode is of type "B" according to IEC SRPS 1024-1, point 2.3.3.2 .. The manufacturing of ground wires from the earth electrode to the test joint and metallic components is envisaged by the Fe-Zn 25x4mm band, and the joints of the earth tape and ground wire are fitted by standard cross-run clamps in the ground, which are filled with bitumen.

The system of down lead conductors:

Four down lead conductors have been provided for the routing of the lightning discharge. The down lead conductors are fitted with galvanized Fe-Zn 20×3mm band, on adequate supports, across the facade of the building. At the very end of a vertical lightning conductor, down lead, and at a height of 1.75m from the ground level, a measuring joint is fitted according to standards and norms, overlapping, and this point is to be secured by a cross-run plate of type P SRPS N.B4.936. At the bottom, towards the earth electrode, an earth leakage is used, a steel galvanized strip Fe-Zn 25x4mm, length 4.5m. A ground wire strip (P 25×4 SRPS N.B4.901 Č) to the level of the measuring joint on the facade of the building shall be mechanically protected by a galvanized section A 40×40× 51500 SRPS N.B4.913 P.

Reception system:

For the reception system lightning protection installations, the natural components of the steel galvanized sheet with more than 0.5mm thickness are partially used, and partially galvanized Fe-Zn 20x3mm strip for the ills and slopes of the roof on the adequate supports at a distance of 1m between each other. The joints of the reception system strip are fitted with standard cross-run clamps. The width of the reception system installation mesh sieve is in accordance with the general requirements of SRPS IEC 1024-1.

Protection against electric shock

Power supply system in terms of earthing (JUS N. B2.730) is TN-C-S. The functions of neutral and protective conductors is only integrated in the part of the system to the main power supply points, and further down it is separated throughout the installation. All built-in equipment shall comply with the standard SRPS N.B2.741 in regards to the protection against direct contact and with other standards that apply to that type of equipment.

Protection against electric shock is provided by automatic power outage in case of failure, by means of the prescribed protection devices of the differential current ZUDS according to SRPS N.B2.741. The zinc-coated strip Fe-Zn 25x4mm is supplied to the main GPU earthing terminal, in a standard box, with the SIP bus mounted at the MPC.

The main potential equalization is provided by connecting all metal components of non-electrical installations at the entrance to the building, by P-Y 1×16 mm² conductor and adequate bonding material.

After the completion of the works, the contractor shall perform measurement of grounding resistance, loop resistance and check the continuity of the protective conductor on all protected circuits and shall perform the equipotential check.

Selection and placing of electric equipment

All electric equipment was selected in accordance with the requirements of SRPS N.B2.751 standard, depending on the external impacts defined in preceding items and according to SRPS N.B2.730 standard, in line with the architectural-construction design.

The selection of the type of power distribution was made in accordance with SRPS N.B2.752 standard, and, in this case, it is BD2 in halogen-free version for electrical installation, i.e. the installation that does not release poisonous fumes in case of fire.

The areas in which water bursts are expected to occur according to AD3 impact class possess the equipment of at least IP X3 protection degree for premises where water jets

according to AD5 class are expected, with the protection of IP X5 class at least, according to standard SRPS N.A5.070.

Type of distribution system

TN-C/S power supply system with earthing is envisaged as the type of distribution system, so that the protection from indirect contact is provided with the automatic switching off of power supply with the application of a special protective line, i.e. protective earthing.

In addition, a measure of additional potential equalisation is envisaged also for all metal masses in the facility and in the sanitary blocks, with the central rail for potential equalisation, connected to the earthing of the facility.

Envisaged as an additional protection of the socket and lighting installations from indirect contact is the faulty current protection switch SZS x/0.3A.

Selection of cables

Cables selected according to permanently permitted currents in accordance with the provisions of SRPS N.B2.752. for the type of distribution according to the place of installation are A1,D1,J, namely, tables of correction factors for certain type of distribution.

Maintenance

Regular maintenance, including periodical inspections, examinations and repairs of all installations and equipment according to the instructions of the manufacturer is required within the given endurance period. It is necessary to periodically check the efficiency of protection measures for safety within the established endurance and to check the reliability of the equipment through which the proper operation of the installation is provided, determined by endurance.

Maintenance works shall be carried out by persons competent in the works in question.

DISTRIBUTION OF ELECTRICAL INSTALLATIONS

The high voltage installations in the facility are distributed in the wall and dropped ceiling through installation pipes.

The distribution cabinet and concentration of all installations are placed at the entry area of the facility.

POWER SUPPLY

The power supply of the facility from the existent metering point is regulated through a project prepared by Hidroprojekt Zrenjanin doo.

The connection of the power supply cable with MPC on the facade of the facility and further to the MDC location should be carried out with the cable of N2XH 5x10mm2 type.

Overall network supply of the facility

Total installed power Pi =22.2 kW, kj=0.5 Pjm=11.1kW

Power supply characteristics are: three-phase alternating current, frequency 50 Hz, rated voltage 3x400/230 V. Distribution system, as regards protection and earthing is TN-C/S system.

DISTRIBUTION CABINETS - Main distribution cabinet MDC

Main distribution cabinet is a built-in distribution panel with IP 40 protection with door. It should be mounted in the entry hallway, at the place shown in the graphical documentation. The cabinet is envisaged for the installation of 36+6 modules.

Automatic switches, whose characteristics are given in the graphical documentation and the Bill of Quantities and price calculation, should be mounted in the cabinet for the protection of

certain terminals from overload and short-circuit currents. 4-pole differential circuit-breaker 40/0.3 A should be installed in MDC for protection from accidental contact with parts under voltage.

MDC should be equipped with buses for neutral and protective line.

LIGHTING INSTALLATION

General indoor and anti-panic lightings are envisaged. General lighting shall have built-in and surface-mounted LED lamps.

Indoor general lighting is turned on with installation surface-mounted switches and dimmers mounted at the height of 1.5 m from the finished floor.

Anti-panic lights are planned to be installed at all exits from the facility. Safe movement and abandonment of premises in the event of power interruption are thus secured. Anti-panic lights feature autonomous reserve battery supply and 2h autonomy in operation.

The general and anti-panic lights should be installed with cables of N2XH 2 i 3x1.5 mm^2 type.

INSTALLATION OF SOCKETS AND PLUGS

Envisaged for the facility is the installation of single-phase sockets of general purpose and single-phase, specific purpose outlets. All single-phase sockets are of module, built-in type.

Single-phase sockets should be mounted at the height of 0.4m except on locations with the heights indicated in the graphical document.

Operating, single-phase sockets in the kitchen should be mounted at the height of 1.1 m.

Power supply of single-phase sockets and single-phase specific-purpose outlets should be done with cables of N2 XH 3x2,5 mm^2 type.

PROTECTION

The protection of cables from overload and short circuits is secured with fuses and automatic circuit breakers, with dimensions in accordance with the cross section, type and manner of cable laying, in accordance with SRPS N.B2.752 standard.

The protection from indirect contact is provided in accordance with the Rulebook on technical norms for low voltage electrical installations (Official Gazette of SFRY, number 53, dated 02.09.1988), by protective device turning off within the prescribed interval (TN - C - S system).

An additional protection from indirect contact is provided by the automatic power switching off by application of the differential protective current 40/0.3A.

The internal electric network shall be built in TN-C-S system, so that the protection from indirect contact is provided with the automatic switching off of power supply with the application of a special protective line, i.e. protective earthing.

In addition to this, the measure of additional potential equalisation is applied also, for all metal masses, through the connection with the protective earthing of the facility.

FINAL REMARKS

The Contractor shall carry out all works according to the effective technical regulations engaging competent workforce. They are obliged to inform the Supervisor, i.e. the Investor on all potential faults and mistakes in the project. At the very location, the works on electrical installations have to be carried out so that they are harmonised with other installations and construction works, as regards the functioning, space and time (according to the dynamics of works).

All used materials must be in accordance with SRPS, EN and IEC standards and have to be inspected before installation and only whole new elements can be installed.

The Contractor is obliged to inspect the whole installation, carry out the required measurements, providing relevant certificates, and perform all tests of correct functioning with the required setting and regulation.

INSTALLATIONS IN TECHNICAL BUILDING

TECHNICAL DESCRIPTION

Upon the Investor's request the Main design for the rehabilitation of the technical building in Klek has been developed, cadastral lot no. 643/2 C.M. Klek. According to the Investor's ToR, the rehabilitation includes the internal ground part of the facility.

The facility is registered at the Real estate as a building for water management purposes cadastre, with the surface of 158m2. There are also other facilities intended for water management purposes at the lot. The lot size us is 9,258.00m2, while the total size of the facility is 361.00m2, so that the floor area of the lot is 3.90%.

The facility comprises only a ground floor. There is a basement under a part of the ground floor. It is of rectangular shape, dimensions 14.47m x 11.22m. The roof is gable, with interlocking tiles.

The structure contains one larger premise, an office, a male and female sanitary block and accompanying rooms. The conference room is organized with two chairs for the lecturers. The space for the participants is arranged in the rows. For the purpose of organizing a different kind of lectures, additional folding tables are also planned that will be stored in the basement. Wardrobe on the north wall of the conference hall is planned for the placement of clothes. The darkening of the hall is provided by the inner wooden folding curtains.

The free walls between the windows and doors are designed for the installation of exhibiting of the museum pieces so that special lighting is provided for these walls.

Office space also serves for the door keeper's stay at the regular use of the building as well as for the usual administration.

The kitchen is provided as a kitchenette for the preparation of the usual beverages and as a distribution kitchen in case of serving meals when the food is brought by the catering.

Sanitary blocks are retained in the existing positions, but completely redesigned.

The project includes the rehabilitation of all electrical installations of the facility. Works on repair of remaining parts of the roof, basement and facade are envisaged within the Main Design for repair of the hydro-technical complex Klek, made by Hidroprojekt Zrenjanin doo, in February 2016.

ANTI-BURGLARY SYSTEM

The role of the envisaged anti-burglary system is to secure all premises of the facility and automatically inform competent persons in case of unallowed access. The base of the system comprises the central unit and peripheral elements. The central unit is placed in the technical premise. 8 IR movement detectors, placed in the facility, are connected to the central unit. Placed in the main entry hallway is the keypad with LCD display through which the system is directly activated and deactivated. The system condition control, activation and deactivation can be done remotely, as well, through phone line (GSM) or through TCP/IP protocols (local computer network or internet). In the case of alarm, the executive functions of the system are the activation of the sound and light signalisation, as well as the automatic notifications to competent persons through GSM network and/or internet.

FINAL REMARKS

The Contractor shall carry out all works according to the effective technical regulations engaging competent workforce. They are obliged to inform the Supervisor, i.e. the Investor on all potential faults and mistakes in the project. At the very location, the works on electrical installations have to be carried out so that they are harmonised with other installations and construction works, as regards the functioning, space and time (according to the dynamics of works).

All used materials must be in accordance with SRPS, EN and IEC standards and have to be inspected before installation and only whole new elements can be installed.

The Contractor is obliged to inspect and test the whole installation, to conduct the required measurements, providing certificates and perform all tests of proper functioning, along with the required adjustments and regulation.

3.3.3.2.Lighting of hydraulic power system
Lights

The lights intended to replace the existing ones and for the lighting of the hydraulic power system are light for urban surroundings with aluminium alloy housing under pressure, protector and polycarbonate cover, mirror electropolished and anode protected aluminium high-purity and control gear, of the type K-LUX/1640/100 MINEL SCHREDER, with high pressure sodium lamp 100W, 230V, 50Hz, under protection IP66 and IK09.

The passage under the bridge is lit with the surface-mounted lamps of TITAN BS103, BUCK, 1xT26 36W, G13, IP65, 230V type, two of which are placed on both sides of the bridge.

Light poles

Replacement and installation of conic light poles, 4m high, Ø60mm on pole tope with the base of min. 400×400×10mm, with Ø90mm opening, protected by warm internal and external zinc plating and additional anti-corrosion protection up to 40cm above the foundation base is foreseen. The pole shall be equipped with:

- carrier and connection panel RPO-4;
- fuse FRA 16/6A or automatic switch B 6A, 1 piece;
- power supply cable for lamp PP00-Y 3×1.5mm², 4m;
- zinc bolt for earthing and inside the pole and on the pole;
- cover with a red arrow (lighting symbol);
- protection of connection area from rain and
- ordinal number of the pole.

Power supply cables

The installation of the lighting on the hydraulic power system will be supplied by power provided from the public electric distribution network of medium voltage (20/10 kV/kV), from the pole-mounted substation 20/10/0.4kV/kV/kV, with the power of 50kVA.

The controls for lighting the hydraulic power system are present and are situated in the low voltage distribution cabinet of the pole-mounted substation.

The power supply cables of the light poles which have not been repaired, i.e. replaced in 2015 (poles with S10.L; S11.L and S12.L marks) are of PP00-Y 4x4mm^2 type, per input/output principle.

The cables for outdoor lighting are laid in a cable trench measuring 0.4 x 0.8 m. At crossing points with other installations, it is envisaged to lay protective PVC pipes in advance. The pipes are of nominal diameter Ø50mm.

Protection against direct contact voltage is carried out in such a way that all live parts are in the pole, on an insulated panel or in a lamp that is positioned at such a height that it can not be reached by unauthorized persons.

On the pole there is an aperture for the connection to the connection board, which is closed by a sealed cover. The cover is fixed with a cap screw.

Protection against indirect contact voltage is foreseen by the same system as for the entire complex.

Additional lightning protection is foreseen. The Fe/Zn 25x4mm strip shall be laid in the same trench, parallel to the cables of the exterior lighting.

3.3.3.3.Marking of waterways

Traffic lights

Traffic lights signalization is foreseen in accordance with applicable regulations on inland waterways navigation. It consists of optical signals formed by red and green lights. It is implemented with input and output traffic lights, one per each unit. The traffic lights consist of a single two-part driver lantern. A two-part lantern consists of one red and one green light.

Traffic lights pole

Traffic lights are fitted on the pole, 3.2m high, Ø60mm on pole top with the base of min. 400×400×10mm, with Ø90mm opening, protected by warm internal and external zinc plating and additional anti-corrosion protection up to 40cm above the foundation base.

Power supply cables

The basic power supply will be provided from the public electric distribution network of medium voltage (20/10kV/kV), from the pole-mounted substation 20/10/0.4kV/kV/kV, with the power of 50kVA. The traffic light distribution cabinet is powered from the low voltage distribution cabinet of the pole-mounted transformer substation, through PP00-Y 3x2,5mm^2 cable. The housing of the distribution cabinet is made of steel sheet metal protected with anti-corrosion paint. The housing has a door, lock and a key. Envisaged in the cabinet is the construction for carrying equipment made of perforated profiles. Placed above the equipment is a protective plate.

According to the design, the traffic lights at the upstream and downstream entrance into the ship lock shall be manually operated, with a switch, from the distribution cabinet DC-Semafor.

The cables for the power supply of traffic lights are laid in a cable trench measuring 0.4x0.8 m. At crossing points with other installations, it is envisaged to lay protective PVC pipes in advance. The pipes are of nominal diameter Ø50mm.

Protection against direct contact voltage is carried out in such a way that all live parts are in the pole, on an insulated panel or in a the traffic light that is positioned at such a height that it cannot be reached by unauthorised persons.

On the pole there is an aperture for the connection to the connection board, which is closed by a sealed cover. The cover is fixed with a cap screw.

Protection against indirect contact voltage is foreseen by the same system as for the entire complex.

Additional lightning protection is foreseen. The Fe/Zn 25x4mm strip shall be laid in the same trench, parallel to the cables of the traffic lights.

3.3.3.4. Pole-mounted substation STS 10/0.4 kV/kV/kv, 50kVA

The hydro-technical complex will be supplied by power from the public electric distribution network of medium voltage (10 kV), from the pole-mounted substation 10/0.4 kV/kV, with the power of 50kVA.

Judging by its condition, no investments have been made in the energy facility for a long period of time. Revision of the transformer station should be carried out for the purpose of the regular operation of the pole-mounted substation and regular and continuous supply of electric power. Based on the revision a complete report will be prepared with expert findings and with the measures required for rehabilitation of equipment.

Works on the revision of the energy facility would include the following:

1. Inspection obligation

Rulebook on technical norms for operation and maintenance of electric power facilities and lines (Official Gazette of SRY 41/93).

2. Manner of inspection

1) Rulebook on technical norms for electric power facilities with nominal voltage over 1000V (Official Gazette of SFRY 4/74);
2) Rulebook on technical norms for fire protection of electric power facilities and devices (Official Gazette of SFRY 74/90) and
3) Rulebook on technical norms for electric power facilities with nominal voltage over 1000V (Official Gazette of SFRY 61/95) and
4) Rulebook on technical norms for protection of low voltage networks and accompanying transformer stations (Official Gazette of SFRY no. 13/78 and Official Gazette of SRY 37/95)

VOLUME 3.4
TECHNICAL SPECIFICATIONS - MECHANICAL WORKS
(KLEK CANAL LOCK AND FLOODGATE)

3.4.1. CANAL LOCK

The design of the canal lock Klek includes the manufacturing of parts, replacement/repairing of the following equipment parts:

- double-leaf doors with a driving mechanism,
- overhaul stop logs,
- ancillary equipment

Within this project's framework, several visits to the canal lock were conducted in order to determine the condition and dimensions of the hydromechanical equipment.

3.4.1.1. Short description of the canal lock

The Klek canal lock consists of the following parts: the upper double-leaf gate, middle double-leaf gate and the lower double-leaf gate. It is a double-chamber lock. The opening and closing of the gates (doors) of the canal lock is operated manually by using manual mechanisms placed in the manholes adjacent to the walls of the lock. Lifting and lowering of the flashboards allowing the water to drain through the door are also carried out using manual mechanisms whose rack, with an operating handle, is mounted on the pedestrian walkway (platform) of the double doors. The middle and lower doors contain flashboards ("klinkete" in Serbian), while the drainage of the water at the upper doors (as well as the backup option at the middle ones) is done through the tunnel channels on both sides of the lock.

Upper gate

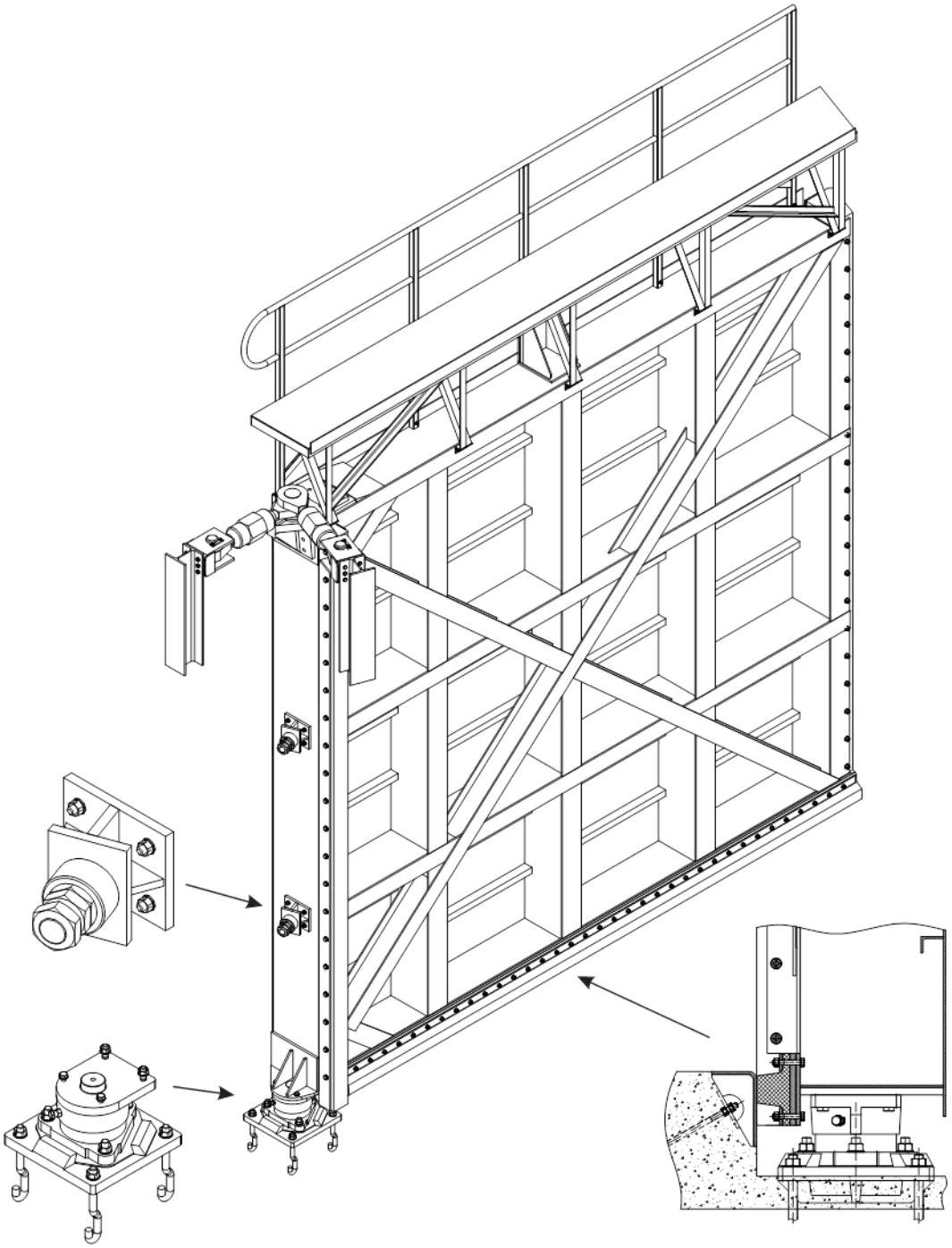
The upper gates are constructed as double-door, with the seal levels in the closed position locking the angle of 70º in relation to the axis of the chamber, i.e. 140º between them. Door leaf dimensions (LxHxW): 5950 x 5140 x 400 mm. On the upper part of both leaves a walking path has been upgraded made of steel plates with a fence made of steel pipes. The lower and upper ends of both leaves next to the wall of the lock are lying on the bearings. The gate was built and installed in the 1960's as a welded steel structure (sheets, profiles, angles, tapes). It is envisaged that the sealing with the vertical concrete walls of the chamber, the concrete bottom, as well as in the middle of the chamber on the composition of both wings is performed using impregnated oak beams.

Water is let in through the upper doors by means of dam diversion channels (tunnels) on both sides of the canal lock. Sealing parts for the flashboards on the tunnels are made of oak, while the opening and closing is designed to be manually activated. The activation is realized by means of two sprockets and chains tied to the counterbalance on one side, while on the other, an oak flashboard ("klinketa" in Serbian) is tied to them. The sides of the flashboards are outfitted with two wheels each for board handling. The position of the flashboards (open/closed) is registered on the column located in the immediate vicinity of the letting-in mechanism.

Based on the inspection of the doors by multiple visits to the site, detailed visual inspection and measurements on the part of the equipment and the structure that is located above the water level, it can be concluded that the steel gate plates (formwork) and the supporting structure have corroded only partially and, based on the assessment of the condition of the part of the structure, that the doors could be **repaired without the necessity to manufacture new ones**, though the final decision is to be made after the equipment underwater has been inspected.

Vital changes to the existing solution refer to the changes of the upper and lower bearings, the

method of door support in the niches, the niches themselves which have been adapted to the new support and sealing, the threshold structure, horizontal sealing (rubber instead of oak beams). All these changes have either no or negligible effect on the visual appearance of the new doors, compared to the existing doors.



Review of the basic upper door elements

Middle gate

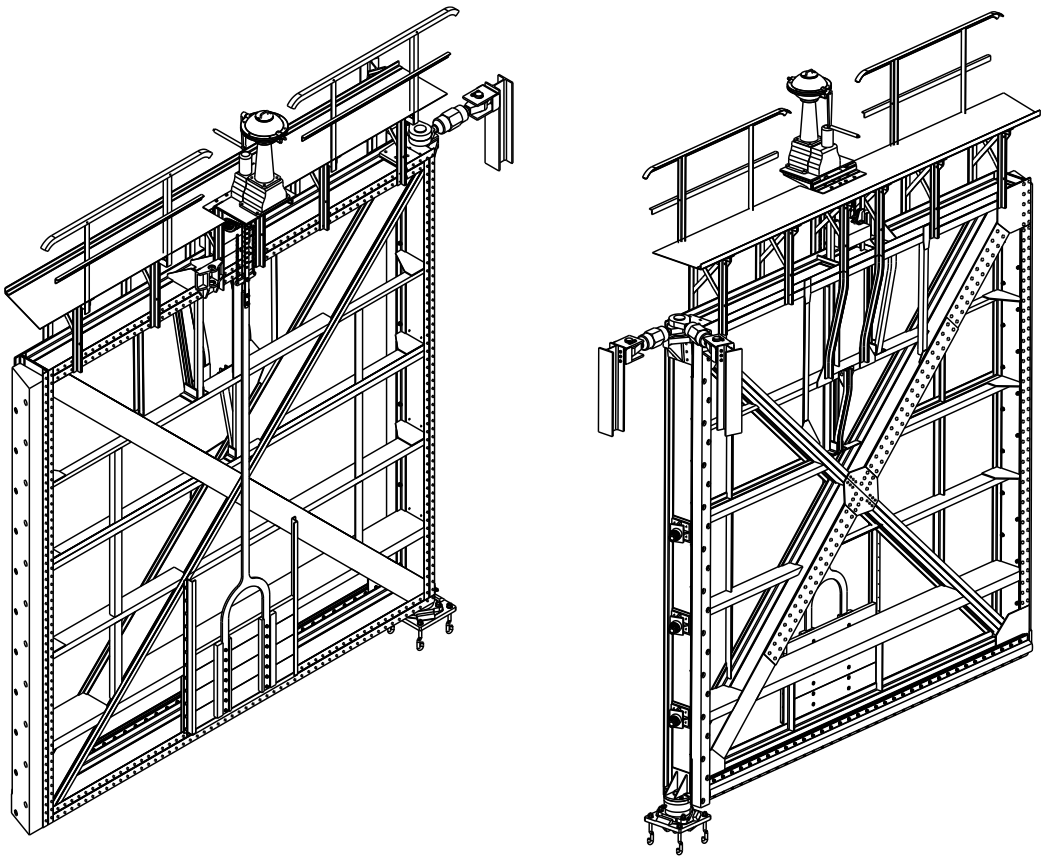
The middle gate is also a double leaf gate, just as the upper gate. Since the gate was built in the period 1910 - 1912, the joining of structural elements of the gate (steel sheets, profiles, ...) was performed with rivets. The dimensions of leaves are the same as for the upper door. The sealing on vertical joints with the concrete wall of the lock (chamber), with the concrete bottom of the chamber, as well as in the middle of the chamber, i.e. on the joints of both leaves, is performed with impregnated oak beams. The lower and upper ends of both leaves next to the wall of the lock are lying on the bearings. Both gate leaves have been upgraded with a footpath made of ribbed steel sheets with a steel pipe fence. Likewise, in the lower parts of both door leaves, there are flashboards installed, one on each leaf, the opening of which allows the filling of the downstream chamber with water. The opening and closing of the gate is performed manually by means of a mechanism with gears that is used to operate a lever which is at one end connected to the gate. Each leaf has its own mechanism.

At the middle doors, water is let in as a back-up option, in addition to the installed flashboards on the door leaves, through dam diversion channels (tunnels) on both sides of the canal lock (as in the case of upper doors). Sealing parts for the flashboards on the tunnels are made of oak, while the opening and closing is designed to be manually activated. The activation is realized by means of two sprockets and chains tied to the counterbalance on one side, while on the other, an oak flashboard ("klinketa" in Serbian) is tied to them. The sides of the flashboards are outfitted with two wheels each for board handling. The position of the flashboards (open/closed) is registered on the column located in the immediate vicinity of the letting-in mechanism.

Based on the inspection of the doors by multiple visits to the site, detailed visual inspection and measurements on the part of the equipment and the structure that is located above the water level, it can be concluded that the sheets (formwork) and the supporting structure have visibly corroded and based on the assessment of the part of the gates under the water **it is necessary to manufacture a new gate.**

The new door is to have the identical geometric shape as the existing door. The loadbearing structure consists of standard sections lined on one side with steel gate plates. The sections of the loadbearing structure and steel gate plates are to be connected by welding. At places where the existing solution has rivets in the visible part of the structure (above water), the connection is to be made by welding with high-quality setting (welding) of strips with rivets as a mask. This is the way to keep the same visual appearance of the doors.

Vital changes to the existing solution refer to the changes of the upper and lower bearings, the method of door support in the niches, the niches themselves which have been adapted to the new support and sealing, the threshold structure, horizontal sealing (rubber instead of oak beams) and flashboards where sealing is done using rubber on a stainless steel strip, L-section supports, with oak board infilling. All these changes have either no or negligible effect on the visual appearance of the new doors, compared to the existing doors.



Review of the middle door leaf

Downstream gate

The downstream gate is designed for the purpose of addressing potential load cases in various water level combinations. It is a double-leaf construction with the dimensions (LxHxW) of 5950 x 6320 x 350 mm. Upper parts of both gate leaves have been upgraded with a footpath made of ribbed steel sheets with a corner plate fence. The gate was built and installed in the 1960's as a welded steel structure. The sealing with the vertical concrete walls of the lock, with the concrete bottom, as well as in the middle, i.e. on the joints of both leaves, is performed with impregnated oak beams. On both gate leaves there are flashboards for discharging water from the lower chamber.

Based on the inspection, it has been determined that the gate is constantly open, according to the statement of the operator, this situation lasts for more than thirty years.

In the future, there will be no need for a two-stage lock. Therefore, the lower chamber, and consequently the lower doors with the entire equipment, will stop being operational. Since lower door is not to be used in the future , **it is necessary to demount door leaf and the associated equipment and place it at appropriate location near the lock**.

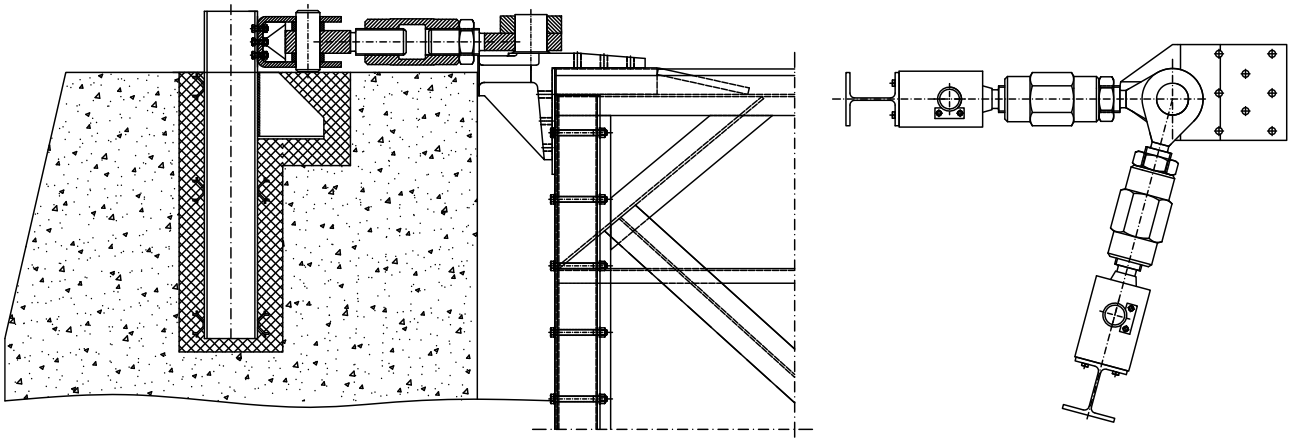
Lower and upper bearings of gate leaves (only for upper and middle gate)

Each door leaf has two bearings. The upper radial bearing is mounted on the side concrete wall. The radial bearing is constructed as a cylindrical support.

The lower bearing is axial (the hinge is a spherical calotte), which is intended to receive vertical (axial) force, as the dominant load. For the purpose of transferring the hydrostatic forces acting on the structure in the closed position of the door, the construction of the door leaf has been designed so to lean on the lateral concrete walls by means of an oak beam throughout the entire

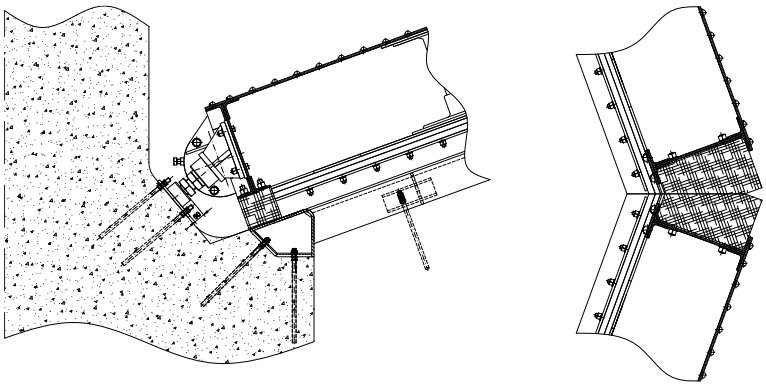
height of the door. In the open position (calm water - aligned pressures) the doors lean solely on bearings.
Based on the inspection of the existing condition of the upper bearings (located above the water level), by repeated visits to the site, detailed visual inspection of the structure, it has been concluded that it is necessary to replace them. On the occasion of door dismantling the actual condition of the lower bearings would be determined. However, in any case, due to their design in terms of being constantly under water and the unification, their replacement is envisaged.

Due to the unification of the bearings on the hydromechanical equipment of the entire hydraulic engineering system, it is necessary to replace the upper and lower bearings on the upper and middle doors.
The figure shows the solution ensuring adjustment of the position of the upper bearing axis, and thus of the doors. The drawings showing the solution for the upper bearing of the middle and upper doors are presented in Drawing No. PUK-1.01.01.02.00.



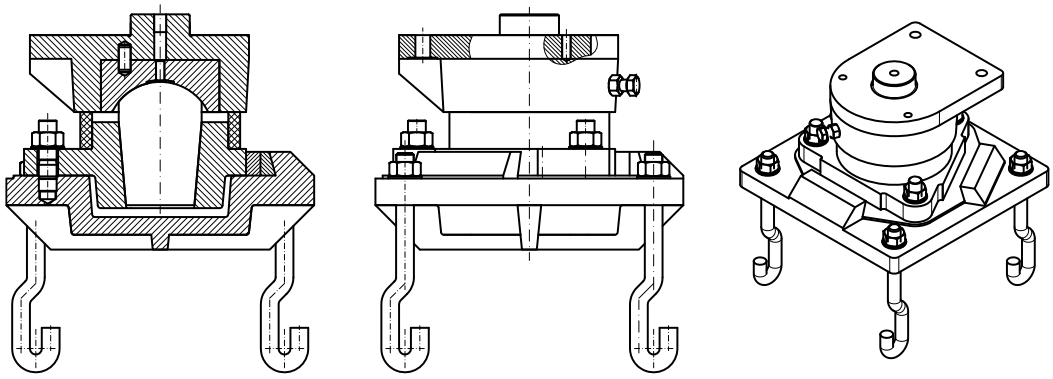
Upper bearing elements

It should be noted that the application of this solution requires careful adjustment of the upper and lower bearings so as to ensure correct fitting of the support elements, arranged at the height of the side section of the doors in the niche, to receive lateral force when the doors are closed together with correct fitting of the vertical oak beams in the niche and between the doors that used for sealing. The solution for lataral supports in this design enables certain adjustment, which is much better than the previous method of door support in niches when the doors are closed. The figure shows characteristic door leaning points.



Characteristic door support and sealing points

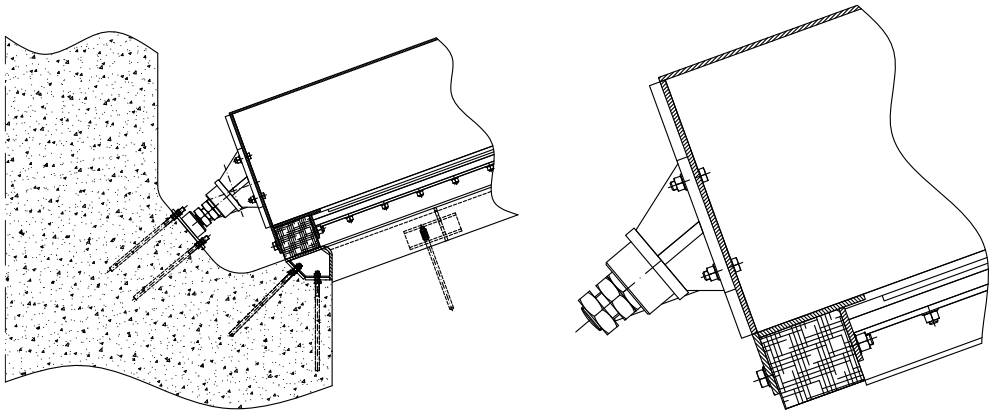
The existing lower bearings are to be changed by the new solution in Drawing No. PUK-1.01.02.03.00, applied at several canal locks with double-leaf doors within the competence of the PWMC Vode Vojvodine. The lower bearing may move partially in the horizontal plane and thus contribute to the adjustment of the support and sealing of the doors via the upper bearing. The maintenance experience shows that there are no significant issues in the structural solution. The use of new bearings of a modern structure should not interfere with the appearance of the double-leaf door, as they are always under water.



New lower bearing appearance

Support and sealing elements in the door niche (only for upper and middle gate)

The existing doors receive horizontal forces (when the doors are closed) via oak beams onto the concrete. The leaning of adjustable lateral supports is applied instead of wood, as shown in Drawing No. PUK-1.01.01.00.00 and PUK-1.01.02.00.00. The solution does not affect the appearance of the gates, given that the supports are hidden in the door niche, both when the door leaves are open and closed. In addition, instead of sealing by having oak beams lean against the concrete, modern lateral sealing solutions involve leaning against stainless steel.

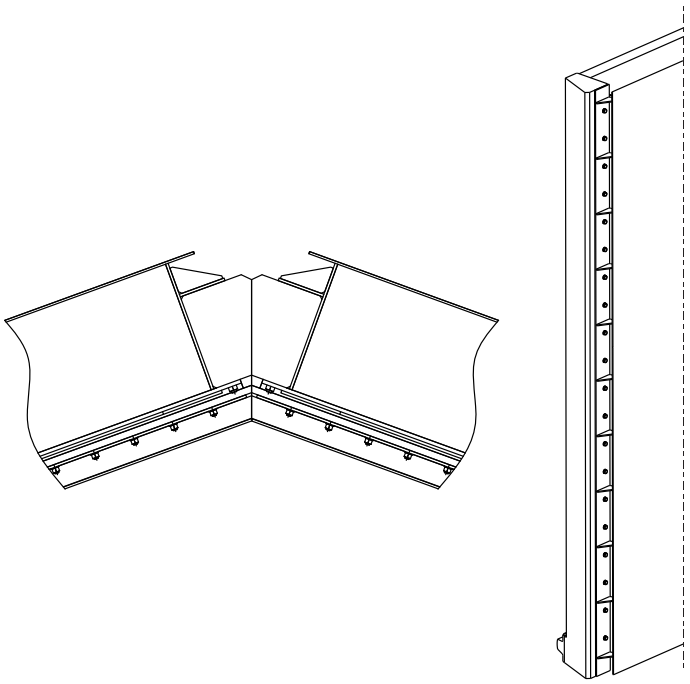


Support and sealing in the door niche

The existing lateral sealing in the door niche via an oak beam leaning against steel lining is to be kept. This solution is acceptable provided that oak beams are regularly maintained and replaced. The Developer owns several locks (in use) with double-leaf doors where the proposed sealing method is applied.

Support and sealing between door leaves (only for upper and middle gate)

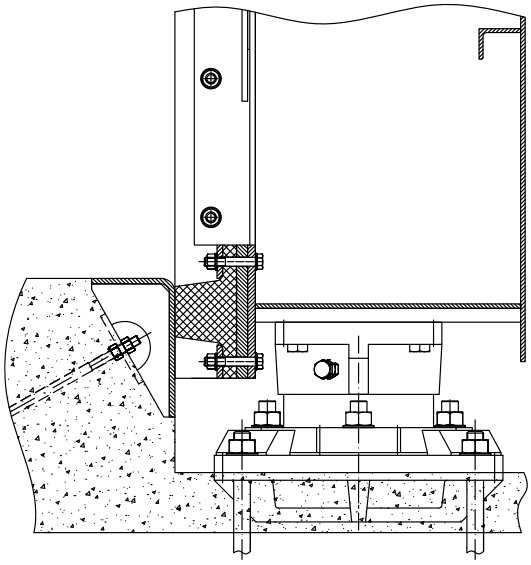
When closed, the door leaves are mutually supported via oak beams, Drawing No. PUK-1.01.01.00.00 and PUK-1.01.01.01.00. The existing solution for the mutual support and sealing of door leaves via oak beams is to be kept. This solution is acceptable provided that oak beams are regularly maintained and replaced. The Beneficiary owns several locks (in use) with double-leaf doors where the proposed sealing method is applied.



Support and sealing between door leaves

Support and sealing at the door threshold (only for upper and middle gate)

Given that this part of the door is always under water, sealing is possible by using structural rubber that can make high-quality connection with vertical oak beam seals on both lateral sides. The support and sealing solution for double-leaf doors is presented in Drawing No. PUK-1.01.01.01.00. This construction solution is well-known and recognized in practice. The Beneficiary owns several locks (in use) with double-leaf doors where the proposed sealing method is applied.



Sealing elements at the door threshold

Mechanisms for opening/closing of gates

(only for upper and middle gate)

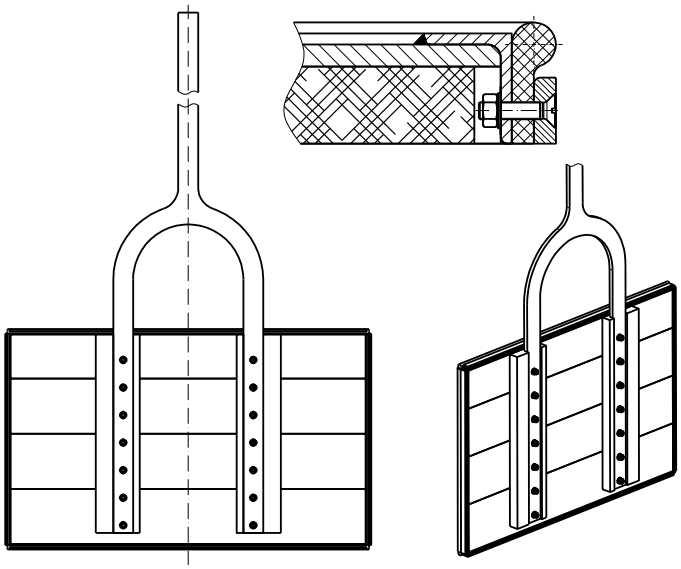
The opening and closing of both leaves of all gates is done by means of hand-operated mechanisms. These are operated by means of two pairs of cylindrical gears and one pair of conical gears, and then the opening and closing of the door leaf is carried out by a gear rack. The complete mechanism is located in a niche in the immediate vicinity of the upper bearing. For the upper and middle doors, one type of mechanism is used, while another type of mechanism is used for the lower door, which is a newer version.

On the basis of detailed visual inspection and measurements it is concluded that the condition of the elements of the mechanism is satisfactory so their repair (overhaul) is necessary.

Since there is no technical documentation for the closing and opening mechanism of the doors, the existing mechanism has been measured and surveyed within this project and documentation has been made based on assembly drawings, No. PUK-1.01.01.04.00.

Flashboards (only for upper and middle gate)

Dimensions of the flashboards will be the same as those of the existing ones. Instead of originally wooden flashboards, these will be a combination of an L-section frame with the filling made of oak boards, while the sealing is done using rubber onto stainless steel. The steel frame is filled with oak boards fastened by screws to the steel frame sheets on one side, and on the other, to the arms of the vertical bar for flashboard lifting, in the same way as in the case of the original solution. This is the way to ensure the same visual appearance and a considerably stronger and durable structure since oak boards are protected upon opening and closing of the flashboard. What may be the greatest advantage of the solution is the sealing made via the rubber note sliding along the segments of stainless steel. The figure shows details of the new flashboard.



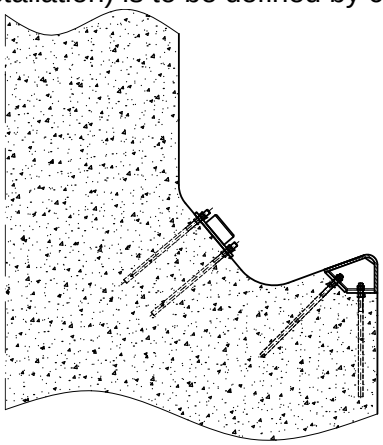
The flashboard with guiding and sealing elements

Lifting and lowering mechanism of the middle door flashboard

As in the case of the mechanism for closing and opening the doors, due to the visual appearance, manual operation of the mechanism for lifting and lowering the door flashboards is to be kept. Based on the inspection, it was found that the elements are in a satisfactory condition. The repair is estimated at 65% of the value of a new structure.

Door niches (only for upper and middle gate)

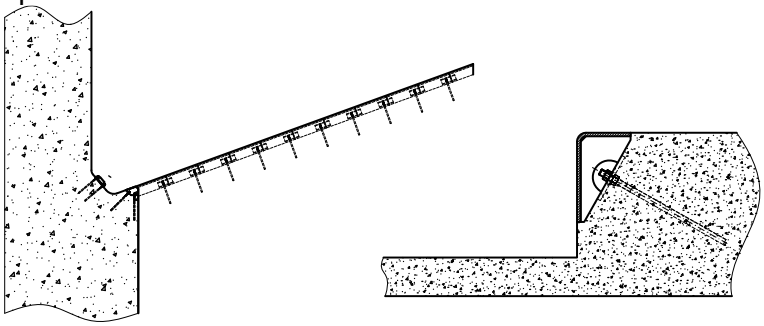
The existing niches should be adjusted to the new solution for the door support and sealing.
NOTE: The part relating to the concreting and connection elements (stalks, anchor bolts, concrete composition and method of installation) is to be defined by construction experts.



Door niche details

The door threshold

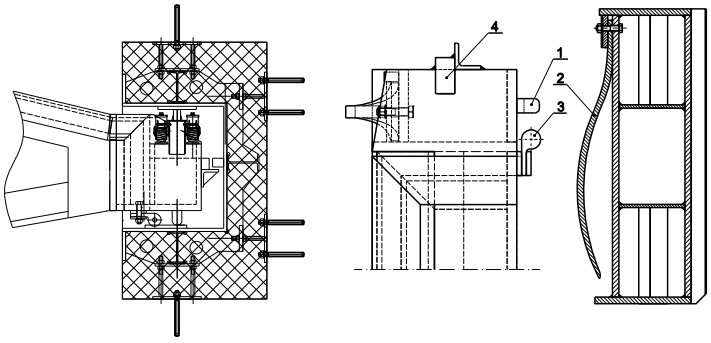
The existing thresholds are flashed with steel sheet and are adjusted, with the new concreting, to the new method of horizontal door sealing.
NOTE: As in the previous case, it should be noted that the part relating to the concreting and connection elements (stalks, anchor bolts, concrete composition and method of installation) is to be defined by construction experts.

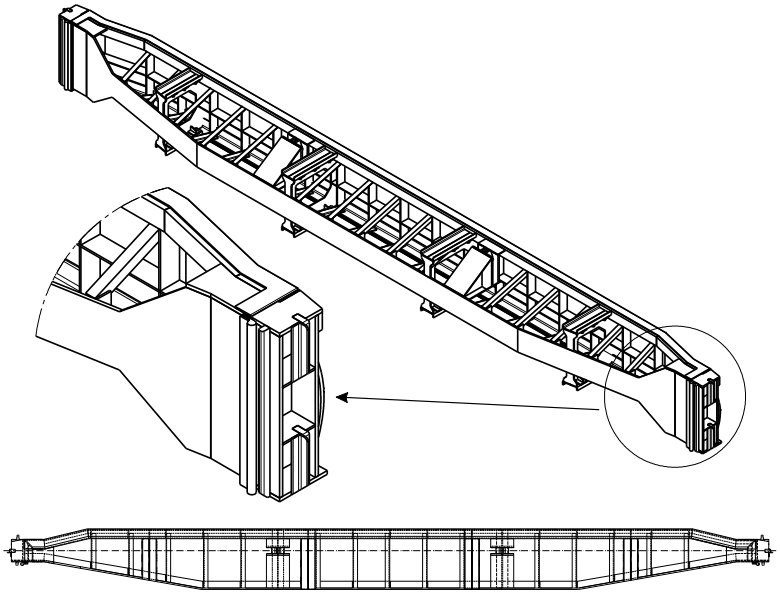


Door threshold details

Stop logs

The condition and defects of the existing stop logs are such that it is necessary to reconstruct the ends of the stop logs in order to improve their functionality, primarily in terms of support and sealing. The basic structure of the logs in the length of 9300 mm is the same for all stop logs. Since the measurements upon the inspection were carried out at the level of the lock crown, the specified lengths are only approximate and need to be precisely determined upon equipment assembly, identifying possible deviations from the values specified here. Furthermore, it is necessary to determine the verticality of the stop log niches, i.e. their being parallel on the lateral ends of the lock.



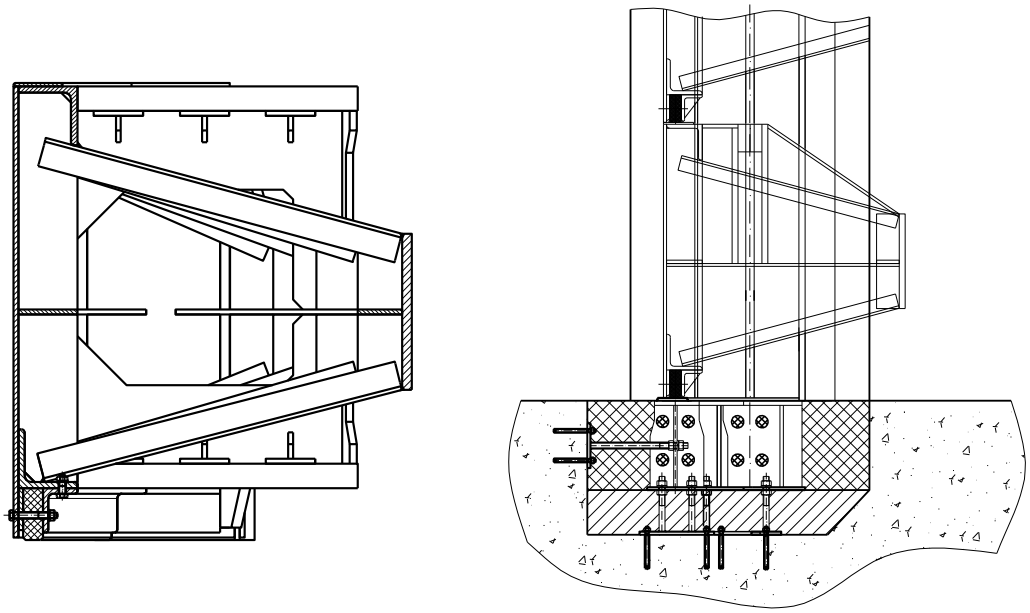


Review of the structure of the stop log boxes and the end of the seals with the elements for support and sealing in the niche

In order to ensure a proper support and guiding of the stop logs in the niche, the design includes, on one side, the support in the shape of a tongue made of thick sheet metal (Item No. 1) welded onto the stop log box. The support is to receive half of the hydraulic pressure lateral load and transfer it to the niche. It is to rest on and slide along the sheet metal strip which is welded onto the steel flashing of the niche. Additionally, the support protects the rubber note against any damage, ensuring appropriate sealing to a small extent by means of its deformation by bending, and to a large extent, by means of water pressure and increasing contact pressure between the rubber note and the stainless steel strip. Installation of new vertical rubber seals in the shape of a musical note, and also the elements to attach them to the steel structure are shown in Drawing No. PUK-1.01.04.01.00.

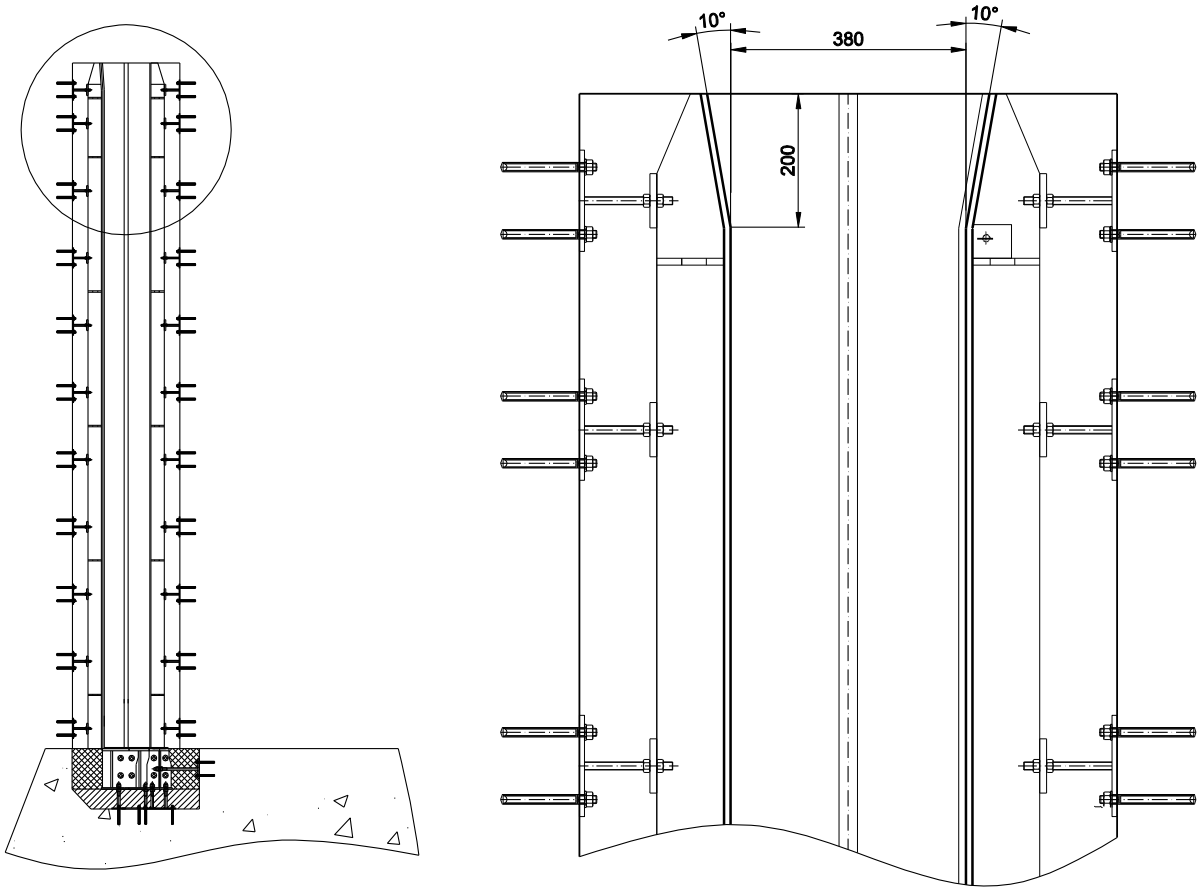
The new solution should ensure deformation of the seals under the impact of the hydrostatic pressure of water. To achieve this, it is necessary to have the support pressed against the stainless steel strip, which is possible to accomplish by the operation of a spring. The lateral pressure is possible to achieve in several ways. This design makes use of a leaf spring (Item No. 2, and Drawing No. PUK-1.01.04.01.01). In addition to ensuring the lateral force, this method is also suitable in terms of good functionality in muddy conditions. The selection of this type of spring is a delicate one, since it needs to meet a larger number of requirements. The shape of the spring with a variable section should ensure the appropriate lateral force (around 2500 N), the tensions in the spring must be lower than the allowable, it should have the appropriate deflection and small contact area with the stainless steel strip, and also ensure “self-cleaning” and easy maintenance.

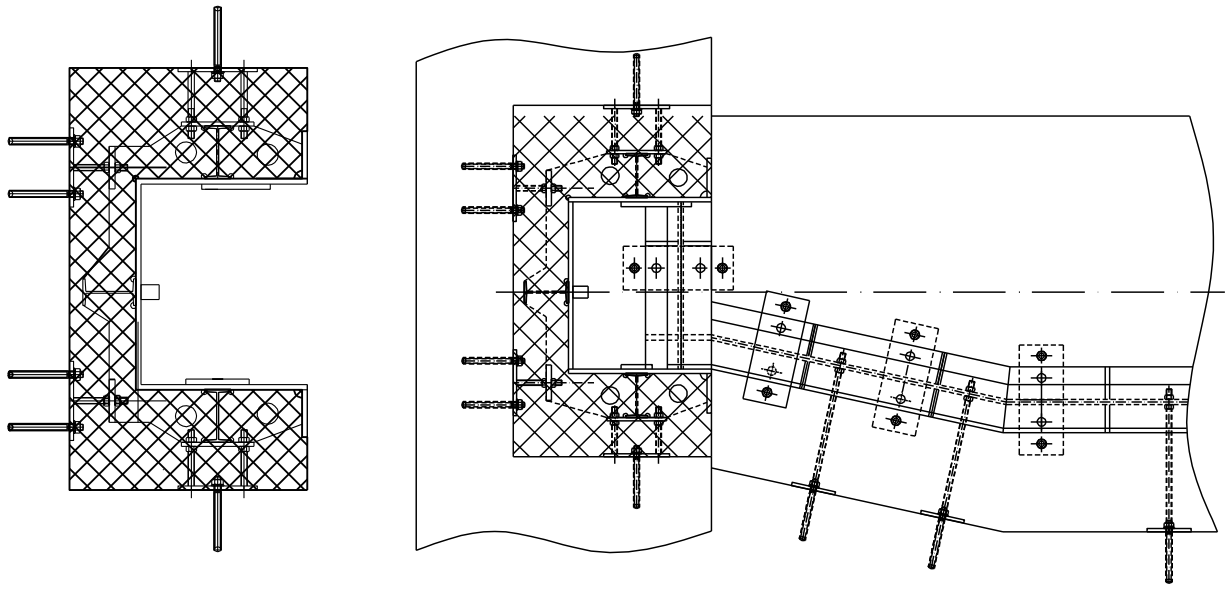
In order to ensure good sealing on the threshold, i.e. the upper surface of the stop log in the area where the two support each other, the stainless steel strip is welded along the whole length of the stop log, with the strip providing good fitting of the lower structural rubber of the next stop log. The reconstruction should prevent direct inter-log leaning on the rubber seal. Support should be made via the blade of the stop log section, i.e. the contact of the steel support with the stainless steel strip on the upper side of the stop log section or at the threshold of the overhaul stop logs. Since stop logs support each other along a relatively thin edge, great precision is required to guide stop logs in the niche, which is achieved by means of the supporting tongue and spring, ensuring guiding in the direction of the lock, while lateral guiding is carried out by means of special stops on the stop log and the niche.



Stop log cross section and position of one against the other

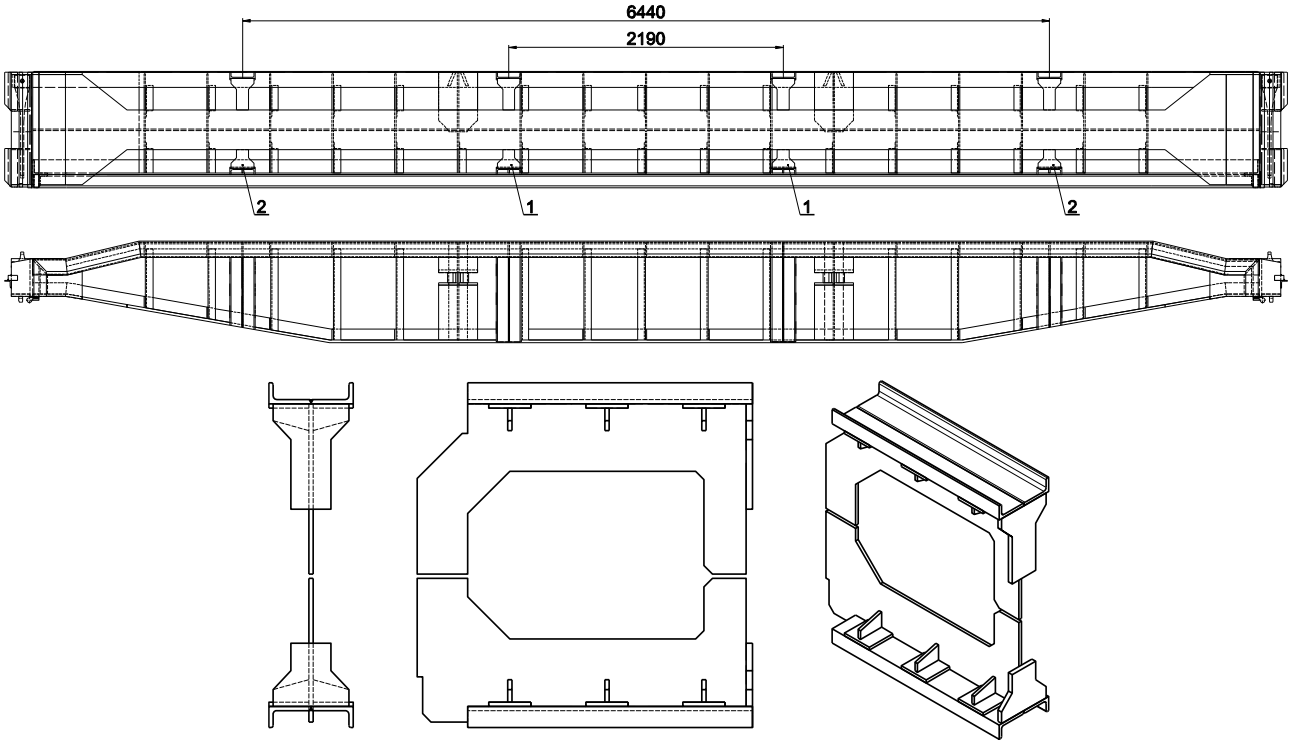
This solution for a stop log requires a larger niche. It is, therefore, proposed that the reconstruction be undertaken as shown in the figure. As already noted, the reconstructed threshold and stop log niches in the support and sealing area should have stainless steel strips welded onto them.





Stop log niches and threshold in the lock

For the purpose of ensuring proper storage of stop logs and protection of the structural rubber, U-sections with ribs are to be welded at four points of the structure, Drawing No. PUK-1.01.04.03.00 and PUK-1.01.04.04.00.



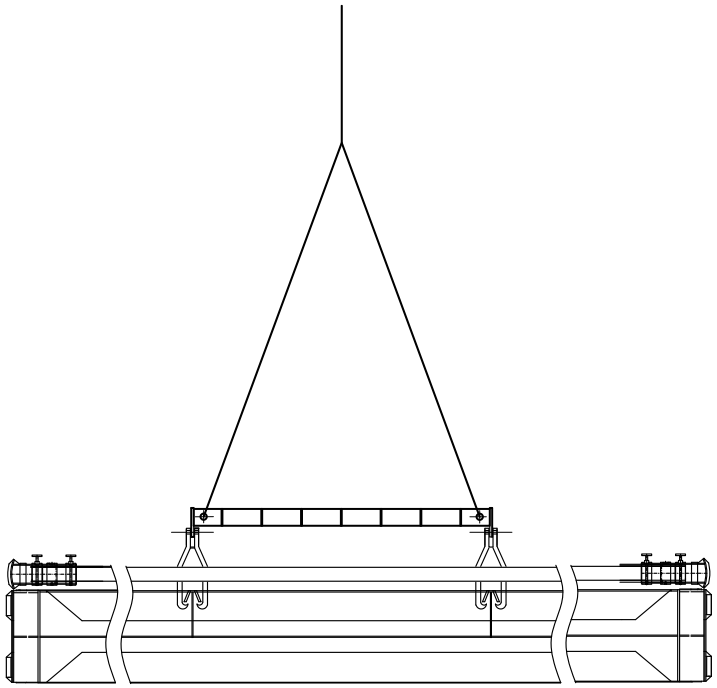
Cross-section of the stop log in the area of semi-automatic tongs engagement and points of stop log support

IMPORTANT NOTE: Due to the conditions in which the measurements were carried out, which is explained in detail in the first chapter (Equipment Condition Review and Analysis), upon disassembly of hydromechanical equipment, conduct accurate measurements of the light size, height of the niches, possible deviations in the lateral spacing at the level of the floor and the crown of the lock in the area of the stop log niches.

Stop logs are to be handled using mobile cranes. It is necessary to designate the appropriate space (platform) for positioning the mobile crane for the upper and lower cofferdam. Based on the particular distances to the centre of the cofferdam, it is necessary to select a mobile crane with a load-bearing capacity of minimum 5 t at an appropriate distance. When stop logs are not used, it is necessary to designate the appropriate space for their storage where it would be

possible to protect them against weather impacts during longer periods. Stop logs should be stored carefully over appropriate oak scantlings in order to protect stop log sealing rubber. The decision regarding the method of arranging the stop logs, either separately or one on the other, is to be made subsequently. One of the solutions could be the storage method applied in Bezdan.

The Bezdan portal crane traverse should be used for handling stop logs. It is not necessary to make a new traverse but only to have traverse connections on-site which would suit the specific lock niches. The figure shows the solution for the devices for handling stop logs.



Traverse for handling stop logs

The traverse connection is defined in Drawing No. PUK-1.05.01.00.00 while the auxiliary traverse is shown in Drawing No. PUK-1.05.02.00.00.

3.4.2. FLOODGATE

The floodgate comprises frames (17 pcs.) over which flashboards are placed and perform sealing. The frames are interconnected by a chain that is used to lower or lift them either manually or by a mechanism (hand winch). Mechanism (hand winch) is fitted on the side of the floodgate (laterally). A modular bridge with rails for the movement of trolleys with a crane for mounting/demounting of the flashboards is placed over the frames.

Frames represent a grid steel structure and are placed at a distance of 1.25 m between each other. They are used as supports for stop logs, which are used to close or regulate the water flow by being inserted or taken out. In the wall of the floodgate towards the canal lock there is a niche in which the frames are laid when the floodgate is fully opened. The floodgate is fully opened before the start of the winter, by manually taking out the flashboards by means of an electric hoist with a trolley and transporting them to the warehouse for storing. The floodgate is once again lifted in the spring.

The frames are articulated to the base plate and by rotating around the horizontal shaft at the bottom of the floodgate they roll towards the lock, with the first three frames entering the niche proportionally to their upper part.

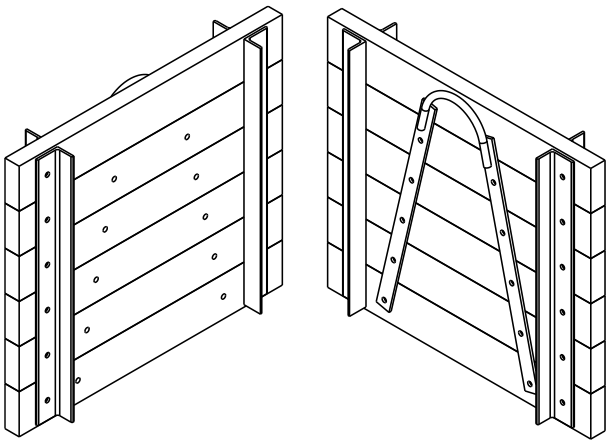
Based on the inspection of the existing condition of the frames by repeated visits to the site, detailed visual inspection of the part of the structure that is above water level and by inspection of the frames on shore, it has been concluded that it is necessary to repair them (anti-corrosion protection).

By inspection, measuring and determining the existing condition of the trolley and hoist for lifting/lowering of flashboards, as well as of the bridge above the frames and rails for the trolley movement that these need to be repaired (overhauled). The traverse, especially the wheels, is in such a condition that it is necessary to manufacture a new one. According to the assembly drawing, Drawing No. PUK-1.02.05.00.00.

Based on the visual inspection of the mechanism for lifting/lowering of the frames (Drawing No. PUK-1.02.11.00.00). it has been found that the mechanism is well preserved and in a very good condition. The gears are in good condition. It is necessary to perform the repair (overhaul) of the elements of the mechanism.

Flashboards ensure regulation of the flow on the floodgate by being lowered by means of a console crane, supported by the sliding surfaces of frames, in the case of the first line from the bottom of the floodgate, while the other lines are supported by already lowered frames to the required level. There are 18 flashboards in the first line and there are 5 lines in total.

By inspection of flashboards, it has been found that some of them are damaged to such an extent that they are no longer fit for use, and therefore it is necessary to construct new ones,using Drawing No. PUK-1.02.02.00.00. Likewise, there is a quantity of relatively new ones, i.e. unused, manufactured several years ago.



Appearance of flashboards

3.4.3. WAREHOUSE BRIDGE CRANE

When the mechanical equipment is concerned, there is a bridge crane in the warehouse. Based on the inspection of its present condition, detailed visual inspection and measurements on parts of its structure, it is noted that the supporting construction of the crane is in a satisfactory condition and that only repair is necessary. It is necessary to replace the trolley of the bridge crane with the lifting gear.