Status / Revision	**Date**	**Description**	**Prepared**	**Checked**	**Approved**

Project Title: **CONSTRUCTION OF LLOGARA TUNNEL**	
Drawing / Document title / subtitle: **DETAILED DESIGN** **MECHANICAL SYSTEMS** **TECHNICAL REPORT**	Date 2021-03-20 Prepared by: Primož Golob Checked by: Primož Golob Approved by: Uroš Mikoš
Llogara Tunnel Design Consortium **iC consulenten □ Elea iC □ IBE □ Seed Consulting □ Infrakonsult**	Document Number: LLO_IBE_DD_ ME_TMS_2000_RP_EN_W_02

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1. Mechanical systems

1.1 General introduction

In addition to the ventilation of the tunnel, which is treated in the previous chapter, we also have facilities and premises that require mechanical installations for their operation. There are two buildings on both sides in front of the tunnel:

- Portal building north
- Portal building south

In the building on the north portal there is a ventilation station, necessary technical rooms, tunnel command center, offices for staff who manage and supervise the operation of the tunnel, crisis management center and station for the tunnel fire brigade. In addition to the above, the building also has warehouses, wardrobe, a rest area, roomclub, bathrooms, toilets and a kitchenette. A crew with a 24-hour presence is planned in the facility. The facility provides mechanical installations for ventilation, cooling and heating, as well as sanitary water supply and vertical sewage.

In the building on the south portal there is a ventilation station, necessary technical rooms, and the presence of a crew is not foreseen. The facility provides mechanical installations for ventilation, cooling and heating.

Mechanical installations are also required for the technical premises in the tunnel, which are located in all five lay by niches of the main tunnel. The facility provides mechanical installations for ventilation, cooling and heating.

1.2 Ventilation, cooling and heating for technical premises

1.2.1 Portal building north, ventilation, cooling and heating

In rooms where there are permanent jobs and where employees are located as offices, club room, rest, command room, system room, crisis headquarters, the room temperature should be 26^{o} C in summer and 20^{o} C in winter. The temperature will be provided by air conditioner for cooling and heating, which will be additionally enabled with the electric radiators.

In rooms such as wardrobe, bathrooms, toilets, the room temperature is expected to be 24^{o} C in winter, and in summer the temperature is not controlled. In winter, the rooms will be heated by electric radiators, however, they will be forcibly ventilated with exhaust ventilation systems.

In the bathrooms, toilets and kitchenette the exhaust fan system will be installed in the suspended ceiling, exhaust via ventilation valve in the room and outlet via protective louvre on the facade. The ventilation system will be switched on via a 5-stage transformer to set the minimum and maximum ventilation quantity and a timer, which will control the room ventilation depending on the schedule. The maximum flow will be during the planned full occupancy of the facility and the flow will be reduced at night. The supply of fresh air is provided via a ventilation grille in the door.

In the battery compartment it is important that the temperature is as constant as possible throughout the year and should be between 22-26^{o} C. The battery room must be naturally ventilated in accordance with the standard EN 62485-2, and the temperature will be provided by air conditioner.

The supply of fresh air to the battery compartment is provided via a fire-insulated duct carried out by the construction contractor in a double floor, and the natural exhaust of air from the battery compartment is provided via a fire-insulated duct carried out by the construction contractor in a suspended ceiling, held directly under the ceiling, and in the battery compartment the exhaust grille will be installed just below the

ceiling. The free area of the inlet and outlet ventilation grille must be larger than the minimum calculated according to the data of the battery manufacturer in accordance with standard EN 62485-2:

Minimum venting conditions necessary for a YUASA VRLA battery of the SWL range consisting of 1 x 44 SWL2500 are :

- V = v x q x s x n x Igas x Crt x 10-3 (m3/h)
- v x q x s = 0,05 (cste)
- n = 44 x 6 cells
- Igas = 8 mA/Ah (cste)
- Crt = 91,40 x 1
- V = 0,05 x 264 x 8 x 91,4 x 0,001 (m^3/h)

V = 9,65 (m^3/h)

* If the batteries are only recharged in floating mode, the venting can be reduced by 8.

V = 1,21 (m^3/h)

Minimum Aef=28xV=270,2 cm^2

And heat dissipation with different ways of charging batteries:

1 Data

Number of cells per string :	**264**
Internal resistance of a monobloc :	**0,0065 ohms**
Total floating voltage :	**600,60 V** *(Floating voltage per cell x number of cells)*
Total capacity in 20hrs (C20):	**92,4 Ah** *Capacity at C20 of a monobloc x N)*
Charging current at 0.1C20 :	**9,24** A

2 Calculation

Heat dissipation in floating mode:

Pfl = Total floating voltage x Floating current
Current in floating is reckoned at 1 mA per Ah of total capacity at C20
Pfl = 600,6 x 0,0924 = 55,50 W

Heat dissipation in recharging (for a charging current of 0.1C20)

Pr = Internal monobloc resistance x Number of monobloc (Nb) x (Charging current)²
Pr = 0,0065 x 44 x (9,24)² = 24,42 W

Heat dissipation in discharge :

No heat dissipation during discharge, because of endothermic effect
Heat dissipation only in connections.
Pd = 0 W

In technical rooms, such as the system room, the room for communication equipment, the UPS room, where more sensitive electronic equipment is located, the room temperature should be between 18 and 27^{o} C, which will be provided with the air conditioners.

The air conditioner must be suitable for business use, which means non-stop operation 24/7 and must allow a wide working range of at least -15 to '+46^{o} C .

In technical premises such as medium-voltage, warehouses and wardrobe the room temperature should be 35^{o} C in summer and not controlled in winter. The temperature is maintained by means of a exhaust ventilation system. The exhaust fan system will be installed under the ceiling (in the suspended ceiling), there are two exhaust ventilation grilles in the room and utlet via protective louvre on the facade. The ventilation

system will be switched on via a 5-stage transformer to set the minimum and maximum ventilation flow and a room thermostat, which will control the room ventilation depending on the room temperature.

The supply of fresh air to the ground floor of the warehouses and wardrobe is provided via a ventilation grille in the door.

On the first floor, fresh air is planned to be supplied to the medium voltage room and warehous via a protective louvre on the façade in a double floor, in which there will be two floor ventilation panels, which are within the scope of work and delivery of the construction contractor.

The transformer rooms will be naturally ventilated so that the room temperature is guaranteed to be maximum 50° C at full load, and in winter the temperature is not controlled. The supply of fresh air is provided via the façade protective louvre under the podium and the exhaust is provided via the façade protective grille under the ceiling of the room. Additional supply protection louvres are provided in the doors. In determining the free surface of the façade protective louvre, the data of the transformer manufacturer and the electrical designer were taken into account and it is stated in the drawing and BoQ.
Further details can be seen in the drawings: schemes, floor plans and sections.

1.2.2 Portal building north, water supply and sewerage

1.2.2.1 PLUMBING CONNECTION AND WATER METER SHAFT

The implementation of the external water supply is not the subject of this plan and must be prepared in advance for the water meter shaft.
The water supply will take place in the ground to the water meter shaft. It is made of high density polyethylene pipe PEHD for plumbing, PN16, material PE100, in accordance with the standard ISO4427 / EN12201-2 / DVGW for drinking water, including electrofusion moldings (couplings, arches, reductions, T pieces, ...) and electrofusion welding materials.

Plumbing HDPE pipes are laid in a sand bed: thickness under the pipe 10 cm and backfill with sand 30 cm thick above the pipe. The laying depth of the PEHD water pipe is at least 110 cm. The planned depth is 120 cm. Associated construction works for laying plumbing are:

- all necessary geodetic works of the water supply system; a recording of the water pipe, welds, the terrain above the pipe and a recording of all the crossings of the utility lines (electricity, telephony, gas pipeline, sewerage, etc.),
- slaughtering, manual excavation and protection of all utility lines on the route,
- excavation of a ditch (separate humus from the rest of the excavation),
- construction of a sand bed 10 cm thick and backfilling of the installation with 0-4 mm granulation sand 30 cm thick above the pipe,
- laying PVC warning tape in blue with the inscription ATTENTION PLUMBING,
- backfill of the ditch with the originally excavated material (without stones larger than 20 cm).

The water supply runs through the water meter shaft, where the water meter and other suitable water fittings PN16 are installed, in accordance with the standards for drinking water EN 805, EN 806:

- two FF pieces DN 50 / length 600 mm,
- two DN 50 valves with handwheel for opening / closing,
- T piece DN 50/50, with added valve DN 25 on the blind flange for discharge and disinfection of pipelines,
- DN 50 dirt trap with fine sieve,
- MDK piece DN 50 / s adjustable length from 155 to 205 mm,
- water meter Qn = from 0.03 to 20 m3 /h DN 40, with output for remote reading,
- non-return flap DN 50

The calculation showed that the peak water consumption will be from **0.94 l/s** to a maximum of **3.33 l/s**.

Based on which, the appropriate dimension of the pipeline for the facility and the water meter was selected.

1.2.2.2 INDOOR PLUMBING

Peak water consumption for water supply is estimated according to DIN 1988-3 for office buildings.

The internal distribution of the plumbing installation is designed in accordance with DIN 1988 (05.02) /EN 806.

Sanitary water distribution in the building will take place in the floor, under the ceiling, in the suspended ceiling, in the walls, or in the constructions of individual modules. Branches of the plumbing installation to individual risers will be equipped with shut-off valves so that they can be eliminated if necessary.
The internal plumbing installation includes wall installation systems (prefabricated prefabricated elements for the installation of sanitary equipment), sanitary elements and associated fittings, as well as hot and cold drinking water distribution networks.

Sanitary elements are designed in accordance with the construction substrates and the requirements of the client.

A local electric water heater with a volume of 120L and an electric power of 2 kW is provided for the preparation of hot sanitary water on the ground floor.

Upstairs, a local electric water heater with a volume of 80L and an electrical power of 2 kW is provided for the preparation of hot sanitary water.

Support and suspension of pipelines should be performed as follows:

- that there are no thermal bridges and thus no dew, ie pre-insulated clamps on the outside of the insulation,
- to enable dilatation of pipelines up to 0.3 mm/m of pipe.

Pipelines and fittings will be adequately thermally insulated in accordance with the regulations on efficient energy use. Thermal insulation of pipelines should be carried out with thermal vapor barrier insulation made of synthetic rubber, with a closed cell structure, which in case of fire does not drip, does not spread fire and is self-extinguishing.

1.2.2.3 VERTICAL SEWERAGE

In the considered project, the vertical sewage of the building is treated, the horizontal sewage in the foundations or at an angle of the terrain is treated in the plan of building structures.

The facility will be connected to a non-flowing septic tank into which fecal sewage from the facility will be collected. Installation, selection and design of the septic tank system and horizontal sewage in the foundations and the ground to the septic tank is not the subject of the plan of mechanical installations and hardware and is the subject of the plan of building structures.

The runoff flow for gravity sewage, which includes the sewage of sanitary elements of the building according to SIST EN 12056-2: 2001 is QWW = **1.9 l/s**.

Vertical sewage is planned in accordance with the EN 12056 standard.

Vertical sewage consists of horizontal and vertical connections to sanitary equipment, in accordance with the architectural plan. Horizontal distributions will take place in the floor, walls and under the ceiling. Vertical faecal sewers will run in and along the walls.

For pressure equalization in the pipes of the vertical sewage system, vents are made:

- the main outlet for toilets is carried out on the roof of the building,
- additional deaeration in the kitchen sink with deaeration sewer valve according to EN 12380

The distribution of fecal sewage will be carried out from PP pipes. The pipes must be sealed with original seals for sewer pipes. After installation, it is necessary to test the tightness and strength of the sewer network.

1.2.2.4 GENERAL AND STANDARDS FOR WATER SUPPLY AND VERTICAL SEWERAGE

Antivibration and sound insulation

All the equipment must be installed in such a way that any vibrations and noise are not transmitted through the pipework or to the building structures.

Test operation

The test operation should be performed :

- inspection of installation, valves and equipment,
- review of the operation of devices and control elements,
- sanitary water sampling and analysis to achieve the prescribed parameters.

The test run lasts continuously for 72 hours.
Equipment and materials must be checked in accordance with good engineering practice (GEP Commissioning) before installation. Upon completion of the installation of the equipment, the installation qualification IQ inspections (Installation Qualification) are required. After completing the IQ examinations, it is necessary to perform OQ (Operation Qualification). IQ and OQ reviews must be properly documented and archived.

Pressure test

The pressure test of the internal water distribution must be carried out in accordance with the requirements of the SIST EN 806 standard: test pressure = 1.1 x maximum design system pressure = **8.8 bar**.

The pressure test of the strength and sealing of the vertical sewer piping system with water according to EN12056 and EN1610 must be performed: test pressure = 30 kPa = **0.3 bar**.
A record of the pressure tests must be drawn up and signed by the inspection body and the contractor.

Disinfection of sanitary water pipelines

At the end, after the pressure test the water supply pipes are flushed, the drinking water system is disinfected in accordance with EN 805 or in accordance with the regulations for drinking water. The maximum length of the pipe is 100 m and must not be exceeded. Normally, all outlets should be open. Cleaning takes place at a minimum speed of 0.5 m/s.
The disinfection of the water supply system is carried out by an authorized organization, which also prepares a report on the successful completion of disinfection.

Standards

The following standards are taken into account when designing and implementing a water supply or drinking water system and sewerage:

- EN 805: Water supply - Requirements for system and components outside buildings
- EN 806: Specifications for installations inside buildings conveying water for human consumption
- DIN 1988: Technical Regulations for Drinking Water Installations (TRWI) --- Codes of Practice for Drinking Water Installations (TRWI)
- EN 12056: Gravity drainage systems inside buildings
- EN 1717: Protection against pollution of potable water in water installations and general requirements of devices to prevent pollution by backflow
- DVGW W 515: Drinking Water Heating and Drinking Water Piping Systems; Technical Measures to Reduce Legionella Growth; Design, Construction, Operation and Rehabilitation of Drinking Water Installations.

Further details can be seen in the drawings: schemes, floor plans and sections.

1.2.3 Portal building south, ventilation, cooling and heating

In technical rooms, such as the system room, the low voltage room, the TC room, the UPS room, where more sensitive electronic equipment is located, the room temperature should be between 18 and 27^{o} C, which will be provided with the air conditioners.

The air conditioner must be suitable for business use, which means non-stop operation 24/7 and must allow a working range of at least -15 to '+46^{o} C.

In the battery compartment it is important that the temperature is as constant as possible throughout the year and should be between 22-26^{o} C. The battery room must be naturally ventilated in accordance with the standard EN 16798-3;2018, and the temperature will be provided by air conditioner.

The supply of fresh air to the battery compartment is provided via vertical duct in the wall carried out by the construction contractor, and the natural exhaust of air from the battery compartment is provided also via a vertical duct in the wall carried out by the construction contractor, and the exhaust grille will be installed just below the ceiling. Air intake and exhaust will be on the façade via a protective façade louvre.

The free area of the inlet and outlet ventilation grille must be larger than the minimum calculated according to the data of the battery manufacturer in accordance with standard EN 16798-3; 2018:

Minimum Aef=28xV=270,2 cm^{2} ; See calculation in chapter: PORTAL BUILDING NORTH, VENTILATION, COOLING AND HEATING

The Corridor will be naturally ventilated via vertical duct in the wall carried out by the construction contractor, and the natural exhaust of air is provided also via a vertical duct in the wall carried out by the construction contractor, and the exhaust grille will be installed below the ceiling. Air intake and exhaust will be on the façade via a protective façade louvre.

In the medium-voltage room the temperature should be 35 C in summer and not controlled in winter. The temperature is maintained by means of a supply ventilation system. The installation of a supply ventilation system is planned at the floor of the room. The air intake will be in the corridor via a round protective louvre and via a round fire damper with a fire resistance of 90 min. A circular duct fan is provided in the room, and a blow into the room via a round protective louvre. The ventilation system will be switched on via a 5-stage transformer to set the minimum and maximum ventilation flow and a room thermostat, which will control the room ventilation depending on the room temperature. Exhaust air is provided under the ceiling, over the wall into the Corridor. In the wall will be a round fire damper with a fire resistance of 90 min and a round protective louvre on both sides of the fire damper.

Other technical rooms will be ventilated as needed, indirectly through the hallway.

The transformer rooms will be naturally ventilated so that the room temperature is guaranteed to be maximum 50^{o} C at full load, and in winter the temperature is not controlled. The supply of fresh air is provided via the façade protective louvre under the podium and the exhaust is provided via the façade protective louvre under the ceiling of the room. Additional supply air protection louvres are provided in the doors. In determining the free surface of the façade protective louvre, the data of the transformer manufacturer and the electrical designer were taken into account and it is stated in the drawing and BoQ.

Further details can be seen in the drawings: schemes, floor plans and sections.

1.2.4 Tunnel technical premises ventilation, cooling and heating

The transformer room will be forcibly ventilated with a supply fan system, which must be equipped with filter unit ISO Coarse 90% on the inlet, so that the room temperature is guaranteed to be 50 C at full load.

The optimum operating temperature in the room should be in the range up to 40 °C and the maximum room temperature 55 °C. The installation of a supply ventilation system is planned at the floor of the room. The air intake will be in the tunnel via a round protective louvre and via a round fire damper with a fire resistance of 90 min, with filter unit. A circular duct fan is provided in the transformer room, and a blow into the room via

a round protective louvre. The ventilation system will be switched on via a 5-stage transformer to set the minimum and maximum ventilation flow and a room thermostat, which will control the room ventilation depending on the room temperature. Exhaust air is provided under the ceiling, over the wall into the tunnel. In the wall will be a rectangular fire damper with a fire resistance of 90 min and a rectangular protective louvre on insides of the fire damper, and outside -in the tunnel, will be non-return damper, which prevents the flow of air (and dust) from the tunnel.

In the E technical room with UPS, system and communication equipment, where more sensitive electronic equipment is located, the room temperature should be between 18 and 27 C, which will be provided with the air conditioners. Due to redundancy, two air conditioners are planned.

The air conditioner must be suitable for business use, which means non-stop operation 24/7 and must allow a working range of at least -15 to '+46^{o} C.

Further details can be seen in the drawings: schemes, floor plans and sections.

1.3 Specifications for mechanical systems

1.3.1 Specification of the ventilating, heating and cooling equipment

Air conditioners

The air conditioner - inverter split system must be suitable for business use, energy class minimum A/A; it also must enable reliable operation 24h/7days. Indoor wall units are selected, which must be mounted on the wall, under the ceiling, and external compressor condensing units are intended for mounting on supports that will be attached to the facade. The air conditioner is controlled by an infrared remote control, which is mounted on a plastic carrier near the front door. Switching between cooling and heating is automatic. The connection between the outdoor unit and the indoor unit is provided via pre-insulated copper pipes with Armacell - Tubolit insulation, according to EN12735 standard, connection length of up to 15 m, and should be placed in a plastic protective-decorative channel. Vacuuming the system and pressure test should be carried out before commissioning. Cooling must be possible at least at an outside temperature of -15 °C to + 46 °C and heating must be possible at least at an outside temperature of -15 °C to + 15 °C.

The drainage of the condensate from the indoor and outdoor units will be gravitational, with a minimum drop of at least 1 cm/m to the vertical in the corner of the room, which goes down into the double floor and leads into the drainage pipe covered by the construction project.

Piping and thermal insulation

SPLIT air conditioning interconnecting pipelines have been processed. Pipelines are planned to be made from pre-insulated copper pipes, which are intended for transfer of technical gases in cooling and air-conditioning technology for R32 refrigerant and are available in coils/rolls. Copper pipes should be manufactured in accordance with EN 12735 standard, factory cleaned, degreased and sealed on both sides. The insulation provided should be a closed-cell polyethylene material with additional outer film resistant to UV radiation and external damage. Insulation thickness should be 9 mm. The insulation provided should be made of synthetic rubber with a closed cellular structure, low-flammable and self-extinguishing, non-dripping and does not spread fire - type B2 according to DIN 4102/1, with thermal conductivity $\lambda <$ 0,035W/mK at 0 °C and with a diffusion resistance coefficient of $\mu > 5000$ acc. to EN 13469.

The pipe connection should be made without joints between the connections to the indoor unit and the outdoor unit; if it is necessary to connect pre-insulated copper pipes, it should be done with the patented SAE-Flare fitting system.

Condensate drain of SPLIT air conditioners

Condensate drainage from indoor and outdoor units of split systems is provided in the length of 1 m from

PVC pipes ϕ 16 mm, and then from pipes suitable for domestic sewerage PP ϕ 32 mm. The combined condensate drain in the double floor is provided from a pipe suitable for house sewerage PP ϕ 50 mm. Condensate drainage must be carried out with a drop of 1 cm/m.
Pipeline pressure tests and system vacuuming
The pressure test must be carried out for the SPLIT air conditioning devices.
The pressure test is performed with nitrogen at a pressure of 4.20 MPa and lasts a minimum of 12 hours.
The system must be vacuumed for 3 hours before starting. The pressure test shall be completed by a record signed by the inspection body and the contractor.

Technical data are given in BoQ items.

Electric radiators

Convector radiators are provided, which operate on the principle of gentle convection of heated air. The electric radiator must enable a low-temperature mode of operation so that the convection of heated air is gentle, directed towards the floor, as in this way we retain heat at the floor as much as possible. They must be equipped with an extremely precise electronic thermostat, calibrated to room temperature, so that the room temperature can be set in the range from + 5 ° C to + 30 ° C. The thermostat must also have a built-in anti-freeze function, which maintains the room temperature above + 5 ° C and protects the plumbing system from frost. The level of protection must be IP24, which allows installation in bathrooms and other damp rooms, provided that they are installed at a distance of at least 60 cm from elements such as showers, bathtubs and the like. Radiators must also have a built-in safety thermostat, which switches off the radiator in case the radiator is covered.The installation of the electric radiators is carried out via the enclosed wall bracket. It is necessary to take into account the height of the installation, which should be between 5 and a maximum of 10 cm from the floor. In this way, the radiators will heat the room along its entire height and save maximum energy.

Technical data are given in BoQ items.

Circular duct fan

The Circular duct fan is reliable in operation and maintenance free and it's box consists of electroplated steel plate. The K Sileo series is designed for installation in ducts. The casing is manufactured from galvanised sheet steel and airtight folded, air leakage class C acc. to EN 12237:2003. All K-fans have a minimum 25 mm long spigot connections according to EN 1506:1997 allows an easy assembling.The fans have backward-curved blades and external rotor motors. To simplify the installation the K Sileo fan has a fixing bracket together with screws for mounting the bracket included as standard. The FK mounting clamp facilitates easy installation and removal, and prevents the transfer of vibration to the duct. The fans can be speed-controlled via a 5-step transformer. To protect the motor from overheating the fan has integral thermal contacts with manual reset. For indoor installation as well as in wet areas due to the air tight casing.

Technical data are given in BoQ items.

Protective louvres

Protective lovres are installed on the facades in the openings for air intake and exhaust as protection against external influences: rain, birds, larger insects. They are made of drawn aluminum profiles and galvanically protected in the natural color of aluminum. They consist of a supporting frame, specially designed transverse slats and galvanized wire mesh.

Technical data are given in BoQ items.

Ventilation grilles and valves

Ventilation grilles, rectangular, made of aluminum, for supply and extract air with air volume damper. Preferably for wall and sill installation but also suitable for rectangular ducts.

Ventilation grille for door installation, made of aluminium, rectangular, suitable for air transfer applications. Construction with fixed horizontal blades and counter frame, made of aluminium profiles anodized in natural aluminum colour.
Ventilating valves are designed to extract air from sanitary rooms and other premises. Construction with fixed diffuser ring, adjustable disc for valve opening and closing and subframe, made of steel sheet metal and Powder coated RAL 9010 (white).

Technical data are given in BoQ items.

Non returne damper in the tunnel
Non-return dampers open and close automatically. When the system is in operation, the blades open when air flows. The blade opening angle depends on the volume flow rate. When the system is shut down, the blades close due to their weight. They safely prevent air from flowing against the intended airflow direction. Robust, maintenance-free construction with maximum differential pressure 5000 Pa. Closed blade air leakage with back pressure, in closing direction, to EN 1751, class 4. Construction, blades made of aluminium, casing made of galvanised steel, duct connection without flange holes.

Technical data are given in BoQ items.

Filter cassette
Filter cassette is fitted with a standard type F3 panel filter. The cassette housing is manufactured from galvanised sheet steel with rubber-sealed circular connections, toggle locks and disposable filters.
The filter cassette is suitable for use as a supply-air filter in heavy industry and industrial workshops.
The recommended final pressure drop is 170 Pa for the coarsefilter.

Technical data are given in BoQ items.

Ventilation ducts and pipes
Rectangular ventilation ducts are planned, which will be made of galvanized sheet metal according to EN 1505 and thickness according to DIN 24190, Form F - twisted (gefalzte), pressure level - Stufe 1 and 4, including design pieces, control elements and inspection openings, which must comply with EN1507.

Round ventilation ducts will be made of galvanized sheet metal according to EN 1506 and thickness according to DIN 24145, including design pieces, control elements and inspection openings, which must comply with EN1507.

Measurement of total (cumulative) air flow through the system

After completion of the leakage test of the ducts to regulate and adjust the designed volume flows, the measurement of air flows in the main branches of the ducts must be carried out with the above equipment. The ducts are adequate when the measured air flow rates are the same as those designed.

Measurement of inlet/outlet air on grilles

After completing the duct test, measuring total air flow, and adjusting design flow rates, air flow measurements in inlet/outlet anemostats and grilles must be carried out with the above equipment. The ducts are adequate when measured air flow rates are the same as those designed.

Ducts are deemed appropriate when the conditions of the above three points are met.

These tests must be collected in a record signed by the inspection body and the contractor.

Technical data are given in BoQ items.

Fire dampers
The fire dampers are provided at the air inlets and air outlets with a 90-minute fire resistance EI90-S in accordance with EN15650: 2010; tightness in accordance with EN 1751 at least class B. Control of the

damper by external signal with a spring-loaded electric motor (230 AC), including open/closed position microswitches; a kit with three temperature guards Tf1, Tf2 and Tf3 with actuation above 72 ℃ triggered if they detect an increase in temperature around Tf1 or between Tf1 and Tf2. Fire damper must be tested in accordance with SIST EN 1366-2 for pressures of at least 300 to 500 Pa. The fire dampers in the wall toward the tunnel tube are triggered via thermo-link when the ambient temperature reaches 70 °C (in the tunnel tube immediately before the cross-passage) or via signal from the fire control panel if a fire in cross-passage is detected.

Technical data are given in BoQ items.

Supporting and hanging

Supporting and hanging will be done differently depending on the possibilities offered by the construction of the building and the space between the foundation beams. Galvanized prefabricated profiles and elements of manufacturers (such as SIKLA, HILTI, MUPRO) or a suitable third-party manufacturer will be used for the construction of the hangers.

Technical data are given in BoQ items.

Corrosion protection

Corrosion protection of steel profiles and structures must be carried out in accordance with the requirements of the EN ISO 12944 series standard. Corrosion resistance according to EN ISO 12944-2: 1998; "Paint and Varnishes - Corrosion protection of steel structures by protective paint systems - Part 2: Classification of environments" must comply with the following parameters:

- Plant life 25 years
- Corrosivity category C4 (high) from Table 1 p. 5 of above standard

Corrosion protection shall comply with all standards of EN ISO 12944 series from Part 1 up to and including Part 8, which prescribe the preparation of surfaces before painting, paint protection systems, test methods, requirements for the implementation and control of painting works, and the development of specifications for new works and maintenance corrosion protection. Prior to installation on the building, surface must be protected under brackets, clamps and other surfaces that are no longer accessible after installation.

Operating and maintenance instructions for the facility

Operating Instructions - Maintenance is a mandatory basis for the safe and operationally reliable use and maintenance of the installed equipment.

The Operating and Maintenance Instructions as well as the submission for the Statement of Work (SOW/PID) shall be prepared or prepared by the contractor. The instructions include a systematically compiled collection of pictorial materials, plans and texts in the form of warranties, certificates, lists, schemes, instructions and similar components that determine the rules for use or operation and maintenance:

- Built structure,
- Installed equipment and materials.
- Installed fixtures, devices and equipment.

All instructions should be in Albanian language.

The client is obliged to fully comply with and follow the instructions of the contractor. Only in this case may the client enforce the warranty requirements with the contractor and its subcontractors.

The contractor is obliged to submit the operating and maintenance instructions, together with the drawings, at least one month before the completion of the works. The scope of the documentation also includes all

attestations, certificates, necessary calculations and other evidence of the quality of the installed individual parts, devices and equipment, reports on the test operation and the pressure tests performed, the performed measurements, as well as instructions for the operation and maintenance of the equipment provided by subcontractors.

1.3.2 Specification for the water supply and sewerage

Valves with handwheel for opening /closing
For permanent contact with drinking at permissible operating temperature up to 50ºC, according to EN 806 . Closing two-way valve. Current speed max. 3.0 m/s is permitted at operating pressures up to 10 bar in max. 4.0 m/s at an operating pressure of 10 to 16 bar.
Materials of main parts:
The body, cover and wedge are made of nodular cast iron, the wedge is fully rubberized with EPDM rubber (W-270), stainless steel spindle with 13% Cr, screws made of stainless steel A2-70, sealing gasket made of NBR rubber, brass sealing nuts.
Spindle seal:
The spindle has a triple seal and double protection nuts. The spindle has a ring that prevents the possibility entry of dirt. The spindle is mounted in a slide seals made of POM (polyoxymethylene). Spindle
it has a special bearing, which allows for minimal friction. It is possible to change the spindle sealing nut under pressure (in the open position). It has a spindle protection against nut pull-out when opening the latch.
Management:
With the handwheel, the wedge closes when the working element turns clockwise.
Corrosion protection:
Strong surface protection GSK-quality. Share from cast iron is coated on the outside and inside with epoxy color min 250 µm.
Testing:
Tested with water according to EN 12266-1, leakage rate A.

Dirt trap with fine sieve
For permanent contact with drinking water at the permitted working level temperature up to 50ºC at max. pressure 16 bar, according to EN 806. One-way dirt trapping element from the liquid. A dirt trap with a drain plug is used in the case of minor impurities. Materials of main parts The body and the cleaning flange are made of gray cast iron, a sieve stainless steel, brass drain plug, galvanized steel bolts, washers and nuts.
Corrosion protection
Ductile iron parts are outside and inside coated with epoxy paint min. 250 µm. Screws, washers and nuts are hot-dip galvanized, sieve and the drain plug is uncoated. Installation method In any position, but the direction must be fluid flow always match the arrow that is cast on the body, cleaning flange or the drain plug must always face downwards. Tested according to EN 12266-1, test P10 and P16. Leakage is unacceptable.

Water meter
Multi-precision water meter with submerged, dry (TRP) dial. They are used to measure consumption cold (up to 30 ° C). Water meters are tested according to the MID standard. They can be used up to PN 16.
Materials:
The body of the water meter is made of brass, and inside and out coated with epoxy paint thickness 60/70 µm. The glass is 6 mm thick.

Non-return flap
For permanent contact with drinking water, to the operating temperature 50ºC and allowable pressure up to

max. 10 bar, according to EN 806. The installation length is according to standard EN 558-1 series 48 (F6).
One-way automatic valve prevents backflow of operating fluids.
The non-return valve is not a shut-off valve.
Materials of main parts:
The body and lid are made of gray cast iron, the flap is fully rubberized with EPDM rubber, bolts and nuts made of stainless steel.
Corrosion protection:
Ductile iron parts are outside and inside coated with epoxy paint min. 250 µm.
Operation:
Check valves operate automatically.
Installation method:
Installation is possible horizontally (horizontally) or vertically (standing) so that the direction of flow coincides with a marking arrow on the body. If the installation in horizontal position - the position of the lid is upwards.

Ball valves
Ball valves for drinking water according to EN 806, medium temperature range from -30 ° C to + 150 ° C (water from 0 ° C to 110 ° C) and for operating pressures up to 16 bar.
Material of the main parts:
The body and the ball are made of brass, the handle is silumin or steel and plasticized. Seals are PTFE, EPDM or NBR.

Hand basin with single lever mixer tap
Consisting of:
-Duofix prefabricated element for washbasin, H = 112 cm, the element is suitable for universal solid installation and drywall installation, for pre-wall and wall mounting;
-Washer made of stainless material, dimensions 500/350mm, deep version including all necessary sealing and mounting material;
-mix mixer HANSAPRIMO XL,
- angle valve with filter, PN16, rosette included with angle valve, R1/2"/R3/8";
- non-return valves DN15;
- siphon for washbasin, consider connection to NIRO VTO pipe;
-rubber cuff, siphon seal with wall hose, DN40/DN50;
-rubber sleeve, for sealing the PE drain elbow on the mounting element on the VTO pipe. Cuff size DN50/DN50;
- branch on VPH pipe with valve DN15 with adapter for flexible hose;
-fine material, acid-resistant silicone for sanitary ceramics, color according to the architect's request, before delivery obtain his written confirmation.

Kitchen sink for built-in kitchen counter with manual fittings
Consisting of:
- 1000 x 600 stainless steel kitchen sink;
- standing single lever mixer for kitchen sink;
- two DN15 angle valves and connecting pipes;
- siphon for kitchen sink;
- including fastening and sealing material, color according to the architect's request, before delivery obtain his written confirmation.

Shower for a cabin with mixer taps
Consisting of:

-Duofix mounting element for bathtubs and showers, H = 112 cm;
The element is suitable for universal solid construction and drywall installation, for pre-wall and wall mounting;
-Siphon, low design, consider connection to PVC ALL pipe;
-Rubber sleeve, for sealing the PE drain elbow on the mounting element on the VSO;
-HANSA MIX mixer tap;
-Shower set HANSABASICJET, wall bracket 600mm with handle;
-fine material, acid-resistant silicone for sanitary equipment, color according to the architect's request, before delivery obtain his written confirmation.

Cantilever toilet with front activation
Consisting of:
-Duofix mounting element for wall-mounted toilet, with PO cistern UP300, activation at the front, H = 112cm. The element is suitable for universal solid installation and dry-mount installation, for pre-wall and wall mounting.
- Angle valve and cuff are part of the assembly;
-Suspending toilet ceramic bowl;
-Plastic toilet seat;
-Double function for toilet cistern;
-Rubber sleeve, For sealing the PE drain elbow on the mounting element.
-Fine material, acid-resistant silicone for sanitary ceramics, color according to the architect's request, before delivery obtain his written confirmation.

Cantilever urinal
Consisting of:
-Duofix mounting element for urinal, H = 112-130 cm, the element is suitable for universal solid construction and drywall installation, for pre-wall and wall mounting;
-control electronics for urinal with cover plate made of stainless steel, 230V;
-wall cantilever urinal made of quality ceramics, basic white color, color and type chosen by the architect, before delivery obtain his written confirmation;
-rubber sleeve, For sealing the PE drain elbow on the mounting element on the VSO. Dimension DN50, observe connection to PVC ALL pipe;
-fine material, acid-resistant silicone for sanitary ceramics, color according to the architect's request, before delivery obtain his written confirmation.

Electric sanitary water heater
The electric water heater for vertical mounting on the wall must be suitable for supplying several consumption points and equipped with an electric immersion heater. The temperature setting thermostat allows temperature settings up to 65 °C, economical temperature setting is 55 °C and frost protection 10 °C. The water temperature in the boiler is indicated by a bimetal thermometer, and the control light shows the operation of the heater. The boiler must be protected against corrosion with enamel and magnesium anode.
Equipment includes:
- Safety valve suitable for drinking water in accordance with EN806, opening pressure 4 barg, threaded connections, material stainless steel AISI 304 or better, drinking water certificate, EN10204-3.1, compliance with PED, CE declaration, complete with sealing (PTFE sealing tape) and fastening material, corresponds to the product LESER type 459 or equivalent (VV 14.02.11);
- Funnel with water and mechanical odor resistance;
- Non-return valve, seat version, suitable for drinking water according to EN 806, PN16, material stainless steel AISI304 or better / PTFE, with threaded connections and threaded Dutch for pipe dimensions according to ISO1127, drinking water certificate, EN10204-3.1, CE statement, complete with sealing (PTFE sealing tape)

and fastening material;
- Ball valve, for drinking water, threaded version, PN16, with lever, brass / PTFE material, including fastening and sealing material, for water supply, drinking water, compliance with EN 806.

Pipes for sanitary drinking water
PE pipes for drinking water distribution are manufactured in accordance with standard EN12201. Polyethylene pipes for drinking water distribution are marked with a blue line. The main supply lines are carried out with pipes made of PE 100. Higher strength of the material gives the possibility of producing pressure pipes of larger diameters. These tubes are available in reels and rods after 12 meters and more. Pipes made of PE are most often welded with known ones procedures: frontal and electro-fusion. The pipes can be connected also mechanically with gear couplings, iJoint couplings, MultiJoint couplings and PVC / PE couplings.

MLCP pipes for the internal distribution of cold and hot sanitary water will be made of multilayer aluplast pipes MLCP (PE-RT / bonding layer / aluminum / bonding layer / PE-RT) diffusion tightness of pipes in accordance with DIN4726, resistance to elevated temperatures in accordance with DIN16833 (maximum permanent loads at 10 bar 70 ° C, maximum short-term load up to 95 ° C), DVGW certificate for the use of drinking water distribution systems in accordance with DIN1988 TRWI, quality class for drinking sanitary water. Pipes must have the appropriate certificate for plumbing, for drinking water.

Sewage pipes for vertical sewerage, sealed versions, compliance with EN1451, class B and EN14366, material homopolymeric polypropylene PP-M with internal PP and external PP protection, silent version LSC, A = 12dB (A) at water flow 2 l / s , chemical resistance pH 2 ÷ 12, temperatures up to 80 ° C, pressures from -0.5 to 1.5 barg, fire classification C-s3-d0 according to EN13501-1, including shaped pieces (elbows, reductions, branches,…), coupling and sealing material, corresponds to the product VALSIR type TRIPLUS or equivalent, complete with hanging material (threaded rods, brackets, anchors, ...) and pipe clamps with rubber lining for noise reduction according to DIN4109.

Insulation of pipelines
Thermal insulation of pipelines and pipe fittings with vapor barrier insulation made of elastomeric foam based on synthetic rubber according to EN14304 with the following properties: does not contain CFC, $\mu \geqslant$ 7000 according to EN13469, $\lambda \leqslant$0,040W / mK according to EN ISO8497, fire classification B-s3-d0 according to EN13501-1, for temperatures -50 to + 110 ° C, glued to pipelines and fittings with the manufacturer's original adhesive, including seam strips, observe the manufacturer's Insulation Installation Installation Instructions (such as the Armaflex Installation Manual);

General remark
The Technical Specifications must be viewed in conjunction with the Technical Report and Specifications document and the BoQ document.