Section V

Employer's requirements

Contents

1 Site Visit

Due to the complexity and variety of the construction work that has to be carried out a site visit by each Bidder is deemed an absolute necessity. Each Bidder has to familiarize himself with the type and extent of work required and has to make sure, that all costs of construction are covered by and included in his tendered rates.

The locations of the sites are:

- Rustavi Central Archive, People Friendship av. 6, Rustavi City, Georgia
- Kindergarten # 32, # 21 district, Rustavi City, Georgia
- Public School # 1 in Kvemo Bolnisi, Georgia

2 Existing situation

2.1 Rustavi Central Archive

The Rustavi Central Archive of the Ministry of Justice of Georgia is a quite modern building built in 2015. It is a 4-floor building which is fully heated and cooled with basement floor level -1. The roof area level 5 is formed as open air technical area including roofed boiler house.

The building has a footprint area of 384 m^2 and a total net heated floor area of 1 600 m^2. The floor height is 3.7 meter.

The net conditioned volume of building is 5 920 m^3. Overall condition of the building is that the building envelope (roof, walls and floor) is quite new. Technical installations are also quite new (from time of construction of building), however not very energy efficient.

Building is occupied 9 hours per day in workdays. The heating system in the building operates during workdays. During weekend and holidays, the heat supply is reduced.

Building is heated by heating system which is supplied by gas boiler. Boiler house is located on the roof top of the building. Electricity is used for lighting, ventilation, fan coils, cooling, elevator and equipment/computers, detectors and security system.

The building is occupied by personal and daily visitors that in total constitute permanent occupancy as: 30-35 persons.

The building has a load bearing wall with façade boards. The condition of the external façade is generally good.

External walls on building has an insulation thickness of 5 cm covered with façade panels with total thermal transmittance U_{wall} value of *0,73* $W/m^2 \cdot K$. Total area of walls (excluding transparent elements) is approx. *1 856* m^2..

Transparent elements – windows and doors have total area of approx. *184* m^2. The windows are new and generally in good condition. The average U-window value of these windows is *2,5* $W/m^2 \cdot K$

Roof has a resulting thermal resistance value: U-roof *0,7* $W/m^2 \cdot K$.

Floor is constructed as a concrete slab on ground and over the heated basement. The resulting thermal transmittance: U-floor is *0,5* $W/m^2 \cdot K$. (including resistance of ground and floor layers).

The heating system of the building is operated by one gas boiler. The boiler is located on the roof top in the boiler room.

The boiler ERENSAN –NA R 160 (160,000 kcal/h ≈186 kW) is equipped with single stag Italian gas burner CIB Unigas and net seasonal efficiency about 90 %. Domestic Hot water is produced with single serpentine accumulator tank KUBUS BOYLERSAN KSBB with volume of 100l (15kW) connected to the boiler. The boiler is equipped with simple standard controller ON/OFF, limit thermostat in circuit signal and safety thermostat without weather compensation signal.

The boiler is not used outside heating season to provide DHW. The optional electrical heater is not connected in the accumulator tank. The recirculation pump for DHW is 400W with flow rate of 0,5

m^3/h and is oversized. The circulators are not VFD and connected successively in series and not optimised.

Overall condition of heating system is good. The pipes in the boiler room are not properly insulated.

The main heating system (ERENSAN boiler) uses night and weekends setbacks. The emitters are different type of 3-speed fan coils and according the design should be equipped with 2 pcs of 2 way valves each. Condensate line is designed for each fan coil.

Mechanical ventilation is installed in the building. Air handling units are from PITSAN Turkey. The special design for archive buildings require keeping overpressure and splitting the system for storage (archives) part and occupied by people part. The flow rate of Air handling unit No 1 is 16,500 m^3/hour ventilated air (the amount of air is determined from perspective of using it as heat/cold carrier), with 11 +7,5 kW fans with heating–90 kW and cooling-90 kW sections and re-heater after humidifier, without heat recovery exchanger but equipped with humidifier (wet chamber with sprinklers). Capacity of the Air handling unit No 2 is 4,100 m^3/hour ventilated air (fresh intake, no by-pass envisaged) with 2,2+2,2 kW fans, with heating–21 kW and cooling-25 kW sections and is equipped with plate heat recovery exchanger. Net efficiency of the heat recovery exchanger is about 55 %. The air handling units are located on roof surface. The insulation of air handling units and ducts exists; however the quality of the insulation work of ducts is not optimal .The air flow is oversized and resulting in high specific fan power SFP of more than 4 [kW/(m^3/s)]. The system operates on over pressure (as required) and suppresses the natural infiltration. The air flow difference is ex-filtrated.

Building is equipped with cooling system through air handling units and by fan coils. The cold generators are two **reversible** Chillers (MIDEA, China with fixed scroll compressors, refrigerant: R410A, with cooling EER about 3.0 and heating COP around 3,2).The chillier No 1 MC-SS130/RN1Lhas a cooling capacity of 130 kW and heating capacity 138 kW and chillier No 2 MC-SS65/RN1L respectively of 65 kW cooling and 69 heating capacity. Chillers are located on roof surface and connected in parallel. The option of operation as heat pumps **is not used** and chillers will stop performing the cooling option if outside temperature will drop below +2 C. To reverse the chillers in heating mode additional adjustment is needed including using of propylene glycol or similar antifreeze medium. The automatic control system is not integrating all units and underdeveloped, nevertheless that 3 way valves exist for the heating and cooling sections of air handling units.

Building is equipped with lighting system of about 640 luminaries (mainly represented by incandescent lighting, only 40 luminaries are TFL and CFl's). Lighting is manually controlled. The lighting system is not divided into smaller zones making it impossible to turn on only smaller part of the lighting system. Light is observed to be lit most of the working hours. The outdoor lighting is represented by 7 TFL luminaries at the entrance and 4 projectors at the upper edge of the facade.

2.2 Kindergarten # 32 in Rustavi

Kindergarten Nr. 32 was brought into operation in 1985. The architectural design of the kindergarten consists of two independent buildings connected with two parallel corridors. The total building internal floor area is 2 470 m^2.

Building is occupied between 9:00 till 18:00 during workdays. The average number of occupants during working hours constitutes: 460 kids and 40 employees'. Building systems such as heating, partial supply of the DHW and lighting are operated during the workdays

Building is constructed as a concrete frame filled in with the block walls. External walls are built of *40* cm thick walls - main block layer and internal and external plaster layers. The overall thermal transmittance value of external walls constitute: U-wall value *of* 1,30 W/m^2.K. Total area of walls (excluding transparent elements) is approx. 1 545 m^2.

The transparent elements – windows and doors have total area of approx. 441 m^2.The old wooden framed single glazed windows have been changed with double glazed metal plastic framed windows several years ago. Currently the windows are with *a glass-package of* double glazing with plastic frame. U-window value was evaluated as 3.0 W/m^2.K. However part of the old single glazed wooden framed windows with the total area of approx. 107 m^2 and wooden doors with total area of approx. 27 m^2 still remain in the building and were not replaced yet.

The roof is flat with the U value that constitutes 1,05 W/m^2.K..

Floor is constructed as a slab over unheated basement with final U-floor 0,65 W/m^2.K.

There are 26 local “Karma” type gas heaters installed in the building for heating purposes, however they don’t cover demand of a whole building (corridors, halls, staff rooms remains unheated).

There are natural ventilation channels in all group rooms ~~the~~ in the building as well as in toilets. The mechanical ventilation system is installed in the kitchen, but system doesn’t operate due to the absence of the three phase electrical cable.

The DHW system consists from 4 local water heaters that are operating on natural gas and one electrical water heater.

Building is equipped with lighting system. About 5 years ago the new wiring was installed, as well as efficient lighting system/ luminaries in one part of the kindergarten (one of two buildings’ that is occupied by 6 group of children) with efficient luminaries. However building with the main entrance still remains with the depreciated and unsafe lighting with broken switchers, sockets and 124 inefficient incandescent bulbs.

2.3 Public School # 1 of village Kvemo Bolnisi

Public School N1 of village Kvemo Bolnisi (the Bolnisi Municipality) was built in the 1963 and later partially reconstructed. The building has two floors. It consists from the main part and two symmetrical wings.

The total area of building constitutes: 1 796 m^2. There is no basement in the building. The height of the floor is 3.6 m.

External walls consist of bricks that together with plaster layers constitutes thickness of 30÷ 50 cm. Total thermal transmittance U $_{wall}$ value of *1,78* W/m^2·K was calculated for walls. Total area of walls (excluding transparent elements) *is* **1 000** m^2.

Transparent elements – **windows and doors** have total area of *287* m^2. The metal plastic double glazed windows were installed in the school 6 years ago. The average U-window value of these windows is estimated as: 3 W/m^2·K.

Roof is arranged over the *unheated* attic space. It is *not i*nsulated and resulting value for roof constitutes: U-roof 1,25 W/m^2·K.

Floor is constructed as a concrete slab on the ground.

The space heating system operates in the building. Heat is supplied from the ”Fondital “ gas boiler placed in the boiler room that was constructed as a separate building on the territory of school. Overall condition of the heating system is good.

There are no ventilation systems in the building. There are no toilets in the school building, they are located on the territory of a school as a separate building. There is no domestic hot water system in school as well.

The building is equipped with the lighting system that partly consists from the energy efficient bulbs that are installed with the partial renovated/ new wiring, however about 570 linear meter of wiring is depreciated and calls for replacement together with 26 sockets, 26 switchers and 39 incandescent bulbs.

The total number of occupants during occupancy hours consists of 370 students and 50 teachers. The heating system in the building operates during workdays.

Gas is used for heating purposes, while electricity is mostly consumed for lighting and pumps of the heating system.

3 Scope of works

The purpose of the energy efficiency project is to reduce energy resources consumption and to improve indoor conditions for pupils and personnel through implementation of package of energy

efficiency measures and, as a result, to achieve economic savings for energy costs and reduction of greenhouse emissions.

3.1 Rustavi Central Archive

The project envisages:

1. Reverse the chillers MIDEA and remodel heating system for heat pump mode (Rustavi Central Archive)
2. Optimization of pumps for space heating and DHW
3. Ventilation system improvement - new heat recovery exchanger (enthalpy wheel) and redesign and adjust the air-flow
4. Installation of small thermal solar collectors system for Domestic Hot Water
5. Installation of the new efficient lighting and occupancy sensors on lighting system
6. Installation of new automation control system, training the personnel and O&M routines

Required works:

1. Development of detailed design documentation and obtaining approval for it from the Client, including:
   - Performing needed measurements and layout drawings for the building
   - Development of detailed design, including detailed technical specifications as well as calculations for justification of proposed technical solution and specification of applied buildings norms and regulations.
2. Supply of needed materials and equipment and implementation of dismantling, installation and construction works in accordance with the developed detailed design
3. Development of Operation and Maintenance Manual for newly installed equipment and performance of training for the technical personnel of the Archive
4. Connection of new equipment to the engineering networks, test, adjustment and commissioning
5. Removal of construction waste from the territory and their disposal in accordance with the current norms of Georgia.
6. Development and handing over of “As-Built documentation” to the Client

3.2 Kindergarten # 32 in Rustavi

The project envisages:

1. Thermal insulation of walls.
2. Thermal insulation of the flat roof;
3. Partial installation of new EE windows;
4. Installation of new heating system with interconnection with DHW
5. Installation of individual ventilation units with heat recovery;
6. Installation of the new efficient bulbs together with part of wiring switchers and sockets

Required works:

1. Development of detailed design documentation and obtaining approval for it from the Client, including:

- Performing needed measurements and layout drawings for the building
- Development of detailed design, including detailed technical specifications as well as calculations for justification of proposed technical solution and specification of applied buildings norms and regulations.
- Development of Façade renders for getting approval from the Municipal Architectural Administration.

2. Supply of needed materials and equipment and implementation of dismantling, installation and construction works in accordance with the developed detailed design
3. Development of Operation and Maintenance Manual for newly installed equipment and performance of training for the technical personnel of the School
4. Connection of new equipment to the engineering networks, test, adjustment and commissioning
5. Removal of construction debris from the School territory and their disposal in accordance with the current norms of Georgia.
6. Development and handing over of “As-Built documentation” to the Client

3.3 Public School # 1 of village Kvemo Bolnisi

The project envisages:

1. Thermal insulation of walls.
2. Thermal insulation of attic floor (unheated attic);
3. Installation of individual ventilation units with heat recovery;
4. Installation automatic controls, Thermostatic valves and heat insulation of pipes in boiler house;
5. Installation of the efficient LED bulbs with part of wiring, switchers and sockets

Required works:

1. Development of detailed design documentation and obtaining approval for it from the Employer, including:
   - Performing needed measurements and layout drawings for the building
   - Development of detailed design, including detailed technical specifications as well as calculations for justification of proposed technical solution and specification of applied buildings norms and regulations.
   - Development of Façade renders for getting approval from the Municipal Architectural Administration.
2. Supply of needed materials and equipment and implementation of dismantling, installation and construction works in accordance with the developed detailed design
3. Development of Operation and Maintenance Manual for newly installed equipment and performance of training for the technical personnel of the Public School
4. Connection of new equipment to the engineering networks, test, adjustment and commissioning
5. Removal of construction debris from the territory of the building and their disposal in accordance with the current norms of Georgia.
6. Development and handing over of “As-Built documentation” to the Employer

3.4 Temporary Works

The Contractor shall procure, furnish, provide and arrange for all the necessary electric power, water and services; be responsible for the construction and maintenance of the necessary construction camps, offices and warehouses; and perform all other work necessary for completion of the Works described herein in strict conformance with the Employers Requirements.

4 General requirements to the materials and works

When developing detailed design documentation the requirements of the following or equivalent norms, regulations and standards should be followed in addition to the Georgian norms in force:

- Main guidelines for development of architectural and construction part of the detailed design for thermal insulation of facades are “EAE European Association for External thermal insulation composite systems. European Guideline for the application of ETICS (External Thermal Insulation Composite Systems)”
- EN 12097:2006 Ventilation for Buildings - Ductwork - Requirements for ductwork components to facilitate maintenance of ductwork systems
- EN 12599:2012 Ventilation for buildings - Test procedures and measurement methods to hand over air conditioning and ventilation systems
- EN 15423:2008 Ventilation for buildings - Fire precautions for air distribution systems in buildings
- EN 12792: 2003 Ventilation for buildings. Symbols, terminology and graphical symbols
- EN 13053: 2006 Ventilation for buildings. Air handling units. Rating and performance for units, components and sections

- EN 13779: 2007 Ventilation for non-residential buildings. Performance requirements for ventilation and room-conditioning systems or EN 16798-3 Energy performance of buildings - Ventilation for buildings, Part 3: For non-residential buildings – Performance requirements for ventilation and room-conditioning
- EN 15251: 2007 Indoor environmental input parameters for design and assessment of energy performance of buildings addressing indoor air quality, thermal environment, lighting and acoustics
- EN 12207:2016 Windows and doors - Air permeability – Classification
- EN 12208:1999 Windows and doors – Water tightness – Classification
- EN 12210: 2016 Windows and doors - Resistance to wind load – Classification
- EN 14351-1 Windows and doors - Product standard, performance characteristics - Part 1: Windows and external pedestrian doorsets
- EN ISO 10077-1 2006 Thermal performance of windows, doors and shutters -- Calculation of thermal transmittance -- Part 1: General
- EN 410:2011 Glass in building - Determination of luminous and solar characteristics of glazing
- EN 673:2011 Glass in building - Determination of thermal transmittance (U value) - Calculation method
- EN 12828:2012+A1:2014 Heating systems in buildings - Design for water-based heating systems
- EN 215:2004/A1:2006, Thermostatic radiator valves - Requirements and test methods;
- EN 442 - (all parts), Radiators and convectors
- EN 13162:2012+A1:2015 Thermal insulation products for buildings - Factory made mineral wool (MW) products – Specification
- EN 13164:2012+A1:2015 Thermal insulation products for buildings Factory made extruded polystyrene foam (XPS) products Specification
- EN 308: 1997 Heat exchangers — Test procedures for establishing performance of air to air and flue gases heat recovery devices
- EN 13500:2003 Thermal insulation products for buildings - External thermal insulation composite systems (ETICS) based on mineral wool – Specification
- Delegated Regulation (EU) No 811/2013 of 18 February 2013 supplementing Directive 2010/30/EU with regard to the energy labelling of space heaters, combination heaters, packages of space heater, temperature control and solar device and packages of combination heater, temperature control and solar device.
- Resolution # 57 of 24 March 2009 on the “Rules of issuing construction permits and permit conditions”;
- Technical regulations approved by the Decree No. 41 of the Government of Georgia, January 28, 2016, "Building Safety Guidelines";
- Resolution # 61 of February 6, 2017 of the Government of Georgia on amendments to the Resolution # 57 of the Government of Georgia on "Rules of issuing of construction permits and permit conditions" of March 24, 2009;
- Resolution N64 of February 6, 2017 of the Government of Georgia "On Approval of the Technical Rules -" Safety Rules of Building and Construction "
- Decree N498 of the Government of the Government of 20 November 2017 on "Approval of the Safety Rules of the Building Regulations"
- On the amendment to the Resolution N41 of January 28, 2016 of the Government of Georgia.

- Str. Approval of regulation rules for the use and development of the municipalities of Tbilisi Municipality. .May 24, 2016 St. Tbilisi
- During the whole period of design development the Contractor shall closely cooperate with the Client, including submission of technical solutions and their discussions.

5 Specific requirements to the materials and works

5.1 Reverse the chillers MIDEA and remodel heating system for heat pump mode (Rustavi Central Archive)

5.1.1 Existing situation:

Currently the heat is provided from natural gas boiler ERENSAN – NA R 160 (186 kW) with standard control panel based on boiler temperature. The existing chillers MIDEA MC-SS130/RN1L and chillier No 2 MC-SS65/RN1L are factory produced as reversible with total heating capacity of 138 kW+ 69 kW = 207 kW. The units can be adjusted to work as heat pumps at the place of installation for heating purposes.

5.1.2 Scope of works and technical requirements

The following technical solution is envisaged:

The existing chillers MIDEA are declared with COP=3,2 (EN 14511) and temperature operative limit > -2ºC. The supply water temperature between 45-50 ºC will be lower the standard rating conditions for the installed fan coils and the heat pump option *is considered to be utilised* for heating mode operation when the outdoor temperatures is more than 0ºC. When the temperatures will drop lower this threshold, existing boiler ERENSAN will have to be switched on to provide higher temperatures of the water.

The chillers loop should be filled with antifreeze for -15ºC.

The existing boiler ERENSAN will stay to cover the peak loads, as a reserve source or can be used for bivalent source with the heat pump when/if there is a need to cover the temperature difference required. The reversing of chillers may require new double serpentine accumulator tank. The connection of existing controllers to integrated automation system and integrating the slave and master mode of the chillers and interconnection with the boiler through common sequence of operation algorithm is required.

5.1.3 Summary of required works

- Visual inspection;
- Measurements;
- Development of the detailed design for remodelling and operating of the heating system with consideration of technical solution reversed chillers to work as heat pumps. System has to operate together with the existing boiler ERENSAN for covering pick loads as a reserve or a bivalent source. Technical design has to incorporate all additional equipment considered for operation of system such as: new double serpentine accumulator tank for operation of chillers in the heat pump mode (depends on design solution), new piping, antifreeze filling, insulation of all pipes, wiring, pumps etc. System has to be connected to the new automatic controller, with adjustment of valves at fan-coils side and at air handling unit's side. The detailed design has to foresee sequence of operation algorithm and connections to the integrated automation control system.
- Delivery of all needed equipment on site such as: piping, insulation material for all pipes, serpentine accumulator tank for operation of chillers in the heat pump mode, 2pcs 3 way, 2pcs 2 way and stop valves with actuators, wiring, for connection to new automatic controller, antifreeze filling etc.
- Installation of the all requested equipment and automation control system according to technical design specifications;
- Connection of new equipment to the engineering networks, test, adjustment and commissioning;

- Development and handing over to the Client the “As Built” documentation;
- Development of Operation and Maintenance Manuals and training of technical personnel;
- Disposal of construction debris caused by the construction works

5.2 Optimization of pumps for space heating and DHW (Rustavi Central Archive)

5.2.1 Existing situation:

Pumps for space heating are installed in series. The pump for operation of the DHW supply is oversized. Such installation doesn’t increase the flow rate however it increases the pump’s pressure.

5.2.2 Scope of works

The following technical solution is envisaged: re-arrangement of the pumps and replacement with VFD electronic pumps since the high pressure does not seem to be needed. It is foreseen that 50% of the pumps capacity can be saved. The pumps will have to be integrated to the new automatic control system.

5.2.3 General technical requirements

Requirements for the technical design and installation has to be based on the appropriate norms and standards that are given in the Chapter 4.

Optimization of pumps for space heating and DHW should consider recalculation of the hydraulic balance and reconfiguration of the existing pumps (50 % its total capacity) as well as installation of new electronic pumps (VFD electronic pumps).

In case of thermostatic control used for central heating systems, the pumps/pump groups for heating system should be variable speed (variable speed/frequency drive**)** or at least 3-speed pumps, with delta pressure or flow rate control (circulation pump designed on demand) and EEI<0,27.

Recommended operating modes for pumps are: Proportional pressure mode; Speed adjustment; Soft start; Continuous power adjustment depending on operating mode

5.2.4 Summary of required works:

- Visual inspection;
- Measurements;
- Development of the detailed design envisioning reconfiguration of existing pumps as well as installation of new electronic pumps with the VFD electronic pumps with valves, wiring, piping, insulation and connection to the new automatic control system
- Delivery of all needed equipment and materials on site;
- Installation of the all requested equipment as well as for automation control system according to the technical design specifications;
- Connection of new equipment to the engineering networks, test, adjustment and commissioning;
- Development and handing over to the Client the “As Built” documentation;
- Development of Operation and Maintenance Manuals and training of technical personnel;
- Disposal of construction debris caused by the construction

5.3 Ventilation system improvement - new heat recovery exchanger (enthalpy wheel) and redesign and adjust of the air-flow (Rustavi Central Archive)

5.3.1 Existing situation

The Air handling unit 1 is without heat recovery exchanger but recirculation by pass is available, however not automated. The total air flow rate is sized based on requirement of using the air as heat/cold carrier (air heating/cooling of archives areas). The personal is already taking measures to limit the fresh air intake by blocking the system!

The existing plate heat exchanger in Air handling unit No 2 works without automated by –pass and the air volume for office part of the building is not controlled depending on required fresh air need (30 service personnel and no CO_2 sensor). The system No 2 is pushed to deliver the full fresh air amount in all time of occupancy.

5.3.2 Scope of works

The following technical solution is envisaged:

Air handling unit 1: redesign for lower air fresh intake (proportionally variable quantity) flow and installing one small heat recovery section of about 2 500 m^3/h fresh air intake rotary exchanger (enthalpy wheel) with efficiency of minimum 75 %. Air handling unit will continue working as heating cooling source to condition re-circulated mixed air based on logic comparing return air humidity and temperature versus outdoor data and mixing ratio. The redesign will require automating the by-pass and equalising the pressure drops and connection to the new heat recovery section. The measure will decrease the heat/cold load from fresh air and dehumidification and pumps el demand. The exact ratios and sequence of operation should be thoroughly designed. The additional benefits with the rotary exchanger including variable speed drive control of rotation, based on temperature sensors are: control the efficiency to the optimum, freeze protection, night ventilation without full recovery for cooling mode.

For air- handling unit No 2 installation of automated bypass to partially re-circulate return air when CO_2 emissions are low in the office areas and new VFD fans controlled by timer and CO_2 emission sensor in return air. The by-pass for unit No 2 should be automated.

Special instructions and operation routines should be developed for cleaning the wet camera and to avoid bacteria legionella. The design shall address the specific problems with the place to fit, connect the exchangers, re-assembling of the air handling units sections.

All outdoor new and old ducts will be reinsulated.

5.3.3 General technical requirements *:

Minimum heat recovery efficiency - 75%

Capacity of the heat recovery section to be selected according to calculations

5.3.4 Summary of required works

- Visual inspection;
- Measurements;
- Obtaining technical conditions for connection for the power networks (if necessary)
- Development of detailed design with all necessary calculations;
- Supply of all materials and equipment on site;
- Installation of the new heat recovery section in the Air handling unit 1;
- Automating the by-pass and equalising the pressure drops and connection to the new heat recovery section;
- Based on detailed technical design for handling unit No 2 to install automated bypass to partially re-circulate return air when CO_2 emissions are low in the office areas and install new VFD fans controlled by CO_2 emission sensor in return air;

- Insulation of outdoor ducts
- Connection of ventilation units to power networks;
- Testing, adjustment and commencement of ventilation system;
- Testing of operation modes of units with heat recovery;
- Development and handing over to the Client the “As Built” documentation
- Development of Operation and Maintenance manual instructions and training of technical personnel of the building on operation of the ventilation units
- Disposal of construction debris caused by the construction works

5.4 Installation of small thermal solar collectors system for Domestic Hot Water (Rustavi Central Archive)

5.4.1 Existing situation:

Currently, the gas boiler ERENSAN is used for DHW preparation when is operating in heating mode. However the boiler is not used outside of heating season for provision of the DHW supply. The optional electrical heater is not connected in the accumulator tank.

5.4.2 Information on scope of works:

It is foreseen to design and install a new solar thermal system for DHW supply. The vacuum solar collectors (evacuated tubes) should be minimum 4,6 m^2 of aperture area, or about 2-3 collectors. It is possible to install equivalent thermal system with flat solar collectors with increased area of collectors. It is assumed that the system can deliver annually about 3 400 kWh of DHW accounting the way of the usage of the building. The proposed solar thermal system for DHW will require piping, insulation, heat transfer medium, and other necessary equipment such as expansion tank, valves, circulator, thermostatic mixing valve and automatic control. The system should be interconnected through new accumulator tank of min. 1x200l (2 internal heating coils and electrical re-heater for overheating and legionella protection) to the existing boiler/chiller heating loop for DHW.

5.4.3 General technical requirements:

- To ensure availability of automatic protection of the solar system for domestic hot water against stagnation and forced circulation of heat carrier;

- Temperature of the hot water to be discharged from the taps shall not be higher than 37 ^{0}C.

- To ensure that supporting structures of the solar collectors are not directly leaned on the external waterproofing of the roof covering.

- Location of solar collectors on the roof shall be selected taking into consideration orientation of the building. Solar collectors should have optimal orientation to the South with possible deviation up to 30 ^{o} to the East or West.

- Take into account shading of the solar collectors by each other, structural elements and other buildings located nearby

- To ensure measures eliminating the possibility of the heat carrier freezing in the solar system for domestic hot water.

- Pipelines of hot water supply systems, in addition to connections to appliances, as well as pipelines of cold water supply systems (except dead-end fire pipelines), which are laid in canals, sanitary cabins, tunnels, and in rooms with high humidity should be isolated against heat losses and condensation.

* Requirements for components and installation are given in Chapter 6 “Technical specifications” of the Employer’s Requirements.

5.4.4 Summary of required works

- Visual inspection;
- Measurements;
- Determine the location of solar collectors and accumulation tank as well as carrying out calculations (if necessary) to strengthen mounting points
- Development of detailed design envisioning installation of the solar collectors system for DHW supply with inclusion of circulator and double serpentine accumulator tank as follows:
  - carrying out heat engineering and hydraulic calculations;
  - selection of all equipment;
  - development of the specification for the selected equipment
- Delivery of all needed equipment and materials on site;
- Arrangement of the place of location for installation of solar collectors with carrying out general construction works such as: drilling for piping, etc (if necessary);
- Installation of the all requested equipment as well as for automation control system according to the technical design specifications;
- Connection of new equipment to the engineering networks, test, adjustment and commissioning;
- Development and handing over to the Client the “As Built” documentation;
- Development of Operation and Maintenance Manuals and training of technical personnel;
- Disposal of construction debris caused by the construction

5.5 Installation of the new efficient lighting and occupancy sensors on lighting system (Rustavi Central Archive)

5.5.1 Existing situation

The current lighting system is mainly made of incandescent lighting bulbs which is a very energy inefficient light source.

The existing lighting system is operating without occupancy sensors. As result the light is turned on early in the morning and is left burning the entire workday. Furthermore, the light is “grouped” in larger zones so that several light sources are turned on at a time.

5.5.2 Scope of the works

All incandescent bulbs have to be replaced with LED light sources.

Lighting system is to be fitted with occupancy sensors (PIR). Furthermore, lighting system is to be grouped that only smaller portion of the light fixtures are operated from a lighting switch, Thereby only a smaller portion of the lights are turned on. It is estimated that this will decrease the average “burn-time” for the light system by 33%.

5.5.3 General technical requirements

The general technical requirements for LED lights have to be followed up according to the information given in the Table 2. Lamps must be installed with the diffuser down

With regards to the occupancy sensors for lighting:

- To ensure accurately record /actual locations of control components, including relays, power supplies, and sensors.
- To develop drawings to reflect actual installation and operating sequences.
- To provide as-built equipment location and wire routing diagrams, as-built termination and interconnection drawings as well as as-built elementary diagrams.

- To provide detailed set-up information indicating required initial configuration switch settings;

5.5.4 Summary of required works

- Visual inspection
- Measurements;
- Development of the detailed technical design based on technical requirements for installation of occupancy sensors;
- Supply of all materials and equipment on site;
- Dismantling of existing incandescent bulbs;
- Installation of new transparent open or half-open plafond with a base E27;
- Installation in the mounted plafonds the new 590 LED lamps with a matte diffuser (Lamp base E 27);
- Installation of the occupancy sensors with all associated equipment;
- Test, adjustment and commissioning of lighting system operating with occupancy sensors;
- Development and handing over to the Client the "As Built" documentation
- Development of Operation and Maintenance manual instructions and training of technical personnel of the building
- Disposal of construction debris caused by the construction works

5.6 Installation of new automation control system, training the personnel and O&M routines (in the Rustavi Central Archive)

5.6.1 Existing situation

The existing HVAC systems are operated without central automation integrating the control over heat supply, recuperation efficiency and cold supply. The central control of heat and cold supply is mostly manual. The zone control of office spaces is made at fan coils level - on-off switch, fan coils recirculation fans 3 speed switch. The air-handling units heating and cooling section are with mixing valves with signal form the units but without display of settings in integrated panel. The boiler and the burner are controlled by its own simple control panel based on the temperature of the boiler.

5.6.2 Scope of the works

It is envisioned installation of new automation and control system for heating, ventilation and air conditioning including humidity control with display control terminal, training the personnel and developing operation and maintenance routines and manuals.

It is envisaged to move the control panels of building systems to more accessible place (so manager can access, monitor, adjust set points, switch on/off and modify the control panel settings). Installation of new display control terminal at the top of 5th floor.

The designer team should develop the control strategy (integrate the boiler plus chillier/heat pump controller)and sequence of operation, program the controllers, develop energy monitoring and O&M routines and manuals, instructions and inspection check lists and perform training of the personnel.

5.6.3 General technical requirements

The minimum requirements to automation and control system are: terminal should have own programmable controller/s with bus communication serving thermal valve actuators (weather compensation) to account and modify the flow temperature – mixers, with sensors from the heating/cooling system and indoor, relays for circulators pumps (pumps work to be checked and optimised by the designer) and fans, dampers and by-pass sensors from the return air from both

air-handling units - linked with the controller of the heat recovery units and the chillier/heat pump and/or boiler.

The heating distribution system should be equipped with minimum mixing valves with actuators for each branch of space heating system supplying the fan coils, plus adjusting existing sets of mixing valves for the coils (heating and cooling) in each air handling units.

The control terminals should automatically control temperature set points (according design in archive storage area the max temperature should not reach more than 18 ºC in heating mode) of heating system and cooling system (weekly schedule – different for each unit) and reduction/stop of ventilation and humidity plus heat recovery control (prevention of overheating, night ventilation, humidity control etc.).

5.6.4 Summary of required works

- Visual inspection;
- Measurements;
- Development of the detailed technical design for operation of the new automation system with the control strategy based on technical requirements;
- Supply of all materials and equipment on site;
- Installation of the new automation system;
- Test, adjustment and commissioning of new automation system;
- Development and handing over to the Client the “As Built” documentation
- Development of Operation and Maintenance manual. instructions and check lists followed with training of technical personnel of the buildings on energy monitoring;
- Disposal of construction debris caused by the construction works

5.7 Thermal insulation of walls (Kindergarten # 32 in Rustavi and Public School # 1in Kvemo Bolnisi)

5.7.1 Existing structures:

Kindergarten # 32 in Rustavi

Main materials: blocks

Wall width: **- 0,4 m**

Total wall area for insulation – approx. **1 709 m^2** together with the area of walls below the ground level

(Total area above the ground level constitutes approx**. 1 545 m^2)**

Public School # 1in Kvemo Bolnisi

Main materials: bricks

Wall width: - **0,3 ÷ 0,5 m.**

Total wall area for insulation - **1 056 m^2** together with the area of walls below the ground level

(Total area above the ground level constitutes approx.: **1 000 m^2)**

5.7.2 Scope of works

Kindergarten # 32 in Rustavi

The wall area has to be insulated - approx. **1 709 m^{2*}**

Insulation of walls shall be done with the mineral or rock wool as well as insulation of the plinth area with diffusion tight insulation layer such as XPS together with the water proofing material with the

height 0,5÷0,7 m over the ground level. Thermal insulation along the building perimeter with the approx. length of 328 m with the depth of the 0,5 m below the ground level.

For ensuring good attachment of the thermal insulation system to the vertical and horizontal elements of the building (including to the blind area) and to avoid water penetration into thermal insulation the rehabilitation of the blind area along the building perimeter has to be done. Repair of the porch and aprons (if necessary); Replacement of water drainage gutters and downpipes; Total replacement of water outflow from windows (window gutters), dismantling of evacuation metal stairs from the building façade along with, air ducts, chimneys, etc and their re-installation after insulation of walls with heat insulated anchors and fixing units

Restoration of blind area along the building – 328 m.

Repair of the porch and aprons (if necessary);

* Wall area for insulation (including insulation of outdoor window slopes) will be adjusted during the design stage

Public School # 1in Kvemo Bolnisi

The wall area to be insulated – approx. **1 056 m^2 ***

Thermal insulation with the mineral or rock wool (including external window slopes) and insulation of the plinth area/ socle with the height approximately about 0,7-0,8 m over the ground level and insulation of foundation walls with the depth up to 0,5 m below the ground level including water proofing.

The foundation walls insulation will be installed only on 112 linear meters of the building perimeter (excluding part of the building perimeter with the already existing reconstructed blind area.

For ensuring good attachment of the thermal insulation system to the vertical and horizontal elements of the building (including to the blind area) and to avoid water penetration into thermal insulation the partial rehabilitation of the blind area has to be done where necessary. Repair of the porch and aprons (if necessary); Installation of a water drainage apron, along the upper mark of insulation in places where the roof does not overlap the wall insulation.

Restoration of blind area along the building – 112 m.

* Wall area for insulation (including insulation of outdoor window slopes) will be adjusted during the design stage.

5.7.3 General technical requirements

Kindergarten # 32 in Rustavi and Public School # 1in Kvemo Bolnisi

Requirements for installation of the thermal insulation of the building structural components are given in Chapter 6 “Technical specifications” of the Employer’s Requirements

Main thermal insulation material:

- The mineral wool with the density minimum **150 kg/m^3**. (insulation of walls and external windows slopes)

- extruded polystyrene with density **38-45 kg/m^3** (insulation of walls up to **0,5÷ 0,8 m** over the ground level)

Thermal conductivity factor **λ ≤ 0,04 W/mK**

Thickness of thermal insulation layer:

- mineral wool for walls - (in Kindergarten # 32 in Rustavi): **≈ 80** mm, (in the Public School #1of Kvemo Bolnisi) **90 mm**;

- mineral wool for external window slopes: **≈ 20 mm**

- extruded polystyrene (XPS): (in Kindergarten # 32 in Rustavi): **≈ 80** mm (in the Public School #1of Kvemo Bolnisi) **90 mm**;

- Applied thermal insulation shall ensure max **U ≤ 0,38 W/m^2 K**.

5.7.4 Summary of required works

<u>Kindergarten # 32 in Rustavi and Public School # 1in Kvemo Bolnisi</u>

- Visual inspection;
- Measurements;
- Development of Façade Renders;
- Development of the detailed technical design;
- **For the Public School # 1** in the village of the Kvemo Bolnisi removal of the architectural decorative moulding elements: at the upper level of the final border of the plinth area/ sockle with the wall as well as with the border of wall at the lower level (close to the ground level of the plinth area/sockle) for ensuring the smooth application of the thermal insulation has to be considered.
- **For the Public School # 1** in the village of Kvemo Bolnisi the technical design solutions should consider removal of the decorative architectural elements under the windows for ensuring smooth application of insulation on the walls
- **For the Public School # 1** in the village of the Kvemo Bolnisi the supporting structural calculations should be carried out related to the decorative bricks' walls insertions located between "coupled" windows for ensuring load bearing issues regarding application of the thermal insulation. Technical solution on insulation of part of the walls regarding filling up space located from both sides of the decorative bricks' walls insertions between "coupled" windows (in compliance with the main walls structural thickness) should be foreseen in the technical design as well.
- **For the Public School # 1** in the village of the Kvemo Bolnisi the technical design should foresee the technical solution for insulation of the window slopes with consideration of its architectural particularities –the "step-like outer slopes".
- Dismantling works, including when necessary dismantling of metal elements from the building façades (escape stairs, air ducts, grills, chimneys, etc.) and their further re-installation after thermal insulation of walls with thermally insulated anchors and fixing sections, as well as dismantling of power cables (high and low current) and their re-installation and commencement according to current norms
- Removal of damaged sections of plaster and re-applying of new plaster on the facades
- Repair and restoration works: roof eaves, parapets, aprons over entrances, ramps, steps of entrances, etc (if necessary)
- Walls levelling for application of the thermal insulation
- Supply of all needed materials and equipment on the site
- Installation of the thermal insulation above the ground level
- Installation of the thermal insulation below the ground level where the blind area will be reconstructed
- **For the Public School # 1 in the Kvemo Bolnisi** - Arrangement of the blind area along the part of the building with the maximum length about 112 m with the implementation of the transverse slope from the outer walls of the building
- **For the Kindergarten # 32 in Rustavi** - Arrangement of the blind area along the part of the building with the maximum length about 328 m with the implementation of the transverse slope from the outer walls of the building
- Installation of drainage system from the roof
- Development and handing over to the Client the "As Built" documentation
- Disposal of construction debris caused by the construction works

5.8 Thermal insulation of the flat roof (Kindergarten # 32 in Rustavi)

5.8.1 Existing structures:

Roof of the kindergarten building is flat, constructed from the main reinforced concrete slab with thickness- **0,22 m.**

Total area of the flat roof (for both buildings and corridors) – approx. **1 475 m^2**

5.8.2 Scope works

The flat roof area is foreseen for insulation: approx. **1 475*m^2**

* Roof area for insulation will be adjusted during designing.

5.8.3 General technical requirements:

Main thermal insulation material: mineral wool

Thermal conductivity factor **λ ≤ 0,04 W/mK**

Thickness of thermal insulation layer: mineral wool for flat roof: **≈100 mm**;

Applied thermal insulation shall ensure max **U ≤ 0,3 W/m^2 K**.

Technical solution of roof insulation envisages application of additional layers starting from "top to bottom" direction and will include:

- smoothening of roof with cement sand screed, taking into account the slope;
- 2 layers of bitumen membrane;

-insulation layer/mineral wool σ= 0.10 m, λ=0.04 W/m^{0}C;

-vapor barrier;

The roof sheets should be additionally supervised for leakages and the places under doubt to be sealed

Requirements for installation of heat insulation structures are given in Chapter 6 "Technical specifications" of the Employer's Requirements

5.8.4 Summary of required works

- Visual inspection;
- Measurements;
- Development of detailed design;
- Supply of all needed materials and equipment on site
- Removal of all existing roof layers up to the roof slab;
- Installation of the new layers on the top of the roof's reinforced concrete slab with sequence as follows: the vapour seal, thereafter application of the thermal insulation boards. Afterwards the existing light pumice filling can be returned back and fixed. It has to be covered with waterproofing membrane over it followed with the reinforced concrete bad with min thickness of ≈10 cm and finally completed with the multilayer cover materials (Please follow illustration given in the Figure 6 of the Chapter 6 Technical Specifications)
- Cleaning of drainages (if necessary)
- Development and handing over to the Client the "As Built" documentation
- Disposal of construction debris caused by the construction works

5.9 Thermal insulation of the attic floor/unheated attic (Kvemo Bolnisi Public School # 1)

5.9.1 Existing structures

Sloped roof is arranged over the unheated attic space

Thickness of attic floor slab : **220 mm**

Area of attic floor – **898 m^2**

5.9.2 Scope of works

The attic floor to be insulated with the total area of– **898* m^2**

* Attic floor area for insulation will be adjusted during the design stage

5.9.3 General technical requirements

The main thermal-insulation material: mineral wool with density minimum **40 kg/m^3**

Thermal conductivity factor **λ ≤ 0,04 W/mK**

Thickness of thermal insulation layer: mineral wool for attic floor: **≈110 mm**;

Applied thermal insulation shall ensure max **U ≤ 0,30 W/m^2 K**.

5.9.4 Summary of required works:

- Visual inspection;
- Measurements;
- Development of detailed design;
- Supply of all needed materials and equipment on site
- Elimination of leakages in the roof (if necessary)
- Replacement of damaged elements (if any) of the wooden truss system of the roof
- Cleaning of attic floor up to the slab
- Installation of thermal insulation on attic floor, including installation of pathway floor/ walking passages (bridges) with the 60 cm width over the insulation
- Fire retardant treatment of wooden roof structures (in accordance with the Resolution of the Government of Georgia Nr. 41 dated 28 January 2016, Chapter 5)
- Cleaning of water drainage from the roof (if necessary)
- Disposal of construction debris caused by the construction works.

5.10 Partial installation of new EE windows (Kindergarten # 32 in Rustavi)

5.10.1 Existing structures:

Some old single glazed windows still remain in the building - about 107 m^2 together with the single glazed doors with total area of about 27 m^2.

5.10.2 Scope of works

Replacement of the remaining single glazed windows and doors with the new EE windows & doors;

The total window and door area that has to be replaced constitutes: about **134 m^2.**

* Area of windows and doors to be replaced will be adjusted during designing

5.10.3 General technical requirements:

Requirements for installation of new windows and doors are given in Chapter 6 “Technical specifications” of the Employer’s Requirements

Type of windows: energy efficient with Max thermal transmittance of news windows and new glazed doors shall be **U ≤ 1,8 W/m^2*K**.

The flap for opening / closing accessories should be considered for airing on all new windows.

During development of detailed design the provisions and requirements set out in the following regulations should be followed:

"Technical Regulations approved by the Decree No. 41 of the Government of Georgia, January 28, 2016," Safety and Security Rules ".

The thermal transmittance (U value) should be declared either:

as a U-value on the "CE-marking" according to the product standard EN 14351-1:2006+A1:2010+A2:2016 Windows and doors - Product standard, performance characteristics - Part 1: Windows and external pedestrian doorsteps. (the size of the window or door in question differs less than 10% from the size used in EN 14351-1)

or

calculated as U-value according to combination of EN ISO 10077-1:2017 Thermal performance of windows, doors and shutters - Calculation of thermal transmittance - Part 1: General (ISO 10077-1:2017), EN 410:2011 Glass in building - Determination of luminous and solar characteristics of glazing, EN 673:2011 Glass in building - Determination of thermal transmittance (U value) - Calculation method.,

Air permeability of windows and doors should satisfy at least Class 2 of EN 12207:2016 Windows and doors - Air permeability – Classification

Water tightness of windows and doors should satisfy at least Class 2 of EN 12208:1999 Windows and doors – Water tightness – Classification

The resistance to wind load and fractures according to Georgian construction norms or minimum Class A3/B3 according to EN 12210 Windows and doors - Resistance to wind load – Classification

The fire protection according to Georgian fire protection norms

5.10.4 Summary of required works

- Visual inspection;
- Measurements on site;
- Development of the detailed design;
- Supply of windows and doors on site;
- Dismantling of old windows and doors;
- Installation of new windows and doors;
- Repair and finishing of external and internal slopes after dismantling / installation of windows and doors
- Installation of drop sills and indoor sills of appropriate size on all newly mounted windows;
- Performing other related finishing works;
- Development and handing over to the Client the "As Built" documentation
- Disposal of dismantled windows and construction debris caused by the construction works

5.10.5 Environmental requirements

Do not use SF6, PFC gases in window glazing.

5.11 Installation of new heating system with interconnection with DHW (Kindergarten # 32 in Rustavi)

5.11.1 Existing situation:

Currently there are 26 wall mounted local natural gas heaters installed in the kindergarten building, however not all the internal space is heated with these appliances. About 40 % of kindergarten internal space remains without heating. The installed local gas heaters aren't safe for children.

There are also installed 4 gas hot water heaters and 1 electrical hot water heater for preparation of the domestic hot water in the building. This amount isn't enough to cover demand of occupants in the hot water. In 2016 the Rustavi Municipality repaired toilets (that are considered for 9 group of students', since several years ago toilets for 3 group of students were already repaired) and have

installed the raisers/piping for the domestic hot water system, aiming connection it to the hot water supply system in the future.

5.11.2 Scope of works

The new space heating system combined with the domestic hot water system and boiler room shall be installed for the building.

The location of the boiler room has to be defined by the contractor (either container type module boiler room or boiler room with wall mounted boilers).

The system shall include new gas boiler/s, pipes (suitable for application in heating system) pumps, water filters, emitters/ radiators, gate valves, thermometers, manometers, automatic controls

New radiators are to be equipped with the thermostatic valves.

Automatic controls maintaining the set-up indoor temperature and with possibility of temperature set-back during non-working hours shall be included.

Air vent valves are to be installed at the highest points of the system and on the heating devices of the upper floor for air release from the heating system.

Pipelines at the intersection of the walls and floors are to be laid in the steel sleeves.

Distribution pipelines are to be thermally insulated.

Actual capacity of boilers is to be adjusted at the state of designing accounting improved thermal characteristics of the building envelope.

5.11.3 Norms and general technical requirements:

When developing design documentation and selection of the equipment the requirements of the following norms and standards should be followed:

New space heaters (gas boilers with burners including the temperature control) should have Seasonal space heating energy efficiency class A or better according to “Delegated Regulation (EU) No 811/2013 of 18 February 2013 supplementing Directive 2010/30/EU with regard to the energy labeling of space heaters, combination heaters, packages of space heater, temperature control and solar device and packages of combination heater, temperature control and solar device”.

New heating system: 2 pipe, water based, design according to “EN 12828:2012+A1:2014 Heating systems in buildings - Design for water-based heating systems” with steel radiators according EN 442-1:2014 Radiators and convectors - Part 1: Technical specifications and requirements and EN 442-2:2014 Radiators and convectors - Part 2: Test methods and rating

Heat insulation material for pipes: mineral wool mats or rigid semi-cylinders with outer foil protection covering, density min ≥ **35 kg/m^3** and thermal conductivity factor max **0,04 W/м*К.**

Installation of thermostatic valves (TRV) on the existing steel radiators (Tamper proof model - with tamper-resistant housing that protects against unauthorized intervention)

Thermostatic valves shall meet EN 215:2004/A1:2006Thermostatic radiator valves - Requirements and test methods

Install automatic weather-dependent controls for the heating system - install the controller, regulation valve and remote temperature sensors – outdoor and in the building’s representative rooms to ensure possibility of temperature regulation depending on outdoor temperature and set-back temperature based on pre-defined time schedule.

* Requirements for installation are given in Chapter 6 “Technical specifications” of the Employer’s Requirements.

Technical requirements for the insulation of distribution pipes are given in **Table 1**.

Table 1 Requirements on minimum thickness of insulation for distribution system pipes and fittings

№	Type of piping / Fittings	Minimum thickness of the insulation layer, based on a thermal conductivity λ< 0,04 W/(m K)
1	Internal diameters up to 22 mm	20 mm
2	Internal diameters greater than 22 mm up to 35 mm	30 mm
3	Internal diameters greater than 35 mm up to 100 mm	equal to Internal diameter
4	Internal diameters greater than 100 mm	100 mm
5	Pipes and fittings according to Rows № 1 to 4 in wall and ceiling penetrations, in the intersection area of pipes, to pipe connections with main distribution manifolds	1/2 of the requirements of the rows 1 to 4
6	Heat distribution pipes from rows 1 to 4, in parts between heated rooms of different users	1/2 of the requirements of the rows 1 to 4
7	Pipes after row 6 in floor construction	6 mm
8	Cooling distribution pipes and cold water pipes and fittings of air-handling and air-conditioning systems	10 mm

5.11.4 Summary of required works

- Visual inspection;
- Measurements;
- Development of detailed design and obtaining independent expert approval;
- Obtaining technical conditions for connection for the new gas boilers to the gas supply system.
- Necessary dismantling works
- Installation and construction works for new heating system
- Connection of boilers to the gas supply system
- Testing and adjustment works
- Disposal of construction debris caused by the construction works
- Commencement works
- Development and handing over to the Employer the “As Built” documentation
- Development of Operation and Maintenance Manuals and training of technical personnel of the building

5.12 Installation of individual ventilation units with heat recovery (Kindergarten # 32 in Rustavi and Public School # 1 in Kvemo Bolnisi)

5.12.1 Existing situation

Kindergarten # 32 in Rustavi

Type of ventilation system – natural,

The mechanical ventilation is only installed in the kitchen but doesn't operate due to the absence of the three phase electrical cable.

Number of pupils – 460

Number of personnel – 40

Public School # 1 in Kvemo Bolnisi

There is no ventilation system in the building. After insulation of walls and roof the level of the natural air infiltration will decrease thus it is important to install the ventilation system in the building to ensure intake of a fresh air.

Type of ventilation system – natural

Number of pupils – 370.

Number of personnel – 50.

5.12.2 Scope of works

Kindergarten # 32 in Rustavi

It is foreseen installation of the **43** individual ventilation units with the heat recovery.

Total capacity of **43** individual ventilation units with the fresh air intake is about ≈ 8 500 m^3/h

* Capacity of each ventilation unit is to be defined during design.

Public School # 1 in Kvemo Bolnisi

It is foreseen installation of **38** individual ventilation units with heat recovery.

Total capacity of **38** individual ventilation units with heat recovery **≈ 7 560 * m^3/h**

* Capacity of each ventilation unit is to be defined during designing.

5.12.3 General technical requirements:

Kindergarten # 32 in Rustavi and Kvemo Bolnisi # 1 Public School

Minimum heat recovery efficiency - 75%

Capacity and number of individual ventilation units – according to calculations.

The overall specific power of fans (SFP) should be not more than 2,5 kW/(m^3/s)

5.12.4 Summary of required works

Kindergarten # 32 in Rustavi and Public School # 1 in Kvemo Bolnisi

- Visual inspection;
- Measurements;
- Collection of initial data (including selection of places for installation of individual ventilation units with heat recovery; location of wiring, width if the walls considering planned heat insulation; selection of layout for cables location for powering ventilation units, etc.)
- Obtaining technical conditions for connection for the power networks (if necessary)
- Development of detailed design with all necessary calculations;
- Supply of all materials and equipment on site.
- Drilling of wall openings for the ventilation units, grooving of inner walls and floors (laying the cable boxes) for wiring to connect ventilation units to power networks
- Installation of ventilation units; sealing of junctions between the ventilation units and walls;
- Ensuring hermetic conjunction of heat insulation to the ventilation units;

- Finishing works after completion of installation works (finishing the openings and grooving).
- Connection of ventilation units to power networks with partial installation of electrical cables (if necessary);
- Testing, adjustment and commencement of ventilation system;
- Testing of operation modes of units with heat recovery;
- Development and handing over to the Client the “As Built” documentation
- Development of Operation and Maintenance manual instructions and training of technical personnel of the building on operation of the ventilation units
- Disposal of construction debris caused by the construction works

5.13 Installation of the new efficient bulbs together with part of wiring switchers and sockets (Kindergarten # 32 in Rustavi and Public School # 1 in Kvemo Bolnisi)

5.13.1 Existing situation

Kindergarten # 32 in Rustavi

Part of the energy efficient bulbs are installed in the kindergarten building, however 124 incandescent- 100 W and 60 W bulbs still remain in the building. The wiring is depreciated together with sockets and switchers and isn’t safe.

Kvemo Bolnisi Public School #1

Part of the energy efficient bulbs are installed in the school building, however 39 incandescent- 100 W bulbs still remain in the building. They can’t be switched on because wiring is depreciated together with sockets and switchers. It can be stated that lighting system isn’t working in part of the building.

5.13.2 Scope of works

Kindergarten # 32 in Rustavi

To install LED bulbs in the building (6W- 9W each) together with wiring, 15 switchers and 30 sockets instead of the obsolete equipment.

Kvemo Bolnisi Public School #1

Installation of new energy efficient 50 LED fixtures in the building (6 W- 9W each) together with 570 m of wiring, 26 switchers and 26 sockets instead of the obsolete equipment

5.13.3 General technical requirements

Kindergarten # 32 in Rustavi and Public School # 1 in Kvemo Bolnisi

General technical requirements are illustrated in the Table 2

Table 2

Technical requirements for LED bulbs			
#	Characteristic	Parameter	To be verified with
1	Operational voltage (acceptable range), V	230 (175 ÷ 250)	Bulb passport

2	Current frequency, Hz	50 ± 5%	Bulb passport
3	Expected capacity, W	6 - 9 W	Bulb passport
4	Colour temperature, K^0	3500 ÷ 4500	Bulb passport
5	Glow angle, ^{0}	180	Bulb passport
5	Min power factor	0,8	Bulb passport
6	Operational temperature, C^0	-30 ÷ +45	Bulb passport
7	Protection level	IP 20	Bulb passport
9	Min index of colour transmittance	70	Bulb passport
10	Min light efficiency, Lm/W	90	Bulb passport
11	Min lifetime, hours	30 000	Bulb passport
12	Min guarantee period	5 years	Bulb passport
	Supporting documents		
- Passport of LED bulb; - Obligatory availability of ISO 9001 certificate with lamp producer; - Availability of confirm positive reference from the end user for operation of proposed lamps at least 1 year			

5.13.4 Summary of required works

<u>Kindergarten # 32 in Rustavi and Public School # 1 in Kvemo Bolnisi</u>

- Visual inspection and checking of electrical wiring;
- Replacement of damaged sections of wiring and damaged switchers and sockets;
- Partial installation of wiring with installation of new switchers and sockets;
- Dismantling of existing incandescent bulbs;
- Installation of a new transparent open or half-open plafond with a base E27;
- Installation in the mounted plafonds the new LED lamps with a matte diffuser (Lamp base E 27), Lamps must be installed with the diffuser down;
- Disposal of construction waste

5.14 Installation of thermostatic valves, insulation of pipes in boiler house, automatic control for temperature set-back (Public School # 1 in Kvemo Bolnisi)

5.14.1 Existing situation

Double pipe hydronic heating system is installed in the school building, however heating system isn't well regulated and as a result they have lower temperature in the classrooms oriented on North.

There is not-sufficient insulation of the heating system's pipes in the boiler house. There is no possibility in the boiler house to setback indoor temperature during non-working time.

5.14.2 Scope of works

Installation of thermostatic valves (TRV) on the existing steel radiators (Tamper proof model - with tamper-resistant housing that protects against unauthorized intervention)

Install automatic weather-dependent controls for the heating system - install the controller, regulation valve and remote temperature sensors (outdoor and in the building's representative rooms) to ensure possibility of temperature regulation depending on outdoor temperature and to ensure possibility of set-back temperature based on pre-defined time schedule.

Heat insulation of distribution pipes of the heating system in the boiler house.

Number of TRVs – **58 pcs**

Set of automatic weather-dependent controls**– 1 set**

* Number of TRV, number of additional radiators have to be installed (if needed), length of pipes to be insulated are to be defined during designing.

5.14.3 General technical requirements *

Heat insulation material for pipes: mineral wool mats or rigid semi-cylinders with outer foil protection covering, density min ≥ **35 kg/m^3** and thermal conductivity factor max **0,04 W/м*К.**

Thermostatic valves shall meet EN 215:2004/A1:2006 Thermostatic radiator valves - Requirements and test methods.

* Requirements for installation are given in Chapter 6 "Technical specifications" of the Employer's Requirements.

5.14.4 Summary of required works

- Visual inspection;
- Measurements;
- Development of detailed design for automatic control system;
- Supply of necessary materials and equipment on-site
- Installation of TRV on existing radiators
- Installation of the automatic controls system to maintain the set-up indoor temperature and possibility of temperature setback during non-working hours.
- Installation of heat insulation on heating pipes in the unheated basement and in boiler house
- Testing and adjustment works
- Commencement works
- Development of Operation and Maintenance Manuals and training of technical personnel of the school
- Disposal of construction debris caused by the construction works

6 Technical Specifications

6.1 Quality of Materials

All materials, fixtures, fittings and supplies furnished under the Contract shall be new and unused, of standard first-grade quality and of the best workmanship and design. No inferior or low-grade materials, supplies or articles will be approved or accepted, and all work of assembly and construction shall be done in a first-class and workmanlike manner.

6.2 Design content

Before designing the Contractor shall assess the technical condition of the building in terms of roof structure and building envelope, considering the works which are to be implemented.

The design documentation shall contain the following parts:

- General explanatory notes and specifications

- Sizing drawings for the buildings

- Architectural and Construction part. The design should obligatory contain situational layout in scale M 1: 2000 - 1: 10000. The drawings of all details and sections are to be presented in scale 1:20; 1:25.

- HVAC (Heating, Ventilation and Air Conditioning) Part

- Automatic control systems

- Electrical and Power Supply Part.

- Water Supply and Sewage (if needed)

- Passport of Façade Finishing

- Design of Construction Organisation including Health and Safety Management Plan

Architectural and Construction part of the design documentation for thermal insulation related to avoiding thermal bridges and moisture penetration should include development of drawings of all related sections and units for thermal insulation and details, to be developed on the basis of engineering calculations, in the details sufficient for implementation of works in-site.

For individual ventilation units with heat recovery the typical mounting section shall be developed within Architectural and Construction part of the detailed design documentation, taking into consideration the external insulation of walls.

The Contractor shall prepare specifications for materials and equipment.

The Contractor shall provide to the Employer four hard copies of the detailed design documentation in A3 and A4 format in Georgian language. Submitted copies shall be accompanied with electronic copies (text part in Word and Excel format, and drawings - in AutoCAD / ArchiCAD and PDF) on electronic carrier.

6.3 Replacement of windows

6.3.1 General requirements for junctions:

For maintain energy efficiency the junctions of windows and doors to the walls shall be sealed in such way that air tightness of the junctions is maintained thought out the operation period of windows and doors.

Junctions shall be waterproof. Functional thermal and sound proof layer shall be continuous over the whole junction perimeter.

Junction shall be performed in such a way that the main functions are satisfied considering the operational conditions.

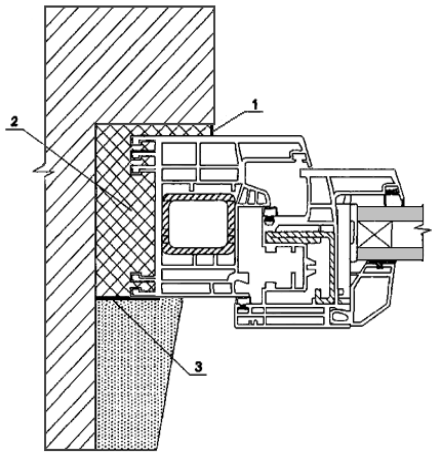


Figure 1 Junction principal scheme

1. External waterproof vapor permeable layer (for example pre-compressed sealing tape or diffusion open sealing tape type SOUDAL or similar);
2. Intermediate thermal insulation layer;
3. Internal vapour-proof layer (diffusion tight sealing tape type SOUDAL or similar).

6.3.2 Requirements for windows installation

A technical correct connection of window and door elements to the building shell including the construction itself, the geometry of joints, the fastening, the thermal insulation and sealing is crucial and must be designed carefully together with other measurements of a thermal refurbishment of the building shell such as an external thermal insulation composite system

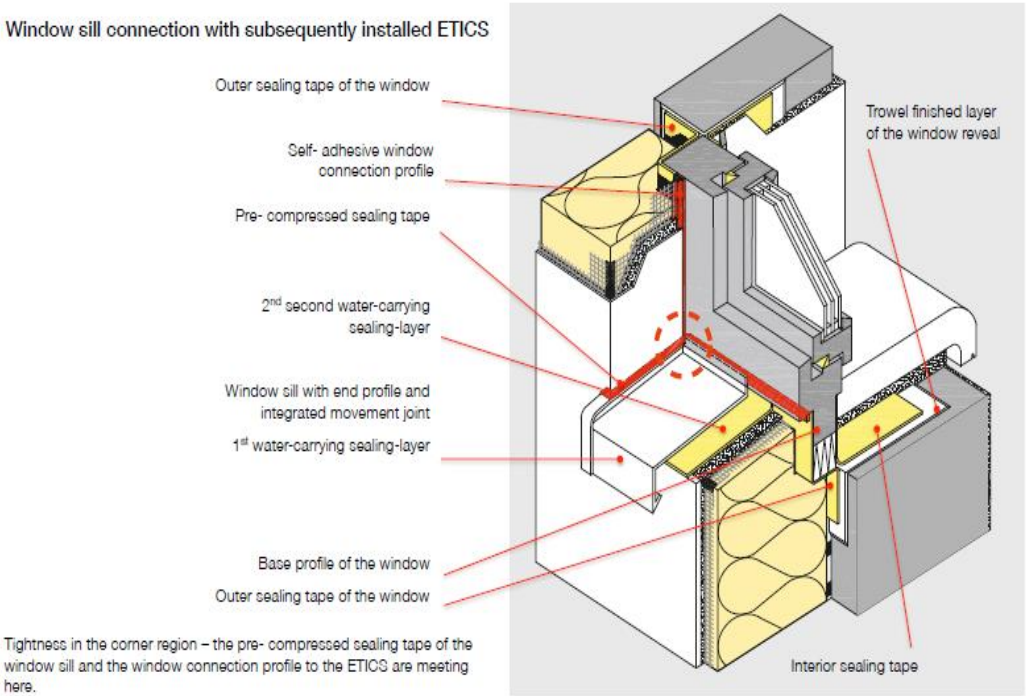


Figure 2 Installation of the outdoor window sill together with ETICS system

6.3.3 Components

1. Complete delivery of windows and doors is required. Complete plant shall include:

- the plant in accordance with the requirements
- set of fixing components to the carrying structures of the building
- plant's passport
- component parts;
- instructions for installation and operation

The plants and goods are to be delivered as assembled. It is allowed to supply handles, units and other elements protruding in relation to the surface of the plant, unassembled as part of the delivery plant set.

2. Plant's passport/**certificate or CE marking** shall include:

a) main operational characteristics:

- thermal transmittance factor;

- air tightness class;

- water-proof class;

- sound-proof class;

- light transmittance class

b) vendor code и and the sizes of the main profiles;

c) vendor code and main parameters and geometrical characteristics of strengthening metal profiles;

d) overall dimensions of the plant

e) brand and characteristics of accessories ;

f) dimensions and characteristics of glazing.

6.3.4 Requirements for technical documentation on goods

The technical documentation for products (window) should contain the following data:

1. Explanatory notes;

2. Types and sizes of products.

3. Assembly drawings of products:

- junction sections of assembly units;

- the number and location of window devices, pads for glazing, sealing pads and mounting sets;

- types, dimensions and mounting options stiffness elements.

4. Drawings of the details:

- cross-sections of PVC profiles with indication of vendor codes, dimensions, tolerances, resistance moment, distance to critical fivers.

5. Options for installation and fixing the goods in the window openings

6. Results of design calculations, testing, etc.

7. Test reports.

6.4 Thermal insulation of walls

The Contractor can select the outdoor thermal non-combustible insulation system of Rockwool, Ceresit, Knauf, Isover Capatect or similar types, materials and installation technology shall be compatible and in compliance with ETICS guidelines.

Thermal insulation system shall:

- ensure sufficient thermal resistance of the building envelope element and required vapour resistance of strengthening, decorative and painting layers.

- meet requirements for strength and deformations,

- meet requirement so fire and environmental safety.

Example of thermal wall insulation installation procedures

Technological steps (walls above ground level):

- preparation of surfaces of external building envelope for works on insulation;

- fixing of perforated socle profiles to the bottom of the building along its perimeter;

- applying a primer on the surface of the outer walls;

- preparation of adhesive mortar solution made of dry mixture and water;

- applying adhesive mortar solution on the surface of insulation plates and gluing them to the surface of the building envelope;

- sealing of the places of junction of insulation plates to window and door frames with, as well as junction points of insulation plates with a cornice plate;

- arrangement of expansion joints in the insulating coating;

- fixing insulation plates on the building envelope structures with the help of connecting elements (dowels)

- preparation of adhesive mortar solution of dry mixture and water and applying it to the surface of the insulation;

- fixing the perforated profiles on the edges of the first floor, as well as on the perimeter of the window openings of the building and gluing the strengthening fiberglass mesh over the entire facade of the building;

- applying a primer on the surface of a hydro protective layer;

- preparation of decorative plaster solutions from dry mix and water

- plastering the surface of the facade;

- painting the facade of the building;

- ensuring the protection of the ends and abutments of the thermal insulation structures from precipitation.

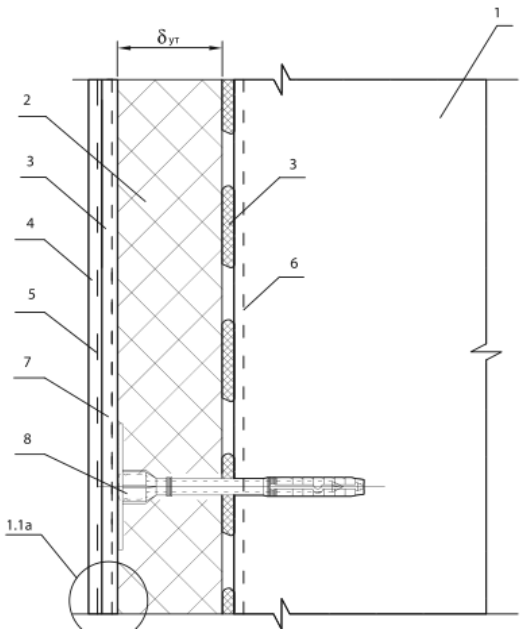


Figure 3 Schematic diagram of wall insulation with reinforced fixing with dowels

1. Wall.

2. Insulation mineral wool plate.

3. Adhesive solution for gluing the mineral wool plates and composition of protective layer.

4. Decorative plastering.

5. Primer paint.

6. Deep penetration primer for exterior walls.

7. Fiberglass Mesh.

8. Dowel

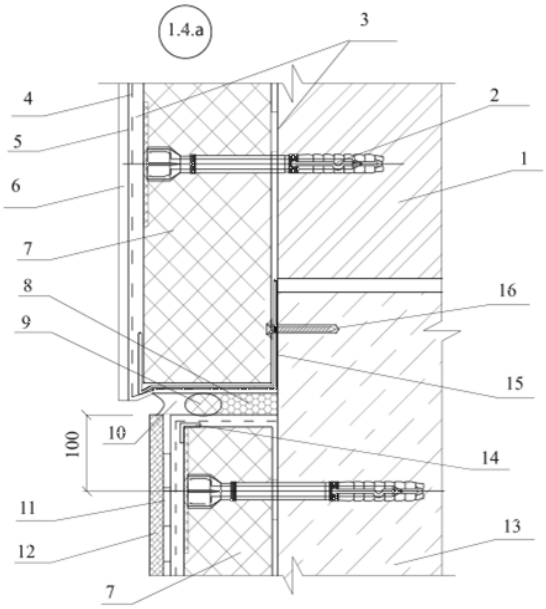


Figure 4 Schematic diagram of thermal insulation of the plinth area/socle. Adjacent to the thermal insulation system of the facade

1. Wall. 2. Dowel. 3. Adhesive mortar solution for gluing the insulation plates and for arrangement of protective layer. 4. Reinforcement with the fiberglass mesh. 5. Primer. 6. Decorative plastering. 7. Thermal insulation plate. 8. Polyurethane foam. 9. Foam polyethylene gasket. 10. Acrylic sealant. 11. Paint waterproofing in 2 layers or water proofing membrane. 12. Decorative plaster. 13. Plinth area of wall. 14. Strengthening profile. 15. Supporting profile. 16. Profile dowel.

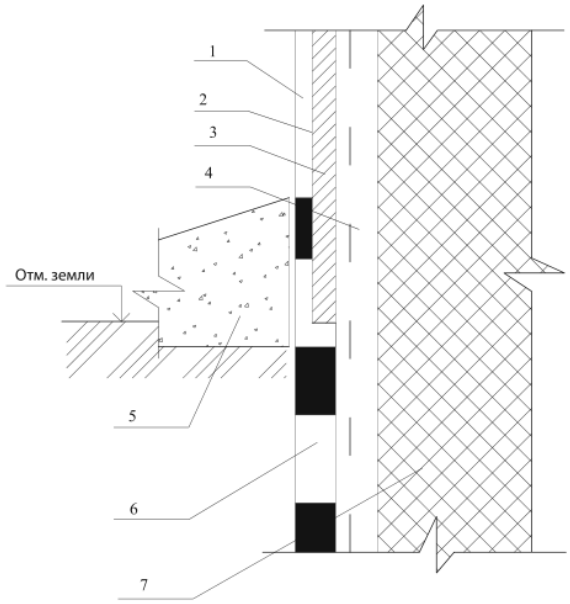


Figure 5 Schematic diagram of adjacent of polymer cement waterproofing with bitumen polymer layer at ground level

1. Decorative mosaic plaster (or tiling).

2. Primer.

3. Waterproofing in two layers.

4. Protective reinforced layer.

5. The blind area of the building according to design.

6. Bitumen polymer waterproofing.

7. Heat insulation plate of extruded polystyrene foam.

Minimum number of mechanical fixing elements (dowels) per 1 m^2 in the edge area – 8 pcs

Minimum number of mechanical fixing elements (dowels) per 1 m^2 in ordinary zone for the mineral wool plate – 6 pcs, for extruded polystyrene – 4 pcs.

Note. Dowels are to be placed along the perimeter of the insulation plate and inside, at that the dowels have to cover perpendicularly located seals of neighbouring rows of plates.

The length of the edge zone -1m.

Requirements to thermal insulation system*

Characteristic	Value
U value - thermal transmittance factors of wall with applied thermal insulation system	Max 0,38 W/m^{2}K
Min. impact resistance, J (Joule), for: socle wall of the 1st floor wall above 1st floor	 10 5 3 At that there should be no cracks and splinters on protective - decorative layer
Min. frost resistance of the protective and decorative layer, cycles	75 – for socle, 50 – for walls
Min. pulling effort on dowel from the wall, N (Newton): concrete, solid brick hollow brick and stone, cellular concrete with a density of more than 600 kg / m	 500 (screw dowels) 250 (plug dowel) 200 (screw dowels)
Min. adhesion strength to the base and protective-decorative layer of insulation plates, MPa (kgf / cm^2), : organic base mineral base	 0,08 (0,8) 0,015 (0,15)
Min. vapor permeability of the fastened thermal insulation system, mg / m • h • Pa,: with insulation on organic base with insulation on mineral base	 0,03 0,04
Max. water absorption coefficient for decorative layer, kg / m 2 • √hour: polymercement mixtures, polymer mixtures	 0,5 0,2
Max mass of 1 m ^{2} of heat insulation system without levelling layer, kg: with organic insulation with mineral insulation	 25 30

Technical requirements for insulation layer material*

Characteristic	Value	
	Polystyrene	**Mineral wool**
Min. tensile strength in tension in the direction perpendicular to the plate, MPa	0,1	0,015 for plates fixed with glue and dowels
Min. compressive strength at 10% deformation, MPa	0,1	0,040
The same, after sorption moistening, MPa	-	0,035
Max. thermal conductivity, W/m K	0,04	0,04
Min. vapor permeability, mg / m * h * Pa,	0,03	0,3
Max. water absorption within 24 hours with partial immersion, kg / m^3	0,5	3,0
Max. deviation of plate dimensions in mm/m along:		
length	±2	±2
width	±2	±1,5
thickness	±1	+3÷-1
Max. deviation of the dimensions of the plane, mm	5	6
Max. tolerances for squareness, mm / m	±2	±5

Note: extruded polystyrene plates must stay before use min 30 days after production

Technical requirements for fiberglass mesh*

Characteristic	Value
Weight of 1 m^2, g	- min 160 for the main facade - 330-350 (anti-vandal) to be applied up to 2 m high from the ground level (blind area level)
Thread thickness, mm	0,315-0,9
Min size of the cell, mm	5x5
Min. bursting load in the initial state, N/5 cm, (in both directions)	1500
Bursting load following accelerated testing method, N/5cm	Reduction of bursting load on max 30 %

Bursting load after 28 days of soaking in 5 % NaOH solution at +(18–30) ˚C, N/5 cm	Reduction of bursting load on max 50 %

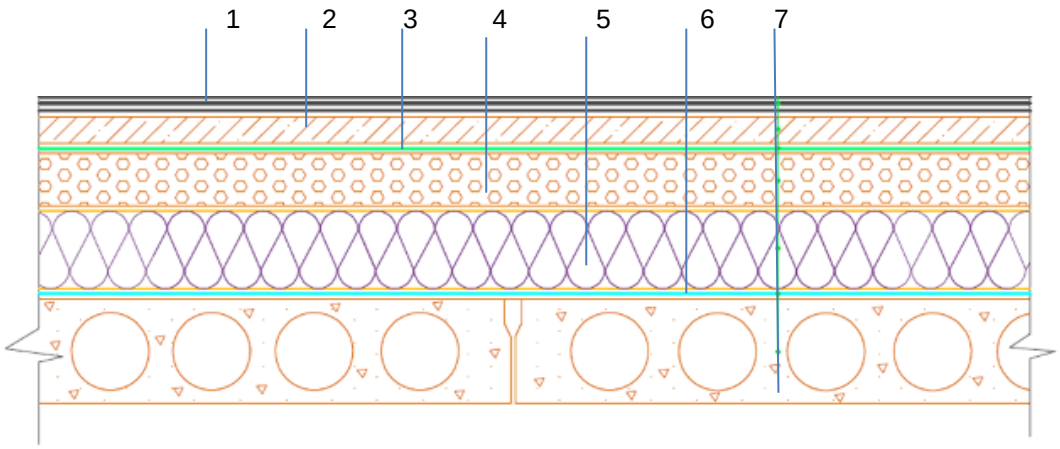
Note: fiberglass mash must be braided

6.5 Thermal insulation of flat roof

Thermally insulated flat roof of the building is a multi-layer structure, consisting of:

- Reinforced concrete slab
- Vapour seal
- Mineral wool insulation layer
- Water proofing layer
- Cement bed
- Three layers of external water proofing cover of Uniflex type or similar waterproofing material with bituminous adhesive elements and special additives. **For the lower layer**, the weight of the waterproofing material per 1 m^2 is min 3.8 kg, the thickness is min 2.8 mm. Waterproofing material with a polymer film on both sides of the layer shall be used. **For the top layer**, the weight of the waterproofing material per 1 m2 is min 4.9 kg, the thickness is min 3.8 mm. Heat resistance during 2 hours shall be min 95 degrees Celsius. Waterproofing material with a coarse-grained cover on the front side and a polymer film on the weld side of the layer shall be used.

The required thickness of the heat insulating layer shall be taken in accordance with the thermal calculation with the achievement of the heat transfer coefficient max U = 0.30 W / m2 * K. and must be at least 100 mm. The minimum density of the mineral wool plate should be at least 180 kg / m^3



1. Multilayer roof cover;
2. Reinforced cement-sand bed;
3. Layer of waterproofing;
4. Pumice light weight filling;
5. Mineral wool thermal insulation plates;
6. Vapour seal;
7. Reinforced concrete slab

Figure 6. Schematic drawing of flat roof thermal insulation

6.6 Thermal insulation of the attic floor

The insulated floor of the building attic with the walkways is a multi-layer structure that consists of a reinforced concrete slab, cement-sand screed, vapour barrier, mineral wool insulation with

wooden beams (rim boards), waterproof (but vapour diffusive) membrane and, where necessary, the walking surface bridge (wooden pathway (bridges) 60 cm width where necessary). The required thickness of the heat insulating layer shall be taken in accordance with the thermal calculation to achieve the heat transfer factor max U = 0,30 W / m^2 K. but should not be less than 110 mm in the Public School # 1 in the village of the Kvemo Bolnisi.

The minimum density of the mineral wool should be 40 kg / m^3

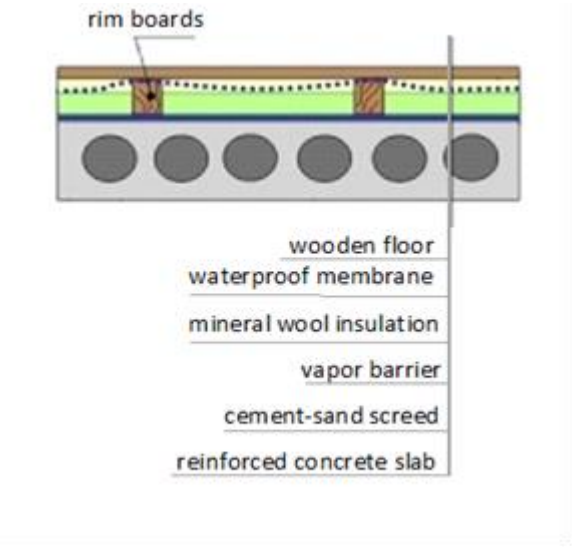


Figure 7. Schematic diagram of attic floor insulation technology with walkways (passage floor)

6.7 Solar collectors for domestic hot water

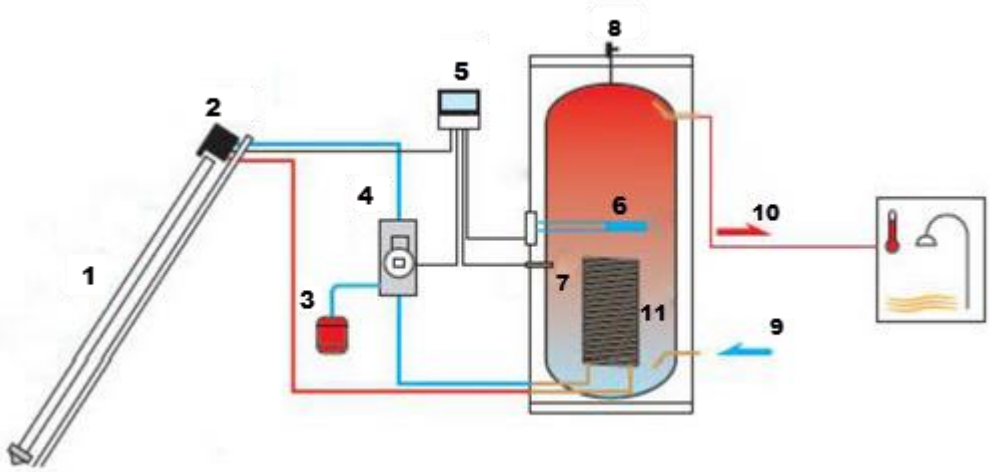


Figure 8.Schematic diagram of the domestic hot water system with solar collectors

№	Main equipment
1	Vacuum Solar collector
2	Temperature sensor Nr.1
3	Expansion tank

4	Working station (incl. pump)
5	Controller
6	Electrical heater
7	Temperature sensor Nr.2
8	Safety valve
9	Cold water
10	Hot water
11	Accumulation tank with one/two copper heat exchangers (coils)

Schematic diagram is only basis for designing of solar system for domestic hot water.

6.7.1 Components of the solar collectors system

Solar system for domestic hot water has to include the following main components:

- Vacuum solar collector
- Buffer accumulation tank
- Energy station
- Set of installation planks
- Installation frame
- Set for hydraulic connection
- Anti-scald unit
- Heat carrier for solar system
- Safety set for water heater
- Pumping equipment
- Expansion tank
- Pipes
- Stop and control fitting (ball valves, filters, stop valves, three-way valves)
- Cabling and wires

6.7.2 Requirements for designing

- Spatial layout of solar collector should be determined taking into account the type of building, landscape and climatic conditions, possibilities of the construction site and the building structures nearby.
- Solar collector on the roof of buildings should not lean to waterproofing layer, at that the gap between the solar collector and the roof should be at least 50 cm.
- In case of installation of solar collectors on the roofs the damaged roof waterproofing layer around the bearing supports should be restored
- Regardless of the material of the supporting structures of solar collector (steel, wood, aluminum, plastic, etc.), they cannot be installed directly on the external waterproofing.
- Bearing structures under solar collector must be checked for bearing capacity taking into account all types of additional load.

- The angle of inclination of immobile solar collectors to the horizon depends on the latitude of the terrain and is determined depending on the period of operation of the system
- When designing the location of the solar collector, it is advisable to consider the location of the building relative to orientation. The optimal orientation of the solar collector is South with a possible deviation to the east or west to 30 °. If the roof slope of the building corresponds to this orientation, then solar collector may be included in the structure of the building.
- If the roof is flat, on which the solar collector is to be placed, it is necessary to take into account the possibility of mutual shading, as well as shading from the parapet, nearby buildings, exhaust elements of ventilation ducts, pipes, etc.

6.7.3 Requirements for installation

- In the case of installation of the solar collectors on the envelope of the building under construction (usually on the roof), the solar collector support structures are installed on the structural elements of the roof or are combined with them, and then external waterproofing is laid.
- All installation work on the roof must be carried out with the help of temporary wooden ladders, enclosed on the external waterproofing for the passage of workers.
- After mounting the supporting structures, solar collectors shall be installed on them with drainage holes downwards and fix them in the manner provided for by the design.
- When installing solar collectors the possible maximum temperature deformations should be taken into account (especially in summer when window glass is used in collectors as a transparent coating).
- Installation of pipelines, pump groups, shut-off and control valves, automatic control devices of the solar collecting system is carried out in accordance with generally accepted standards
- When installing sanitary devices and special equipment, the following should be provided:
    - sealed connections and strength of fastenings of system elements;
    - straightness and the absence of sharp twists in straight sections of pipelines;
    - quality of operation of shut-off and control valves, energy equipment, instrumentation, as well as accessibility for maintenance, repair and replacement;
    - the ability to remove air and completely emptying the system from water;
    - Compliance with the design of pipeline inclination;
    - secure fastening of drive protections in pumps.
- After checking the system for tightness, all pipelines shall be painted and covered with heat insulation. In installations operating only in an unheated period, the supply pipe can be without insulation.
- After completion of all installation work, hydraulic testing of the solar collecting system is carried out, after that the start-up and thermal testing of the system shall be performed.

6.7.4 Hydraulic tests

- Based on the results of hydraulic tests of the solar collectors system and its equipment, a test report shall be prepared, which is signed by representatives of the technical supervision, the Client and the installation organization.
- After carrying out hydraulic tests, the system is adjusted and prepared for thermal tests.

6.7.5 Thermal tests

- Thermal tests are subject to each system that is connected to solar collectors loop.
- In the process of thermal testing, technical personnel can be trained on the system operation rules. Based on the test results, an Act is signed by all members of the commission.

6.8 Installation of individual ventilation system with heat recovery

Individual ventilation unit with heat recovery is mounted in the upper part of rooms in the outer wall. The diameter of the mounting hole in the outer wall is to be defined depending on the selected unit model.

A working module is to be installed into the mounting hole in the wall on the mounting foam or other sealant. Thus, the entire working module is in the body of the wall, and only the ventilation grilles remain visible: one inside the room, the other on the facade. A through hole is made at an angle of 3-5 degrees towards the outdoors. To ensure the normal operation of the ventilation system, it is necessary that its air intake pipe (from the outdoors) protrudes outside the wall min by 5 mm.

The length of the working module - in accordance with the thickness of the wall, where installation of the ventilation unit is planned

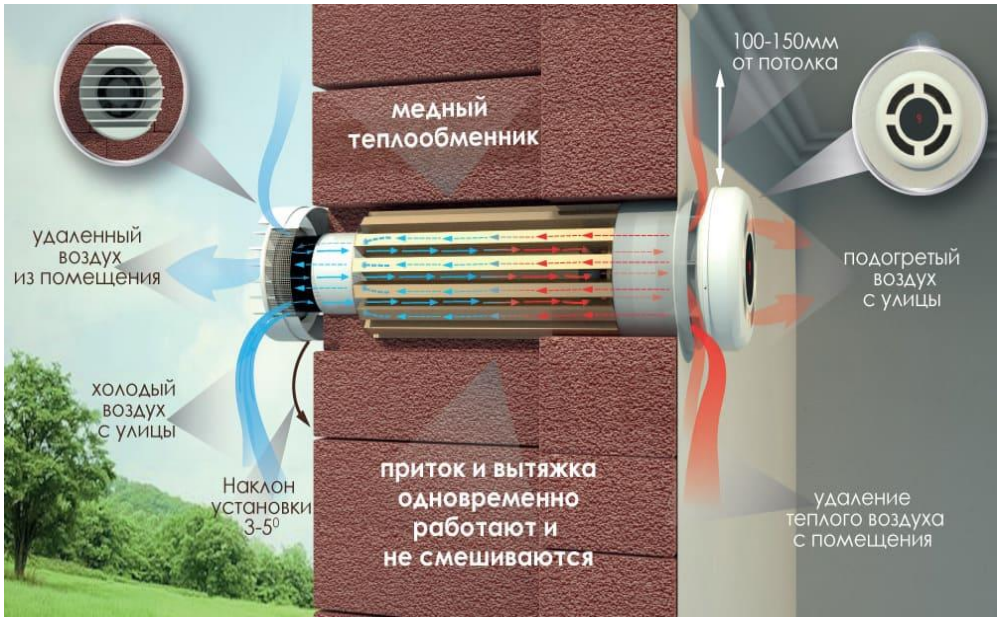


Figure 9 Individual ventilation unit with heat recovery

6.9 Installation of heating system

6.9.1 Requirements to the heating system

1. Design indoor temperature - according to current regulations

2.Components of the heating system must comply with the specification of the design documentation. It is allowed to replace elements of the system with similar ones, if this replacement does not contradict the initial data for designing, current construction standards, operational reliability, economic requirements, improves technical and economic indicators and if the equipment that is replaced is of the higher energy efficiency class. When replacing elements of the system, it is necessary to list and define its new characteristics, including settings for valves and other equipment.

3. The heating system must be adjusted (the flow rate of the heat carrier in the circulating loops is to be in accordance with the hydraulic calculation) and tested for tightness under pressure in accordance with the current regulatory documents.

Pipelines

1. For the pipelines of the heating system, metal-polymer pipes should be used, designed for this purpose according to the relevant regulatory documents.

Appropriate fittings, parts and products should be used for pipes and supplied together with the pipes. Fittings should not degraded, the quality of the heat carrier, ensure the tightness of the system and do not jeopardize the sanitary and epidemiological condition of the room.

2. When using pipes, equipment, fittings, etc. in the same system are made of different metals, if deemed necessary, the measures should be taken to prevent electrochemical corrosion.

3. The method of laying pipelines should ensure their easy replacement during repair.

4. The pipeline at the intersection of the slab, inner wall or partition should be laid in the sleeve made of non-combustible material. The ends of the sleeve must not be lower than the level of the final surface of the building envelope and protrude no more than by 30 mm from the final surface of the building envelope.

In the places where the pipeline crosses the building envelope structures with the rated fire resistance class and fire barriers, special penetrations or couplings should be arranged to maintain the normalized fire resistance class of such structures.

5. Horizontal pipelines in a horizontal plane, when laid in parallels, the chilled water pipeline should, as a rule, be located closer to the outer wall; in the vertical plane - the hot water pipeline should be laid above the chilled water pipeline.

6. In two-pipe systems, the hot water carrier riser should be located to the right of the chilled water riser.

Heating appliances and fittings

1. Heating appliances are usually located under the windows (if there are any) in a places that is accessible for inspection, repair and cleaning.

2. The length of the heating appliance should be determined by calculation and recommended to be at least 70 % of the length of the window in hospitals, kindergartens, schools, nursing homes and the disabled.

3. The staircase heating appliances should be located on the ground floor and, in the staircase divided into compartments - at the bottom of each compartment. Heating appliances should not be placed in tambours with external doors.

4. Radiators should be selected taking into account the low-temperature mode of operation of the heating system.

5. The heating appliance should be equipped with an automatic regulator of the room air temperature (thermostat or electronic flow controller)

6. The design of the automatic thermostatic valve must comply with the installation method of the heating appliance according to the manufacturer’s requirements. For example, for a heating appliance installed in a niche, one should use an automatic thermostat with a remote temperature sensor outside the niche; and for a heating appliance installed behind solid decorative panel with slots or grill at the bottom and on the top, one should use a remote thermostatic element installed on this panel.

7. Automatic regulators of room air temperature (thermostat or electronic flow regulator) for heating appliances of one-pipe systems should be taken with minimal hydraulic resistance, and for devices of two-pipe systems - with increased resistance.

8. For hydraulic balancing of the water system, regulating (balancing) fittings should be used, which ensure the method of hydraulic adjusting chosen during the design and specified in the design documentation.

9. Adjustment of all manual and automatic shut-off and control valves (thermostats, connecting regulating headset, manual and automatic balancing valves, etc.), which are connected to the circulation loops of the heating system, shall be determined by hydraulic calculation, indicated in the design documentation and set. The settings for valves and fittings should be fixed in accordance with the manufacturer's instructions.

10. Valves used in the heating system with factory settings should correspond to the settings in the design documentation determined by hydraulic calculation

It is allowed to change the settings of the shut-off and control valves, determined by the hydraulic calculation in the design, if it is otherwise impossible to ensure the design flow in the circulation loops of the system.

11. Shut-off valves should be installed:

• to disconnect from each heat supply source;

• to shut off and drain the water of each system, separated loops, branches, instrument loops and risers (except for the risers of three storey buildings and lower).

• to shut off pumps (if necessary, to drain the water), heat exchangers, accumulation tanks, heat meters and other equipment, which requires shutdown during servicing;

• to shut off and draining the water of expansion tanks, except open ones.

6.9.2 Requirements for installation of boilers

1. Design has to foresee a boiler room for installation of boilers. It has to ensure installation of gas contamination sensor in the room, which should lead to boiler shut-off when CO_2 level in the air is exceeded. The necessary air exchange in the boiler room/container, should be organized according to current regulations.

2. When installing the boiler, it should not deviate in the vertical and horizontal planes.

3. Chimneys of boilers should be made of special high-temperature and acid-resistant materials.

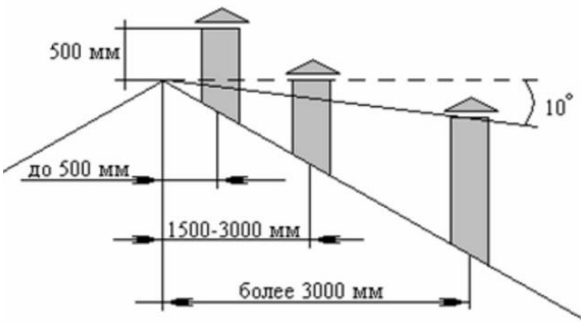
To ensure complete removal of combustion products, the height of the chimney above the roof should be above the boundary of the wind backwater (downwind) zone. The zone of the wind backwater of the chimney is considered to be the space below the line drawn at an angle of 45 ° to the horizon from the highest points near the located structures and trees.

In this case, the height of the chimneys is taken according to the results of aerodynamic calculation and verification of harmful substances according to the conditions of dispersion in the atmosphere and should be:

- not less than 0,5 m above the ridge or parapet of the roof at their location (horizontally) if not further than 1.5 m from the ridge or parapet of the roof;

- at the level with a ridge or parapet of the roof, if they are located at a distance of up to 3 m from the ridge of the roof or parapet;

- not lower than the straight line drawn from the ridge or parapet down at an angle of 10 ° to the horizon, with the chimneys located at a distance of more than 3 m from the ridge or parapet of the roof;



- not less than 0,5 m above the boundary of the wind back zone, if there are higher parts of a building, structure or trees near the chimney.

In all cases, the height of the chimney over the adjacent part of the roof should be at least 0,5 m, and for houses with a flat roof - at least 2,0 m.

The chimney should be protected from precipitation.

4. The boilers should be equipped with automatic weather compensation control with the ability to reduce the temperature during non-working hours. An external temperature sensor (installed

outside on the north facade) and a thermostat with a programmer located in the control room should be included in the design of weather-dependent automation.

6.9.3 Requirements to installation of thermostatic valves, adjustment and balancing of the heating system

- The heating appliance should be equipped with an automatic regulator of the room air temperature (thermostatic valve)

- The design of the automatic thermostatic valve must comply with the installation method of the heating appliance according to the manufacturer's requirements. For example, for a heating appliance installed in a niche, one should use an automatic thermostat with a remote temperature sensor outside the niche; and for a heating appliance installed behind solid decorative panel with slots or grill at the bottom and on the top, one should use a remote thermostatic element installed on this panel.

- For hydraulic balancing of the water system, regulating (balancing) fittings should be used, which ensure the method of hydraulic adjusting chosen during the design and specified in the design documentation.

- Adjustment of all manual and automatic shut-off and control valves (thermostats, connecting regulating headset, manual and automatic balancing valves, etc.), which are connected to the circulation loops of the heating system, shall be determined by hydraulic calculation, indicated in the design documentation and set. The settings for valves and fittings should be fixed in accordance with the manufacturer's instructions.

- Valves used in the heating system with factory settings should correspond to the settings in the design documentation determined by hydraulic calculation

It is allowed to change the settings of the shut-off and control valves, determined by the hydraulic calculation in the design, if it is otherwise impossible to ensure the design flow in the circulation loops of the system.

6.9.4 Requirements for the pipes thermal insulation

Requirements for the pipes thermal insulation were already presented in the Table 1 above!

6.9.5 Components of the automatic system for maintenance of set air temperature with the possibility of reducing the air temperature during non-working hours

The system of automatic system for maintenance of set air temperature with the possibility of reducing the air temperature during non-working hours should include the following main components:

1. Programmable Controller
2. Three-way mixing valve with actuator
3. Heat carrier temperature sensor
4. Outdoor temperature sensor
5. Indoor temperature sensor
6. Circulation pump/s with energy efficiency index EEI<0,27
7. Control cabinet

7 Safety and Health

In executing the work under this Contract, the Contractor shall provide working conditions for each operation that shall be as safe and not injurious to health as the nature of that operation permits. All the work shall be performed in accordance with applicable local and national laws, codes, requirements and regulations including safety, health, welfare of persons and others. The

Contractor shall in general be fully conversant and comply with the relevant sections of all construction regulations enforceable by the law.

The Contractor shall enforce all necessary rules and regulations for the safe execution of the work in order to avoid preventable accidents and to minimize injuries to his employees and those of other concerned entities. Working areas shall be adequately marked with warning signs and posters.

The Contractor shall, during the entire period of his operations on Site, provide emergency facilities with adequate medical and surgical equipment for first aid treatment and approved qualified personnel to administer such treatment to all injured persons.

8 Environmental Requirements

All works under this contract shall be executed pursuant to the Georgian Environmental Legislation and regulations.

Amounts of inert waste, non-hazardous waste and hazardous waste (including asbestos contained waste) would be produced due to the project implementation shall be estimated. Potential sites for disposing excess material (mud, soil, rocks) and construction waste shall be defined, brief description (including cadastral information) of suggested sites and information on nearest landfills for disposing asbestos contained waste in accordance with Rules and Norms for the Arrangement and Operation of Solid Waste Landfills (Governmental Decree # 421, August 11, 2015) shall be included in the detailed design documentation, if needed.

Detailed technical specification shall include instructions for safe management (removal, demolition, temporary storage, transportation and final disposal) of hazardous waste and toxic materials which includes but is not limited to asbestos, toxic paints, noxious solvents, removal of lead paint, etc if needed.

Costs for safe management of inert, non-hazardous and hazardous waste should be included in the project budget.

9 Required implementation schedule

The rehabilitation works may be implemented during various seasons of the year. Correspondingly the seasonal and annual working regime should be envisaged in the construction schedule of the Contractor.

Milestones	Deadline
Submission of the fist revision of the Design Documents to the Employer for approval	Not later than 1 months after signing the contract
Submission of the final revision of the Detailed Designs to the Employer (reflecting provided of Employer comments), as well as documentation needed for obtaining construction permit and obtaining needed independent expert approval;	Not later than 3 months after signing the contract
Obtaining of needed approvals from the relevant authorities and submission to the Employer of the approved Detailed Design	Not later than 4 months after signing the contract
Commencement of construction works of all objects	Not later than 4 months after signing the contracts
Completion of construction works for Rustavi Central Archive	Not later than 3 months after commencement of construction works

Completion of construction works for Public School # 1 in Kvemo Bolnisi	Not later than 5 months after commencement of construction works
Completion of construction works for # 32 Kindergarten in Rustavi	Not later than 6 months after commencement of construction works
Completion of testing, adjustment works and commissioning into operation of all objects	Not later than 1 month after completion of construction works

The Contractor shall provide the Implementation Schedule for Construction Works within the Detailed Design as Construction Organisation Plan.

10 Reporting

Each month the Contractor shall submit report in electronic form providing information about actual progress, discussing any significant deviations from the schedule and, if necessary, explaining the steps proposed to be taken to maintain the approved schedule. The Reports shall be supported by the photo materials to show the progress of the project and each feature thereof. Each picture shall bear the date and location together with a brief description of its content and purpose.

11 Required documentation verifying meeting the Employer's Requirements

As part of the tender proposal, the tenderer must provide the following documentation, which shall confirm compliance with the Employer's Requirements described above.

1. The Bidder must have valid Construction license with the Annex describing the all types of works required for implementation of the Project, as well as class of responsibility and complexity category
2. Valid Permits for the works performance of higher danger class and for the operation (use) of machines, mechanisms, equipment of higher danger.
3. Compliance certificates (confirming that the products meets the EN/ISO/IEC standards or CE marking), Quality Certificates for:

- Windows a[1]
- Insulation boards made of mineral wool and extruded polystyrene
- boiler equipment
- Main equipment of the weather-dependent automatic control system
- Heat recovery exchangers
- VFD electronic pumps
- Solar collectors' equipment for the DHW supply

[1] The thermal transmittance (U value) should be declared either:

as a U-value on the "CE-marking" according to the product standard EN 14351-1:2006+A1:2010+A2:2016 Windows and doors - Product standard, performance characteristics - Part 1: Windows and external pedestrian door sets. (the size of the window or door in question differs less than 10% from the size used in EN 14351-1)

or

calculated as U-value according to combination of EN ISO 10077-1:2017 Thermal performance of windows, doors and shutters - Calculation of thermal transmittance - Part 1: General (ISO 10077-1:2017), EN 410:2011 Glass in building - Determination of luminous and solar characteristics of glazing, EN 673:2011 Glass in building - Determination of thermal transmittance (U value) - Calculation method.

- Occupancy sensors on lighting

For the following products the compliance certificates will be required during contract implementation before delivery of the products on-site (in addition to products and materials stated above): insulation of pipes, windows accessories, ventilation equipment, automation control system equipment, façade paint, fire protection solutions for wooden structures, roofing materials, waterproofing and vapour barrier materials, reinforcing fiberglass mesh, pipelines of the heating system, heating radiators, thermostatic valves, LED lamps (if used)

4. The manufacturer whose materials and equipment are proposed should have ISO 9001 certification.
5. Manufacturer Authorization in accordance with the Form 8 of Section III “Tender Forms” is required for the following materials and equipment, provided that they are applied in the project:

1) Windows and doors

2) Engineering equipment for buildings:

- Boilers
- Heat pumps
- Solar water heaters
- Ventilation units