VOLUME 3

TECHNICAL DESCRIPTIONS, SPECIFICATIONS

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GENERAL CONDITIONS FOR CONSTRUCTION

Technical documentation

The construction works can be done only based on the same technical documentation that was used for obtaining the construction permit.
The documentation shall be done in accordance to all relevant planning regulations and based on all required approvals.
The Contracting Authority shall provide sufficient number of copies of technical documentation and put them at the disposal for the contractor and construction supervisor. One set of technical documentation enclosed by all verifications and approvals, bound and sealed, shall be kept at the construction site for the construction works consistence-monitoring purposes.
The technical documentation done abroad can be used only upon technical inspection by a company licensed for production of relevant documentation.
Before the construction works commence, the contractor shall timely and comprehensively survey relevant technical documentation and warn the Contracting Authority of all possible shortcomings or request explanations in due time.
The warning/explanation is considered issued/requested in due time if to the Contracting Authority, according to the circumstances, is given sufficient time to act upon the request without causing delay in the construction works.
The Contracting Authority has the obligation to act upon the request of the contractor and submit written explanation of the technical documentation in due time.
The Contracting Authority does not have such obligation if the documentation is provided or produced by the contractor.
The Contracting Authority does not have the right to amend technical documentation or equipment anticipated therein.
Should the contractor perceive any shortcomings in the technical documentation or feel it should be amended, either to improve it or for other reasons, the contractor shall inform the Contracting Authority duly.
If the perceived shortcomings endanger safety, health, traffic or adjacent facilities, the contractor shall put all further works on hold until the rectification measures are taken.
If the Contracting Authority does not immediately rectify shortcomings they have been informed of, the contractor shall inform the construction permitting institution and the relevant inspection board.
The Contracting Authority has the right to amend the technical documentation defining the construction works.
If the amendment is done after the construction permit is issued and if it influences the purpose, construction, equipment, environment or the stability, functionality, dimensions or appearance of the facility, the Contracting Authority shall request alteration of the construction permit.

Other obligations of the Contracting Authority

The Contracting Authority shall hand over the sufficient number of copies of technical documentation and the original (or photocopied) construction permit to the contractor.
This delivery is registered in written in the construction log.
The Contracting Authority shall give data of the contact person in written to the contractor.
The Contracting Authority shall provide access to the construction site and issue all relevant documentation.

Obligations of the contractor

The contractor has the obligation to appoint the company representative and the construction manager and inform the Contracting Authority and the supervisor.
This piece of information is a part of the documentation submitted for technical acceptance.
The contractor shall arrange accommodation for workers, as well as sanitary facilities.
The contractor shall arrange warehousing and safekeeping of for the tools, material and equipment.
The construction manager shall make records of the workers that work on the construction site daily, and to file it with the construction supervisor and the construction logbook.
The contractor shall take all safety measures, protecting the building and works, equipment and material, workers, passers-by, traffic and adjacent buildings.
The contractor has the obligation to secure the construction site, the workers and the material.
The contractor shall provide internal control protecting the construction site in accordance with the provisions given in these conditions and in accordance with the technical documentation, standards, regulations and norms and Supervision instructions.
The contractor shall provide adequate chemical, technical and fire protection measures and file a separate report to the construction supervisor.
The contractor shall keep construction logbook entering all important information and agreements with the designers and supervisors.
The logbook shall be kept at the construction site at the disposal of the construction supervisor.
The contractor shall draft the timeline of the construction works, and bring it inline with the timelines of other contractors if any.
The contractor shall synchronize the position of installations with all other installations in order to avoid collision and unnecessary additional works.

Material and work quality

The contractor shall use material and equipment in line with standards, or, if there are no standards in place, attested by an organization licensed for material and equipment quality control.
If necessary, the contractor shall perform adequate examination of the material.
If the examination methods are not defined by the technical documentation or regulations, they shall be defined by the contractor and approved by the Supervision.
Examination costs are covered by the contractor.
The contractor has the obligation to warn the Contracting Authority of observed lacks of material or equipment defined by the technical documentation and oversights of the material and equipment procured or ordered by the Contracting Authority.
The aforementioned lacking or faulty material and equipment can be used only if the Contracting Authority, having been warned of the overnights, insists so and if their use does not put in question the stability of the facilities, lives of people, adjacent buildings, traffic or environment.
The provisions in the BoQ and Technical Specifications concerning types and manufacturers are given only for technical reference.
The contractor may use material and equipment of the equivalent or better quality and is responsible for its use.
If the contractor does not abide to the technical documentation defined in the contract, technical regulations and standards, or professional regulations, the Contracting Authority has the right to request suspension of further actions, or to require use of the material and equipment of adequate quality.

If adjacent buildings, lives of people or the construction design hit self is brought in danger by actions different than the ones defined in the relevant documentation, the Contracting Authority has the right to have the contractor demolish the completed parts of the design and do it over again in the appropriate way at the contractor's expense.
The contractor shall provide proof of the quality of the material and equipment used and works completed and to allow control by the Contracting Authority.
If such control implies disclosing certain parts of the design or making certain openings, it shall be done at the expense of the Contracting Authority, including the costs of all additional works that become necessary.
All findings of the contractor and Contracting Authority are recorded in the construction logbook.
In case there are some discrepancies between the findings of the contractor's and the Contracting Authority's control, additional joint control shall be performed at the expense of the party whose findings are not confirmed.
The contractor shall issue written verification that the works are completed in accordance with the technical documentation, regulations, standards and norms.

Material and equipment procured by the Contracting Authority

If the contract between the Contracting Authority and the contractor anticipates that the equipment and material installed by the contractor is procured by the Contracting Authority, the contractor has the obligation to store and maintain the said material and equipment until its installation.

Bearing risk

Until the design is completed and the building handed over to the Contracting Authority, the risk of accidental damage and destruction of the works, material and equipment is born by the contractor.
The Contracting Authority bears risk of accidental damage and destruction of the material and equipment they procured until they are handed over to the contractor.
After the design is completed and the building is handed over, the risk of accidental damage and destruction is born by the Contracting Authority.

Construction supervision by the Contracting Authority

The Contracting Authority has the right to supervise the works in order to check their quality and provide that they are done in an orderly manner, especially in sense of type, quality and quantity of works, material and equipment, as well as contracted timeline.
To perform construction supervision, the Contracting Authority has the right to access the construction site, workshops and warehousing space.
Construction supervision is done by an expert entity, individual or organization, licensed for those activities, identified by the Contracting Authority, who shall inform the contractor on the identity of the supervisor in written.
The contractor shall enable construction supervision.
Construction supervision for the contractor or the Contracting Authority, or the company licensed for construction supervision, shall be done by the supervisor under the contract with the contractor, the Contracting Authority or the company licensed for construction supervision.
The construction supervisor has the obligation to submit written remarks on the way the works are done, material and equipment used immediately when observed to the contractor, which shall then be recorded in the construction logbook.

The construction supervisor shall monitor relevant attestations, proficiency certificates of the contractor's employees, attestations of the machinery, and to record all observations in the construction logbook.
The construction supervisor has the obligation to sign (verify) the construction logbook regularly.
The contractor shall act upon all justified requests of the Contracting Authority in terms of construction supervision.
The construction supervisor is not allowed to amend the technical documentation of the construction design, contracted price or other provisions of the contract, or to negotiate on any additional works or property-rights relations with the contractor, unless authorized to do so by the Contracting Authority.
The Contracting Authority shall provide the contractor the address and contact information of the construction supervisor.

Final works

Upon the completion of the project as whole or its parts that can be treated as economic and technical units and used independently, it is necessary to perform all necessary examinations and functional tests, and before their use, technical examination shall be performed to verify technical correctness of the completed works.
The request for the technical examination is submitted by the Contracting Authority or the contractor to the responsible construction-permitting agency.
The technical examination may commence after the construction supervisor gives positive evaluation.
The contractor shall produce designs for all works that include all possible alterations of the technical occurred in the course of the construction.
The contractor shall present the complete documentation, in order and with verification, to the technical acceptance board.
Contents of the documentation depend on the nature of the works done.
This documentation and the designs of the completed works shall be handed over to the Contracting Authority.
The contractor shall provide complete instructions for handling installations and equipment used in the design to the Contracting Authority.
The contractor shall abide with all provisions set put in the Technical specifications or in the description of the items in the BoQ or in other textual parts of the design.

Notice to bidder on Control and Approval of artistic works by the Head Conservationist

The restoration of the Sarajevo City Hall, listed as a National Monument, is an emblematic project for the Donor's Financing Agency, the BiH Central and Local Authorities and the People of BiH and Sarajevo in general.

Beside structural and related technical lots special attention and care will be requested from the Contractor(s) when restoring the main interior spaces of the building and in particular for traditional multilayer mortar, mouldings and decorative paintings.

To that effect the Designer has prepared a comprehensive documentation including 1/10 scale drawings to be enlarged at 1/1 stencils for decorative paintings elements and detailed drawings for all mouldings to be executed.

Furthermore some artefacts will have to be replicated on the basis of saved samples and to a limited extend from original drawings from the XIX° Century.

The implementation of these works will require a sound level of expertise on these issues within the Contractor's management staff and workers on site.

This is reflected in the bidding documents and requirements.

The bidder shall also note that for all interior finishing works including mouldings and final colours of the decorative paintings, and in general for all matters related to the restoration and architectural integrity of the building, a visa from the Head Conservationist will be required.

The Head Conservationist will be appointed by the public authorities, according to the rules of BIH, and will liaise with the Supervisor during the implementation of the Works.

Notably the Head Conservationist will give his agreement on all colour samplings prior to start of Works, composition of the paintings and mortars.

The Head Conservationist will not interact directly with the Contractor.

All the activity subject to artistic approval will be organized well in advance and with the coordination and approval of the Supervision on the timing and method of execution.

GENERAL CONDITIONS

FOR CONSTRUCTION AND CRAFT WORKS

These conditions for construction and craft works are a part of the construction design drafted based on the works estimate for the building.
The works anticipated includes all actions designed by the designer aimed at the finalization of the building and its use by the Contracting Authority.
All construction works defined by these conditions will be done in accordance with the approved designs, details and valid technical regulations.
All works, equipments and plants have to meet the highest standards of quality.
The building will be handed over to the Contracting Authority as complete and ready for use, all premises and the construction site have to be cleared of all waste material and rubble and cleaned.
All accessory facilities, remaining material and soil are to be removed outside of the construction site.

Unit price of works includes:
preparatory works, material, labor, transportation and loading, storage, delivery, installation, dismantling and removal of construction machinery, scaffolding, waste material for performing the works, any eventual civil work needed for fixing installing localizing or setting equipments and installations, any ancillary work or material or device also if not specifically mentioned in the BoQ as a separate item, cleaning inside the building and outside, removal of rubble and waste material to a landfill outside of the town, temporary water supplies, sewerage, electric power and telephone installations, building security, safety of workers and other elements of the construction site in accordance with work safety and fire protection regulations, all state benefits and taxes, profit and utility costs necessary for the construction design.

Warranty period for all works is two years upon the technical acceptance of the building, unless specified otherwise for certain components of the design.

110. EARTHWORKS

Before the commencement of earthworks, the terrain will be cleared of all bush wood, weeds and trees that obstruct the placement of the building.
These works, together with measuring and dividing the land plot, marking the terrain for the building and foundations are included in the unit price of the works and, as such, cannot be charged separately.
Excavations will be done according to blueprints, at the anticipated depth, with leveling of the base and sides, with necessary planking and strutting in line with work safety regulations, and with excess water pumping.
In case mining is necessary, the contractor will implement protection and safety measures according to relevant regulations, which is included in the unit price.
Excavation to a defined depth will be completed before the construction of the foundations commences.
If the excavated pits get damaged, slide down or choke up, the contractor will repair the damage.
The level of the building can be raised only by healthy soil, compressed by machinery to the sufficient level of compactness.
The gravel used for the floor ballast and stone foundations should also be healthy.

All excess material and soil which is not necessary for the building will be removed from the construction site.

120. CONCRETE WORKS

Concrete, reinforced concrete and steel-bending works will be done with sufficient proficiency, of high quality material, in line with the static estimate, form and reinforcement plans, and in line with JUS standards – Book of Regulations for Concrete and Reinforced Concrete.
Compressing will be done well, in 15 cm layers.
Free fall altitude for the concrete will not exceed 1 m in order to avoid concrete segregation.
Before the concrete works commence, the excavations, forms and reinforcement bars will be approved by the construction supervisor, registering this approval in the construction logbook.
The board forms will be sufficiently firm, supported, wet, in the correct position and flat. The board forms and planking will not be removed before due time, depending on the span.
The date of their removal will be entered in the construction logbook.
Concrete compressing by machinery, immersion vibrator or boards; manually only for MB 10.
After the board form is removed, “nests” should not remain.
The concrete is to be maintained by sprinkling water three times a day in summer, and with protection against the cold in winter.
Board form, planking and scaffolding removal depends on the approval by the construction supervisor.
Further concrete works will continue according to regulations.
Three sample cubes of concrete will be taken out of each of the important parts of construction in presence of the construction supervisor ad sent to the institute for testing and materials.
The result of these tests will be entered in the construction logbook and the attestation is presented to the technical acceptance board.
Unit price of the concrete includes board forms, window and door forms, gutter and drain pipe forms, forms for installations and fittings, planking and heavy scaffolding.
Board forms are made according to the measures given in the blueprints, of class 4 boards or adequately thick exterior type plywood.
Board forms are supported by the adequate number of strutting pillars and planks.
They will be removed carefully, without shaking and damaging construction, only after the approval of the construction supervisor.
Scaffolding and planking are made of class 2 wooden beams or steel pipes, connected by reinforced links and stiffeners, boards sheeted and nailed.
Before it is put up and used, the scaffolding has to be approved by the construction supervisor.
The scaffolding will be made and installed in accordance to the work safety regulations.

Materials and JUS standards:

Cement	- JUS.B.C1.010, 015 and B.C8.020
Aggregate	- JUS.B.B8.030-048
Steel	- JUS.C.K3.020
Concrete	- JUS.U.M1.012
Lumber	- JUS.D.C1.041
Nails	- JUS.M.B4.021
Form	- JUS.K.M4.500, M.B1.151 and M.B2.021

Book of Regulations for Concrete and Reinforced Concrete

130. BRICKWORK AND BLOCKWORK

Stock bricks, V-bricks and other blocks will be laid in clean lines, with straight links.
Joints will be filled by mortar, courses horizontal, and mortar in clamps not thicker than 1 cm.
Any excess mortar will be removed by trowel. 1.5 cm in the outside joints will be left unfilled to link mortar, walls and vertical pillars.
Before lying, bricks will be wet, and when cement mortar is used, soaked in water.
Openings for water supply, sewerage and central heating installations will be anticipated in time.
Separation walls made of ½ bricks are connected to the massive walls by bonding bricks, and holes are left in the massive walls for bonds to be put in to link the ¼ separation walls. Closing openings for the installations in the walls and ceilings is included in the price and cannot be charged separately.
Lime is prepared without lumps, cold and left to sit for at least 15 days for bricklaying, and 30 days for mortaring.
Hydrated lime is prepared according to the instructions given by the producer.
Bricks with salty stains cannot be used, and if it appears, it has to be cleaned with brushes and 1:10 muriatic acid solution.
Door and window frames should be well secured, depending on the installation method, and the space between them and the walls filled by polyurethane foam.
When the walls are dried, they are sprinkled with water and then plastered in mortar, one layer of coarse mortar and the other in fine.
Plastered surfaces will be flat and edges sharp.
Unit prices include finishing around the ceramic skirting, stone or other similar material and cannot be charged separately.

Materials and JUS standards:

Bricks	- JUS.B.D1.011
Modular clay blocks	- JUS.B.D1.020
Lime	- JUS.B.C1.020
Sand	- JUS.B.D8.039
Cement	- JUS.B.C1.010 and 020

200. DAMP PROOFING

Damp proofing will keep precipitation water from coming in even in the strongest shower or snow-melt.
Insulation will be laid according to designs, descriptions, details and other technical documentation, with a 5-year warranty period by the contractor.
In case such warranty cannot be given, the contractor's offer will include solutions for which warranty can be given.
Before the hydro insulation is installed, all construction, trade and other works will be completed and their quality examined, as it may influence quality, duration and safety of the hydro insulation.
Hydro insulation material and work is accepted by the Contracting Authority, and work is performed in front of the construction supervisor.

The price is calculated per 1 m2 of the actually insulated surface; rolled hydro insulation material is unrolled and included in the calculation.

Materials and JUS standards:

Technical conditions for desk roof insulation - JUS.U.F2.024

210. SHEET METAL WORKS

All works that precede tin works have to be brought to a phase that allows the tin works to be done under normal conditions.
Steel parts that touch galvanized or zinc sheet metal have to be galvanized or protected in another appropriate way.
In the places where sheet metal touches concrete, the concrete is covered by bituminous sheets or the sheet metal is painted in minium paint, which is included in the unit price.
Trimming wider than 50 cm is tightened by screws and plastic links.
Metal sheets are connected in double folds.
Measure, divide and nail tin links to the surface and lay tin strips.
Edges of moldings, windowsills and trimming are finished in double folds, with sufficiently wide eaves.
Trimming wider than 50 cm should be fixed in the center as well.
Trimming should be lean heavily against the surface.
Roof surfaces covered in sheet metal or eaves without gutter should have 3 cm folded edge, removed by 4 cm from the wall.
Gutters longer than 15 cm should be dilated.
Gutters are fixed to the wall by sheet metal hooks, made 35/4 mm sheet iron, fixed 1 m apart.
Link between the gutters and eaves is made as single clink.
Depth of the gutters is 0.5 - 1 %.
When the works are completed, the building site will be cleared of waste material.
Window sills are folded up the window frames by 4 cm and fixed by nails 2 cm apart.

Materials and JUS standards:

Galvanized sheet metal	- JUS.C.B4.081
Zinc sheet metal	- JUS.C.E4.020
Sheet metal	- JUS.C.E1.141
Nails	- JUS.M.B4.020

230. FACADES

The surface will be flat, coarse enough, firmness according to the requirements of the type of finishing, clear of lime, stains, grease or paint and other dirt.
Base layer has to bind well to the surfaces that are treated and tough enough to accept the final layer.
The final layer should bind well for the base layer.
Fine mortar blend, either ready made or mixed at the spot, should be combined of tested ingredients of stone grains, binder and light-resistant paint.
Ready made blends will be used without any other ingredients but water.

This stands also for artificial stone in sense of color permanence, grain size and binder (cement). Quantity, size and color of stone grains will be defined by the designer.
All treated surfaces will be flat, vertical, or horizontal, slanted and curved if necessary. Profiles and corners will be sharp, exactly matching the form anticipated by blueprints. Facade works cannot be done in bad weather that may influence their quality.
The scaffolding will meet all work safety regulations.

Materials and JUS standards:

Technical conditions for facade works - JUS.U.F2.010

250. TILING

Wall surfaces will be covered in tiles evenly and vertically, without any waves, bulges or holes, with even and sufficiently wide joints.
Horizontal joints run uninterrupted along all walls in the same room, and vertical ones are done by plumb-line, either alternating or continuing.
Finishing rows, corners, protruding parts are covered in round-edged tiles.
Floor surfaces will be covered in tiles horizontally, without waves or bulges, horizontal or slanted if necessary, with even and sufficiently wide joints.
In areas where tiles are set in form of mosaic, for esthetic reasons joint may be omitted, but it has to be explained in the description of the detail.
When the tiles are set, joints will be treated in adequate watertight material.
In places where installation pipes and grids are protruding, tiles should be precisely cut and set.
Setting ceramic tiles is done in two ways: in cement mortar and in tile-setting adhesive. The walls where tiles will be set in cement mortar have to be vertical and rectangular to one another, unless otherwise specified by the design.
Walls are sprinkled in cement mortar made of 1:1 sieved 4-8 mm gravel.
Elevation of the prepared walls will provide space for 2-2.5 cm base.
The floors where the tiles will be set in cement mortar have to be clean and flat, with the elevation providing space for a minimum 2 cm base.
For tile setting under special conditions, with extra resistant tiles, watertight mortars and acid-resistant putty, the whole procedure require special treatment.
The wall surface should be flat, firm and clean, vertical and rectangular, unless otherwise specified, with elevation providing space for 6-8 cm base (depending on the thickness of tiles and layer of adhesive).
When tiles are set, the floor is washed 24 hours later it is covered by cement milk and cleaned.

Materials and JUS standards:

Technical conditions for ceramic tiles setting	- JUS.U.F2.011
Quarry (non-glazed) floor tiles	- JUS.B.D1.310, 320, 322 and 335
Glazed floor tiles	- JUS.B.D1.305, 306, 450 and B.D8.052
Glazed wall tiles	- JUS.B.D1.300, 301, 450 and B.D8.052

260. MASONRY

All stone woks will be done with sufficient proficiency, qualified labor, with good quality material, necessary tools and machinery, in accordance with the design, details and designer's instructions, as well as the provisions of the "Book of regulations on technical measures and conditions for final works in construction" - SFRJ Official Gazette, nr. 49/70.

The stone used has to be healthy, it cannot originate from surface deposits and cannot have visible cracks and fissures.
The stone used in places exposed to wear and tear, such as floors and stairs, besides physical, chemical and mechanical qualities required for all stone used, has to have a good coefficient of wear and tear, which is attested prior to installation.
Unit price includes procurement, transportation, installation, removal of waste material, replacement of damaged elements or elements of poor quality, and protection and storage until the design is handed over.

The material used will be of good quality and meet valid regulations and the following standards:

Stone slates	- JUS.U.F1.210
Stone	- JUS.B.B0.001 to B.B6.020

320. PAINTING

The surface for all painting and varnishing works has to be clean of dust, resin, grease, oil, rust, soot, bitumen, etc.
Only dry and prepared surface may be painted.
Painting and varnishing will be done professionally.
Finishing coat has to cover the surface completely, cannot show brush traces and the color has to be even, without stains.
Lines have to be straight and even.
Water paint, white lime and emulsion paint will adhere to the surface, without cracking or pealing.
Dispersion and plastic coatings have to be light- and water-resistant even past the declared shelf life.
T
he contractor will provide three samples of shade and technique for each type of paint.

Materials and JUS standards:

Technical conditions for wall painting	- JUS.U.F2.013
Technical conditions for varnishing	- JUS.U.F2.012

450. ELOX ALUMINUM (anodicaly inactivated aluminum) WINDOW & DOOR HARDWARE

Aluminum window and door hardware is made of elox aluminum profiles, outside with interrupted thermic bridge, and inside without interrupted thermic bridge, as described for each item individually.
The contractor will keep to the blueprints and details approved by the designer for all positions.
All works will be done with top quality, without visible seams, and with full function.
All window and door hardware is dry installed blind frames made of rectangular steel profiles with anti-corrosive protection.

The contractor will install all window and door hardware protecting the building from elements permanently.
Hardware is of top quality, selected by the planer.
Glazing is done according to the description of each position.
Unit price includes production, shipment, installation, filling gaps between positions and walls by polyurethane foam, and for external positions by permanent elastoplastic putty, production and installment of blind frames, production and installation of 2 mm elox aluminum sheet window sills, glazing according to the description of each position, attestation of hardware and other works necessary for normal functioning of each position. The color of elox aluminum will be selected by the designer.
The contractor has the obligation to double-check all measures and number of frames before commencement of the works.

RENOVATION OF PLASTERED SURFACES

All wall surfaces without plaster and parts of knocked off plaster should be neutralized with appropriate means on places where there are traces of broken out salt saltpeter.
The main spray is made of building lime, natural pozzolana (sandy volcanic ashes) and sand with surface coverage of 75%.
Plasters are renewed in two layers according to original composition of plaster.
The main layer is lime cement plaster with natural components (sand, building lime, hydraulic additions) that by its quality meet conditions of applicable standards.
Besides main components, pad mortar has to be steam permeable, hydrophobic and adherent for old walls.
Due to danger of salt breaking out from old walls that were exposed to rain additives are added to mortar in order ensure porosity of mortar and stop braking out of salt.
Pressure solidity should be between 1,5 to 2,0 N/mm².
It is performed in multiple layers to the total thickness of 6,0 cm.
Fine lime mortar graded up to 1,0 mm for finishing interior walls will be made of natural components, building lime and sand.
Pressure solidity should be up from 1,0 to 1,5 N/mm².

Mortar molding

All horizontally pulled moldings and friezes are done on prepared wooden substructure with basic lime cement mortar in multiple layers and pulled finishing molding in gypsum lime mortar that is sprayed in one layer 10 to 25 mm thick.
Next layer shall be placed wet on wet surface to the required thickness and obtaining planned section (finishing smoothing surface).
Horizontal ceilings (ceilings and spherical surfaces) are done on prepared substructures in the same described manner.

Gypsum works

One-row-woven reed (building gypsum) is white from grey color, with higher or lower contents of water within $CaSO_4$ x 2 H_2O, but mainly semi-hydrate, was used for rough gypsum works (wall plastering, attic and pulling out of cornices) and after it was added to lime mortar for expediting hardening.
Modeling gypsum – composition and characteristics as building gypsum, but whiter smaller grinded was used for finishing gypsum works and casting ornaments.
Alabaster gypsum, composition and characteristics as building gypsum but clear white color and smaller grinded than modeling gypsum was used got fine finishing gypsum works and casting ornaments and figures.
According to literature solvent water or alum (calcium-aluminum sulphate) could be added to gypsum mortars for the purpose of slowing down uniting and increasing solidity of mortar as well as slaked lime powdered due to increasing solidity of plaster.
Most likely slaked lime powdered was added on City Hall because there are no indications on performed polymerization with thinner.
Anyway material for casting ornaments and figures was comprised of alabaster and modeling gypsum with ratio 1:3 without sand.
All specified prefabricated gypsum cornices and decoration details are done in accordance to given drawings, placed on given position with zinc iron anchors in gypsum mortar.

Linear gypsum decoration elements prepared for building in will be placed on given positions in gypsum mortar.
Plaster on which painted layer remains are found is in the form of especially bad quality (Report from the Institute for Materials and Construction from the Civil Engineering Faculty in Sarajevo).
After the research works are completed on the painted layer, and documented, this portion of plaster for the most part is proposed for removal with additional rehabilitation of missing plaster surfaces and preparation for artistic painting.
Rehabilitation of horizontal partly preserved wreath and arcade on three walls of the main staircase with remains of painted layer with triangles above the arcade are subject for specialized conservation reparation, which is addressed in the work description.
The wall at the top of the stairs toward the gallery whose decorations are completely destroyed will be rehabilitated in full in accordance with provided drawings, and in detail in accordance with preserved originals.
Existing iron lowered ceiling is protected with anti-corrosive material during previous works.
Final color is anthracite opaque.
According to the original drawing, stain glass case was made in glass with colored motifs. Original fragments are not preserved.
According to the original drawing in the ration 1:20 and detail 1:20, glass is made as work of art according to provided types of decoration and size if the glass with permanent colors for glass along the backing process up to 600 ˚C. Glass is 4 mm thick.
After the backing process, glass needs to become tile (safety glass) Glass is placed in the existing iron frame with colorless silicone.
Colored application is on the bottom
Development of test samples is obligatory in the ratio 1:1, according to types and motifs and in accordance to provided orientation colors in detail, which need to be approved by the designer.
Basic construction of the lowered ceiling is made out of twofold spuca construction, dimensions 8/8/57cm I class, moist up to 12%, fixated with steel joints and bolts for performed reinforced cement plafond.
Twofold construction which is hung is jointly connected with spuca boards 2 x 2,4/8 cm.
On the basic construction board lining thick 2,4 cm is covered with reed and lath.
Primary plaster is submissive and final processing in cast limestone plaster.
Wooden sub-construction, bearer of cast decoration, is made along edge walls out of vertical pine poles 8x8 cm per gap of 72 cm, which is fixated with steel knots and bolts to the edge walls.
Profile cross-section is made in the wooden construction according to the provided details.
Profile is covered with board lining.
Final cast stalactite row is made as assembled and fixated on prepared sub-construction. After the assembly of joint between elements they are closed with the cast.
Horizontal pulled decorative wreath Type 1 is performed on prepared wooded surface lined with reed and lath.
Submissive limestone plaster is primary plaster, and final layer is cast limestone plaster processed in final in pulled profile.
On the South side of the Ceremonial Hall part of the original wreath is preserved which is being restored
Horizontal wreaths Type 2 and type 3 are completed as assembled cast drainage which are placed on the provided positions with anchors in cast plaster.
New cast line elements are made as assembled and form cassette fields together with existing line elements which are restored.
Cassette fields which are preserved are restored with final layer of cast limestone plaster, and new fields on submissive limestone cast plaster which is also processed in cast limestone plaster.

Frieze of decorative cast arcades on the gallery follow the ceremonial hall along the attic gallery, which is most probably open for visitors.
One part of the arcade is partially opened (attic gallery) and one part of arcades is blind (on the wall parts).
One part of frieze of the upper part of the arcade is preserved and serves as the basis for the development of design.
The basic construction is composed out of wooden skeleton of arcade together with parapet which is lined with poured cast elements (base, pillars, capitols, arcade lining). Parapet is completed on the wooden construction and lined with cast plaster (all elements are painted which is visible from the preserved detail on the remains).
The special touch in the hall gives the decorative portal on the East and West side with decoratively processed horizontal beam whose ends lower to the vertical wall pillar, continuing with ends that are completed in poured assembled pillar in the shape of muquarnas.
Portal is developed in wooden construction which is hung for reinforced cement beam with final processing in cast.
Preserved cast –plastic elements in the shape of muqarnas are restored.
Ceremonial Hall is oriented toward the South where ceremonial balcony is located with decorative pillars and stone fences.
Ceiling is decorated with floral paintings with final cast horizontal wreath. Ceiling is repaired in wooden sub-construction with final processing in cast limestone plaster and horizontal wreath whose original segment is preserved in the facility itself.

CITY COUNCIL HALL

Damaged remains of plaster on the walls are removed, new plastering is performed with submissive limestone plaster, refined plaster and limestone coat.

WATER SUPPLY SYSTEM AND SEWAGE

1.1. GENERAL

The facility is located between Kulina Bana Street, Telali Street and Brodac Street in Sarajevo and consists of

Basement	floor on point 545.885
Ground floor	floor on point 549.385
Gallery	floor on point 553.365
I floor	floor on point 556.975
II floor	floor on point 561.455
Attic	floor on point 565.055

Pipeline design has been done based on the Terms of Reference, architectural-engineering basis, Land Records Office for underground utility systems, inspection of the building (filming) and consultations with other phases of the design.
All floors have sanitary groups and hydro systems except for the attic area where only one air condition unit is placed.
Sanitary units are mainly located one above another (vertically) on all floors and are thus connected with vertical shafts where vertical pipelines for water supply system and sewage are placed.
All vertical sewage and rain drainage pipelines are directed into the basement floor and connected to the outer infrastructure in the shortest way possible.
The whole building is connected with gravity to the city sewage and rain drainage system except air handling units on point -5.20 and sprinkler units on point -5.10 which are placed below rain drainage level.
In these areas water can occur from air handling units or sprinkler systems which can be then pumped out into the rain drainage network through a pump system.

1.2. WATER SUPPLY SYSTEM

1.2.1. Connection of water supply system

It has been anticipated that, for sanitary and fire extinguishing purposes, the building will be connected to the existing water supply network Ø200 mm, pressure 3.5 bar and depth 1.20 m below the existing terrain on the road in front of the building in the Telali Street. Connection for the purposes of sprinkler system is anticipated in the Kulina Bana Street. The accepted section for the connection is ϕ100 mm. dimensioned for the fire extinguishing purposes Q=7.5 l/s. and for the sanitary waters in the building ϕ =1.96 l/s. The accepted section for the sprinkler system is ϕ150 mm.
Water supply network from connection to the water meter must be made of ductile pipes ϕ 100 mm. and ϕ150 mm.
On the connection spot a street valve of ϕ100 mm and ϕ150 mm has been anticipated along with the street cap.
Water metering unit has been anticipated for sanitary, fire extinguishing and sprinkler system.
Bill of Quantities for the sprinkler system anticipates works from the connection to the water meter including the water metering device.

1.2.2. Water system scheme in the building

Water supply system shall be done in accordance with DIN 1988 regulations.
Water supply system must be made of galvanized steel zinc coated pipes IS 1239 DIN 2440-2444 and threaded fitting DIN 2980-2982.
A common connection has been anticipated for fire extinguishing and sanitary water; for the quantity 7.5 l/sec for fire extinguishing and 1.96 l/sec for sanitary water.
Connection pipe is brought into the building below the staircase to the water metering units where water meters for fire extinguishing and sanitary water are placed.
Water meter for sanitary water is ϕ40 mm and for fire extinguishing water ϕ80 mm. Further on the water is directed into the plant for increase of pressure for sanitary and fire extinguishing water.
Water supply system is laid into the floor until it reaches vertical shafts where it will be placed properly in the construction beside the heating and air condition systems, without jeopardizing the existing decorations.
Water system in sanitary areas will be placed in the wall next to the sanitary facilities.
All vertical pipelines will have valves with drain cock.
Access to the valves is enabled by inspection openings with inox door. Valves with nickel-plated cap have been anticipated on all the spots where sanitary system splits from vertical cold and hot water system.
Insulation of cold and hot water pipes must be done accordingly to the installation place and pursuant to the applicable standards.
Visible pipes or those that are placed in installation shafts must be insulated with steam impermeable Armaflx or similar insulation, wall pipelines must be insulated with felt band and pipelines in the floor must be insulated with a layer of mineral wool with protective aluminum foil.
Places where pipes pass through the walls and ceiling must be insured with tubes.
After that, fire proof packing must be laid which will prevent fire from entering.
The outer walls will be protected from entering of underground waters.
Fastening of pipeline must be done with original ring-shaped holder on proper girders on the wall and ceiling.
Under each ring holder a rubber or cork ring must be placed.
Metering of water consumption will be done through water metering units placed within the building, separate units for sanitary, fire extinguishing and sprinkler systems according to the conditions prescribed by the KJKP Vodovod i Kanalizacija (Water and Sewer Public Utility).
Based on the hydraulic calculation and required pressure as well as the pressure anticipated in the city water supply system, a compact device for increase of pressure with frequency regulator has been anticipated.
Pump plants will be placed in separate rooms below the staircase landing.

1.2.3. Preparation of hot sanitary water

Hot water preparation for sanitary facilities (shower baths and wash basin) and the kitchen will be done through central boiler which will be placed on the ground floor.
Boilers for hot water preparation will be addressed in the machine installation design.

1.2.4. Fire extinguishing system

The building is protected from fire from three sides with the existing underground hydrants Ø80 mm which are connected to the existing water supply system Ø200 mm, placed nearby the building.
For fire protection, inside the building, a special Ø80 mm ring-shaped hydrant installation is anticipated in the basement floor leading to the vertical pipelines with wall hydrants which are placed with proper distance between each of them.
Hydrant cabinet has dimensions 50x122x20cm with valve Φ2", trevira pipe Φ52, length 15m and nozzle Φ52/12mm.
With each hydrant two fire extinguishers are anticipated, S9 and CO2-5 type, which serve for manual fire extinguishing.
A dry line is also anticipated with an outer hydrant which contains a suitable connection for connection of fire-fighting truck. Fire extinguishing system must be made of galvanized steel zinc coated pipes IS 1239 DIN 2440-2444 and thread fitting DIN 2980-2982. with prescribed insulation.
Pipeline must be fastened to the walls and ceiling with original ring holder on suitable girders.
Under each ring holder a ring made of rubber or cork must be placed.
Based on hydraulic calculation and required pressure of 2.5 bar on the highest hydrant and pressure in the city network, a compact device for pressure increase has been anticipated.
The device must have three pumps.
Pump plants must be placed in separate rooms under the staircase landing and must be provided with continuous electricity supply.

1.3. SEWAGE AND RAIN DRAINAGE SYSTEM

1.3.1. Connection

External water drainage network is separated into the sewage (sewerage) system Ø500 mm and rain drainage MZ50/75 and MB 75/135.
The design anticipates construction of sewage street collector Ø300 mm in Brodac Street which will be connected to the building from one side and reconstruction of the existing network in Telali Street to the connection to the existing collector Ø500 mm.
On the existing network a shaft must be constructed on to which the building will be connected.
Connection for the rain drainage water will be done in three spots, two connections on the existing shafts in Brodac street and one connection in Telali street with reconstruction of the existing network to the connection on the existing rain collector in Kulina Bana street. External water drainage system in front of the facility (sewage and rain drainage) must be done with Hobas pipes or equivalent, and the connection of the building to the street collectors must be done with ductile pipes with sleeve and fitting parts. Installation of fitting parts has been anticipated on all connections according to the regulations prescribed by K.J.K.P. Vodovod i Kanalizacija, Kanalizacija (Sewage) department.
On the outputs of sewage and rain drainage systems from the building, concrete inspection shafts with low water channels have been anticipated.
Concrete shafts on sewage and rain drainage systems are of the same dimensions; internal diameter is Φ90 cm or 90x90 cm with built-in frame and cover Φ600mm and ladders.
Rain drainage shafts must have perforations for ventilation.
The whole building is connected with gravity to the city utility system except air handling units on point -5.20 and sprinkler units on point -5.10.

Note: Prior to commencement of construction of main water drainage pipelines, the exact position and depth of the existing collectors must be checked, and based on that the pipeline fall must be determined.

1.3.2. Sewerage system from the building

Drainage of waste water must be done in accordance with DIN 19522 system of iron cast SMU pipes EN 877 ISO 9001-2 with appropriate fitting parts, connected by CV connection joint and rubber packing.
Connection of the sewerage system to the city network must be done with ductile pipes, pursuant to conditions prescribed by K.J.K.P. Vodovod i Kanalizacija public company.
On the beginning of sewage and rain drainage vertical pipelines the cleaning/inspection opening must be constructed just above the floor. In the places where vertical pipelines are walled up, the inox door with frame must be made for purpose of access to the cleaner openings. Short lines to the sanitary devices must be connected with iron cast pipes and fitting parts, sealed with rubber packing.
Ventilation caps made of copper tin and placed 50 cm above the roof will serve as ventilation of water drainage vertical pipelines.
Sewerage system will be placed in shafts and will be directed out of the building in the shortest way possible in the basement area.
Places where pipes pass through the walls and ceiling must be insured with tubes, and then packed with fire-resistant packing in order to prevent fire from entering and to prevent underground waters from entering through outer walls.
Pipeline must be fastened to the walls and ceiling with original ring holder on suitable girders.
Under each ring holder a ring made of rubber or cork must be placed.
Outside the building shafts have been made for the purpose of inspection and maintenance of sewage system.
Waste water drainage from the kitchen is done through the same pipes as the sewage. Connection to the sewage system must be done outside the building through oil and grease separator.
Ventilation of kitchen waste waters is done through facade in the ground floor level.
All sanitary intersections must contain floor gulleys with damper for preventing unpleasant odors from entering.
They must also contain a grid for holding of hydro insulation.
The grille must be made of non-corrosive material.
Everything that has not been described here can be seen in the drawings.

1.3.3. Rain drainage system

The design anticipates drainage of snow and rain from the roof by collecting it in the collective container placed under the building roof.
From the container the water will be drained through iron cast vertical pipes Φ200 mm to the connection shafts outside the building.
Installment of electrical heaters (which will be addressed in the electrical installations design) is anticipated on all horizontal gutters.
Rain drainage vertical pipelines are drained below basement floor with ductile pipes to the outer rain system collector.
Cleaning devices are anticipated above the floor at the bottom of rain drainage vertical pipelines.

In the places where vertical rain drainage is being walled up an inox door must be made for access to the cleaners.
Potential waters from the basement air handling units, substations, pump stations and water meter are connected to the rain drainage system.
Drainage from the front road is not addressed in this design because the existing streets have street gulleys.
Places where pipes pass through the walls and ceiling must be insured with tubes, and then packed with fire-resistant packing in order to prevent fire from entering, and to prevent underground waters from entering through outer walls.
Pipeline must be fastened to the walls and ceiling with original ring holders on suitable girders.
Under each šelne a ring made of rubber or cork must be placed.
The design anticipates that the potential water from air handling unit and sprinklers which are lower than the city water drainage system will be pumped out to the rain drainage system.
Pump stations are automatic in cases when water enters into collection shafts.

1.4. SANITARY DEVICES, FITTINGS AND HOLDERS

Sanitary facilities in the building must be first class facilities made of white sanitary ceramic.
Toilet bowl must be white, wall-mountable of Villeroy Boch type or equivalent with toilet seat and toilet cover.
Flush tank must be of build-in type with Viega type or equivalent sub construction for front-of-the wall mounting and two-volume button for flushing placed on the side.
Wash basins must be ellipse-shaped, Villeroy Boch type or equivalent, dimensions 55x46cm with sub construction, nickel-plated S water trap Φ32mm and standing one-hand tap, with angle valve and rosette Hansgrohe or equivalent .
Shower bath is a drainage element with water trap of 90x90cm dimensions with facing for lining and sliding door, inox frame filled with ground glass.
Shower tap is wall-mountable one-hand type with hand shower handle Hansgrohe or equivalent and wall holder which can be moved.
Urinal must be Villeroy Boch type or equivalent with sub construction with hidden water trap and electronic valve for flushing.
Kitchen equipment is part of the kitchen.
Water tap is one-hand with extended outlet and angle valve Hansgrohe or equivalent. Water trap for the sink must be two-part type made of PVC Φ40mm with valve Φ15 with connection for dishwasher.
Shelf-cabinet must be made of ceramic, dimensions 60 cm, white color.
Mirror must have dimensions 60x90cm with holders.
Toilet paper holder must be made of inox, as well as the toilet brush dish.
Toilet and the wash basin for people with special needs must be of the same producer as the anticipated sanitary facilities.
Along with toilet bowl and wash basin the holders for toilet for invalids must be Villeroy Boch product or equivalent.

TECHNICAL CONDITIONS FOR EXECUTION OF WATER AND SEWERAGE INSTALLATIONS

PREVIOUSLY TAKEN MEASURES

Before the works on installation start, the location needs to be visited and checked, in order to produce a work plan necessary due to the specificity of the building and ongoing work.
The contractor has the obligation to stick to the approved design, and to compare the installation design with the actual situation on the location and discuss all issues with the supervisory body before starting the work.
Before any changes, the contractor has the obligation to inform the supervisory body on the anticipated changes in due time.

LAYING PIPES

The contractor has the obligation to verify all elevations in the designs against the actual situation on location and enter modifications.

When constructing sewerage network, the first step is to construct the connection to the line in the street, then the basic network and in the end vertical lines with branches. All horizontal water supply lines are placed with an angle, slanting towards the lowest outlet.

This is especially sensitive if there are more such places.

Change of direction of pipes will be done using arches, not elbows.

Bending galvanized pipes must not be done either in cold or in warm state.

The pipes will be placed in the walls vertically, at right angle.

PIPES IN THE GROUND

All pipes under ground are laid in a layer of sand that surrounds the pipe at lease 5 cm on all sides.
The bottom of the trench should be covered with a thick layer of compressed sand. Humus, debris, construction material and rocks must not be used to cover the trenches.
Pipes may be laid in the trenches after the supervisory body decides that the trench was dug in line with the regulations and the design.
The trench must not be covered until the supervisory body inspects the pipe and the installation.

PIPES IN THE CONSTRUCTIONS

Pipes must not be built into walls and other constructions firmly.
Openings for passage of pipes through constructions must be large enough, and space between the pipes and constructions filled with plastic material to avoid damaging the pipes.

Before passage through constructions, water supply pipes shall be protected with protective pipe, of a diameter 40 mm larger than the outer diameter of water pipe, with space filled with hemp in bitumen or elastic putty.
Sewerage pipes must not be built into walls firmly, but should pass through space filled with moist clay or hemp in elastic putty, if there is risk of leakage into the building.
Any openings in walls and other constructions that is unanticipated by design has to be previously approved by the supervisory body.

PROTECTION OF PIPES

Water supply pipes must not pass through walls of chimneys and ventilation shafts, under toilet floors or sinks, or any other places where they can be exposed to dirt, freezing, heating and corrosion.

In places where they cross, they are to be protected, and laid in such way that the water supply pipe goes over the sewerage pipe, with space between filled with a 20 cm layer of compressed clay.

If it is not possible to allow for such distance, water supply pipe is to go through a protection pipe, in the same way as it is done when passing through walls.

In places where there is risk of freezing, the pipes should have thermal insulation. Special attention should be paid when putting insulation, and lines are not to be closed until inspected by the supervisory boars.

The same goes for sound insulation. Insulation damaged during construction has to be repaired carefully.

If works need to be interrupted temporarily, the pipes should be closed not to get dirty, filled with material or damaged.

LINKS

Links between two pipes or pipes and fixtures must be done with special care.
At places where they are connected inner diameter must not be limited by remains, pieces of fixtures, hemp, tern or in any other way, or deformed when the pipe is bended.
Links are sealed by compressing hemp and pouring melted lead or by rubber gaskets. Links of galvanized pipes are sealed by hemp and putty that must not contain lead oxide or any other hazardous material.
Ceramics or asbestos-cement pipes are sealed by hemp or asphalt putty or rubber gaskets.
Lead pipes are linked by soldering, and plastic pipes by gluing or rubber gaskets. Linking pipes in walls, ceilings and other constructions should be avoided.

FIXING PIPES

Pipes should be fixed to walls and ceilings by hangers, at distances depending on diameter or type of pipes.
Lead and plastic pipes in heated rooms should be fixed to firm surface in their full length.

FIXTURES

Water fixtures can be installed only after being inspected in the workshop.
Installation of fixtures is done precisely, with easy handling and esthetics in mind.
Outlets, mixers and other fixtures that are handled should be fixed to walls by wall tiles.

SANITARY ELEMENTS

Sanitary elements must be installed neatly, cleanly and precisely, with easy handling and esthetics in mind.

Sanitary elements must be fixed to walls using plastic or metal fittings.

Console elements should be able to maintain 100 kp of force at the least favorable place.

Heights of sanitary elements, if not differently defined by design, measured from the final floor, are the following:

- sink, front edge	80 cm
- shelf above the sink	125 cm
- mirror, to the middle	155 cm
- towel holder	75 cm
- wall outlet	110 cm
- kitchen sink	85 or 90 cm
- toilet flusher tank, bottom	200 cm
- toilet flusher tank, low hung	100 cm upper edge
- toilet paper holder	80 cm
- wall hung urinal, front edge	65 cm

INSTALLATION INSPECTION

Prepared, but without insulation and uncovered installation network has to be examined (porousness and functioning).
Water supply pipe network – unless otherwise defined by regulations – is put under trial pressure twice as high as working pressure, at least 15 kp/cm^2, for 30 minutes. Sewerage network is examined by pouring water with temporarily closed openings and outlets.

Examination is done in presence of the contractor, supervisory body and representative of the public waterworks/sewerage company, and recorded in form of minutes.
Examination is done at the expense of the contractor.
Only after successful examination, the pipes can be insulated and trenches/shafts closed.

OBLIGATIONS OF THE CONTRACTOR

It is the contractor's obligation to remove all malfunctions that are discovered in the defined timeframe at their expense.

Supervisory body can take over the costs only of the used material.
Any material that the supervisory body finds unfitting or inappropriate must be removed from the construction site immediately.
The contractor has the obligation to construct the whole installation in cooperation with other stakeholders.

OVERVIEW OF APPLIED REGULATIONS AND STANDARDS

1. Legal regulation on succession and implementation of Federal laws implemented in Bosnia and Herzegovina as Republic laws (Official Gazette R BiH nr. 2/92)
2. Legal on confirmation of law regulations (Official Gazette R BiH nr. 13/94)
3. Legal regulation on implementation of the Law on spatial organization at the time of war or immediate war emergency (Official Gazette R BiH nr. 16/92).
4. Legal regulation on protection at work at the time of war or immediate war emergency (Official Gazette R BiH nr. 16/92).
5. Legal regulation on standardization (Official Gazette R BiH nr. 13/93).
6. Legal regulation on measurement units and measuring devices (Official Gazette R BiH nr. 14/93).
7. Law on spatial organization (Official Gazette SR BiH nr. 9/87).
8. Legal regulation on amendments to the Law on spatial organization (Official Gazette R BiH nr. 25/94)
9. Law on fire protection (Official Gazette SR BiH nr. 15/87), Law on amendments to the Law on fire protection (Official Gazette SR BiH nr. 36/90).
10. Legal regulation on amendments to the Law on fire protection (Official Gazette R BiH 13/93).
11. Law on protection at work (Official Gazette SR BiH nr. 22/90)
12. Law on technical standards for fire hydrant network (Official Gazette SFRJ nr.30/91)
13. Law on spatial organization Sarajevo Canton Official Gazette nr. 7/05.

ELECTRO INSTALLATION

1.2. GENERAL

Design was carried out on the basis of:
design task
annotations and suggestions from the concept design revision report
annotations and suggestions from the expert assessment (inspection and testing the lightning installation)
architectural and civil engineering
requirements from other design phases
current technical regulations, recommendations and standards.

design solutions:
- electro-energetic feeding as follows:
- basic feeding from the substation
- reserve feeding from a diesel aggregate plant, including the plant.
- Uninterruptible power supply from the system of continuous voltage (UP.S.) including those systems

Primary electro-energetic distribution in the building as follows:
- conduit run setting
- distribution boards
- feeding cables

Electro installation distribution as fallows:
- lighting installation (general, necessary and "panic")
- general purpose socket installation
- installation for connection of thermic and technological equipment.
- el. installations for thermo-hydro technical systems
- installation for horizontal gutter heating
- potential equalization installation
- central monitoring and management system
- lightning protection and grounding

Design includes installations from the connection point in the building (main distribution board, marked as **GRB**). From that distribution board to the shaft in front of the building, route for in-coming cables are elaborated.

NOTE: the new power sub-station including his location, construction, equipment, and testing-commissioning is NOT part of this tender.
The Municipality of Sarajevo will provide the building of the City Hall of the electrical power trough the local electrical company which will be in charge of constructing the power substation.
The contractor will not be responsible for the construction and putting in function of this sub-station as of the relevant works to install appropriate ducts transporting the energy to the building.
Any eventual reference in the BoQ or in these TDS regarding the power sub-station shall therefore not be considered since is there for information only.

1.3. EL.POWER FEEDING AND MEASURING

NOTE: Cross sections of power supplying cables are estimated. Real cross sections must be determined within executive design, after definition of equipment. Cables for power supply of electrical control cabinets and cables outside air handling unit areas are specified in electrical installation design.

El. power feeding will be done, according to previous electro energetic agreement, from the distributing substation TS 10/0,4 kV MALI BRAVADŽILUK (0347) 1x630kVA
As a reserve source of power feeding, a diesel aggregate is foreseen, placed in a room in the basement of the building.
For the equipment that can not suffer any power supply breaks (computer equipment), uninterruptible power supply devices (U.P.S.) are foreseen.
These devices are distributed through the building and joined with their functional units (city - library)
Electrical power consumption will be measured in the substation, on the high voltage side, with an appropriate measuring set.
Since the building will have at least two functions (city - library), some catering facilities are foreseen (restaurant, café-pastry shop). Controlled measuring of power consumption of these users is foreseen in the design as for the whole building.
Controlled measuring will be done through power measuring transformers, and the data will be processed through the system for central monitoring and management.

Basic electro energetic data are:

NETWORK FEEDING				
installed power	Pi	=	924,3	(KW)
simultaneous factor	fi	=	0,4	
peak load	Pv	=	369,7	(KW)
voltage	U	=	380	(V)
expected power factor	cos fi	=	0,95	
expected currency	I	=	592,0	(A)

Of which important consumers (that will be supported by the diesel aggregate) use:

AGGREGATE FEEDING				
installed power	Pi	=	356,3	(KW)
simultaneous factor	fi	=	0,5	
peak load	Pv	=	178,2	(KW)
voltage	U	=	380	(V)
expected power factor	cos fi	=	0,95	
expected currency	I	=	285,3	(A)

1.4. DISTRIBUTION BOARDS

All distribution boards in the building should be made of 2x pickled steel tin, colored with hard lacquer.
Boards are, depending on their size and mounting position, foreseen as freestanding closets built in their niches, and as closets mounted on or in a wall.
Protection level is marked on their single – pole diagrams, and it must be respected.
Boards should be made as multinational, with separate parts for each system (network part, aggregate part, UPS etc.) as shown on the single-pole diagrams.
Every section must be equipped with a door and a key (same key for all boards in the building), and battery cases connected with the protection bus bar in them.
Because every board will be equipped with fire alarm sensors, there should be no compartments in the board that could prevent the sensor from detecting heat or burn products.
Elements of protection and managing installation elements should be built in the boards according to the single-pole diagrams.
Equip the boards with appropriate sigh tiles, danger signs, single-pole diagrams and manufacturer attests.
Boards have three bus bar systems:

NETWORK BUS BARS
fed by the distribution network

AGGREGATE BUS BARS
fed from the distribution network and alternatively from the diesel aggregate

U.P.S.
Fed from uninterruptible power supply devices

For the purpose of realizing the foreseen distribution system (TN-S system), equip the boards with 5-rail system of bus bars.
Do not connect zero and protection bus bar.
Connecting and grounding of zero and protection bus bars will be done only in the main distribution board and is not allowed later in the installation.
In front of the distribution boards place attested electro isolation carpets, and in the space where the distribution board is set, place a fire extinguisher CO2-5.

1.5. CONDUIT RUNS

To secure conduit runs for cable fitting (where the concentration of feeding and installation cables is big), a system of cable shelves and parapet canals is foreseen, and they are placed according to the design.
Cable shelves are perforated carriers, width 100 - 300mm and depth 50mm made of galvanized steel sheet.
They are fixed to the construction by corresponding mounting equipment, so that it's "front" side is left open for the insertion of cables.
Parapet canals (two-parted, metal) are placed along parapet walls and provide a simple and flexible distribution of installation cables and a functional organization of connecting points.
One part of the canal is used for distribution of electro energetic cables (220V), and the other communication network cables.

While placing cable shelves and parapet canals, it is necessary to achieve good galvanic connections on the places of mutual element connection, in a way that each section represents a unique galvanic unit.
Units formed in that way, for the purpose of potential equalization, are then connected to a protection bus bar in the corresponding distribution board.
On every 15-20 m along the conduit run, as well as on all passing between floors and fire sectors of the conduit run, it is necessary to make protection from fire spreading by adding an incombustible coat (FLAMASTIK, LIMPET, JUMPET or equivalent)

1.6. DISTRIBUTION OF POWER AND INSTALLATION CABLES

Installation in the building is realized with cables PP00 (feeding and command – signal cables) and PP-Y (installation distribution) and PP00-Y-TG (hardly flammable) for all elements of fire protection system.
Cables are mounted as fallows:

- In cable shelves and parapet canals on sections where conduit runs are prepared
- On sling brackets (3 pcs/m) in suspended ceilings. All distribution boards in that case are set beneath the line of suspended ceiling so that they are approachable when the ceiling is mounted.
- Along the brick walls and division walls, cables are fit in installation pipes of corresponding cross section.
- Part of the installation for floor connection boxes are run through the floor. In that case the cables are inserted into installation pipes of corresponding cross section.

1.7. LIGHTING INSTALLATION

General lighting is foreseen in all rooms and realized with appropriate luminaries.
Type and kind of luminaries is adjusted to the given conditions on the site and interior demands.
Part of the lighting fittings (chandeliers, wall lamps in the state room and Great Hall, wall lamps on the stairways, lighting in the museum area, part of facade lighting lamp, etc..) are not defined in this part of the design.
These lighting fittings are included in interior design design where they will be explained in detail.
This design includes suitable outlets for these luminaries.
On the designs, every bulb position carries a sign of the lighting fitting, according to which the mounting is done.
Part of the lighting in the building (c.c.a. 30%), are connected (in the distribution boards) to bus bars of aggregate voltage, so in the case of network power failure, they switch to aggregate feeding.
That lighting is considered as necessary lighting.
Except for general lighting, there is also "panic" lighting realized with luminaries fed from a local source (Ni-Cd accumulators).
In the case of power failure, the luminary is automatically switched on and luminaries fed from the accumulator.
When the power is connected again, the lamp is switched off and the accumulators are recharged by a built in charger.
These luminaries are placed in hall ways and exits, and they show the closest way out of the building.

LIGHTING CONTROL

Controlling the lighting of common rooms and communication will be done through the system of central monitoring.
Lighting in other rooms will be controlled locally, by switches mounted in the rooms.

1.8. INSTALLATION OF CONNECTORS AND OTHER CONSUMERS

For connecting different mobile consumers that can appear in the building, a sufficient number of mono-phase sockets are foreseen place as given in the design.
Sockets in the building can be separated in two groups:

- Sockets connected to working stations
- Service sockets

For working places, there are connection points with two sockets supplied by network power, and two sockets supplied by uninterruptible power supply (UPS).
For correct using of interruptible power, sockets connected to it should be in red color.
Service sockets are basically connected to aggregate power bus bars.
For technological equipment, appropriate outlets are foreseen and they are brought to the place where plant equipment is set, and to their control boards.
Micro location of the ports needs to be adjusted to the equipment on the site.
For the needs of thermo- technical equipment of catering facilities (restaurant café-pastry shop) adequate outlets are foreseen in corresponding distribution boards.
Further distribution needs to be adjusted on the site with the equipment disposition and its connection points.
For the needs of thermo and hydro technical system equipment, appropriate outlets are foreseen according to data form designs of those systems.

NOTE:
For certain rooms, where electro installation distribution depends largely on interior design, (state room, city council room, mayor and chairman of the council office, museum, restaurant, café-pastry shop), the given distribution plan must be adjusted with interior design requirements.

1.9. HORIZONTAL GUTTER HEATING INSTALLATION

For the purpose of maintaining the horizontal gutters passable, an installation is foreseen for heating the gutters, realized with heating cables, power 36W/m (220V), and suitable connecting and mounting material.
Heating cables are placed directly in the gutters so they are in direct contact with ice and snow (they should not be placed beneath the roof or covering material).
In the case of parallel lying of two cables, it is necessary to make sure that they are separated about 10cm and prevented from crossing and touching.
Use appropriate distancers and place them 1-2m from each other.
On the passages beside vertical gutters, insert the heating cables in those verticals up to the garret zone.
Controlling the heaters is automatic, through a regulator (2 pcs), placed in distribution board RB-G-T.
Control system is built of:

- regulator

- humidity and temperature sensor placed in the gutter

Gutter heating control system is autonomous, and sends status information to the central monitoring system.

NOTE:
This work depending from his particularity (internal and external installation) must be coordinated with the external works eventually in progress.
In case of the presence in site of others contractors dealing with works not part of this contract the Contractor will organize the works and related activities in coordination with such contractors and with prior approval of the supervisor.

1.10. PROTECTION AND POTENTIAL EQUALISATION

Protection from dangerous touch voltage is foreseen as a system of breakers with a special protection conduit (TN-S system).
Because of that, all feeding and installation cables have a special strain (yellow-green color), at the end connected to metal masses of devices that are not a part of a current circuit, and protection pin on schuko sockets.
In distribution boards, these strains are connected to a separate bus bar (protection bus bar), and in the main distribution board GRB that bus bar is connected to zero bus bar and grounded.
Connection of protection and zero bus bar is done only in the main distribution board and is not allowed later in the installation.
Besides that sanitary knots also have a potential equalization installation.
All metal masses in the toilets (toilets, drains etc.) are connected with conduit P/F 6 mm2, through box PS-49, with a protection bus bar in the corresponding distribution board.
Cable shelves and parapet installation canals, formed as galvanic units, are connected with conduit P/F with a protection bus bar in the corresponding distribution board.
In that way all metal masses in the building are leveled to the same potential (zero potential) and users are protected.
Protection from overload and short circuit is foreseen with automatic breakers and wire fuses.

1.11 CENTRAL MONITORING AND MANAGEMENT SYSTEM

The foreseen system of monitoring and management is based on elements of EXCEL 5000 product of the “Honeywell" company but depending from the provider of the contractor and upon acceptance of the Contracting Authority any other equipment of same or better quality and functionality provided from a high quality factory reputed as provider of such type of equipment may be accepted after formal approval by supervisor.
Monitoring center of the system is placed in the technical monitoring room on the ground floor, and the substations of the system are distributed along distribution boards in the building.
The system provides:

- monitoring and controlling the lighting in common rooms
- monitoring electro energetic consumption of the building
- monitoring and controlling garage ventilation system
- monitoring and controlling other common functions in the building (fan coil units, floor heating etc.)

Installation is realized with command-signal cables of adequate capacity for connection between operational elements (assemblers) and substations of the system CNU, and cable LiYCY for the connection between substations of the system CNU and monitoring center.

Signal list is enclosed:

CENTRAL MONITORING AND MANAGEMENT SYSYTEM SIGNAL LIST					Signal path
RB-G-T	DI	DO	AI	AO	
Lighting above dome decorative glass (ON/OFF, status)	3	3			RB-G-P (CNU -substation 1)
Chandelier above central stairway (ON/OFF, status)	3	3			RB-G-P (CNU - substation 1)
Signalisation from gutter heating regulator (status)	2				RB-G-P (CNU - substation 1)
RB-G-II-3					
Ventilation convectors (ON/OFF, status)	1	1			RB-G-P (CNU - substation 1)
RB-G-I-3					
Gallery lighting (ON/OFF, status)	3	3			RB-G-P (CNU - substation 1)
Façade illumination (ON/OFF, status)	3	3			RB-G-P (CNU - substation 1)
Ventilation convectors (ON/OFF, status)	1	1			RB-G-P (CNU - substation 1)
RB-G-M					
Ventilation convectors (ON/OFF, status)	1	1			RB-G-P (CNU - substation 1)
RB-G-P					
Stair way lighting (ON/OFF, status)	1	1			(CNU - substation 1)
Official entrance lighting (ON/OFF, status)	1	1			(CNU - substation 1)
Lighting poles on the central stairway (ON/OFF, status)	2	2			(CNU - substation 1)
Great Hall lighting (ON/OFF, status)	4	4			(CNU - substation 1)
Entrance hall lighting (ON/OFF, status)	3	3			(CNU - substation 1)
Entrance porch lighting (ON/OFF, status)	1	1			(CNU - substation 1)
Façade illumination (ON/OFF, status)	1	1			(CNU - substation 1)
Ventilation convectors (ON/OFF, status)	1	1			(CNU - substation 1)
PS-1					RB-KU; RB-G-P (CNU - substation 1)
Hydro plant of faecal canalisation (status)	1				RB-KU; RB-G-P (CNU - substation 1)
RB-KU					
Façade illumination (ON/OFF, status)	1	1			RB-G-P (CNU - substation 1)
Ventilation convectors (ON/OFF, status)	1	1			RB-G-P (CNU - substation 1)
RB-B-II					
Ventilation convectors (ON/OFF, status)	1	1			RB-B-P-2; RB-G-P (CNU - substation 1)
RB-G-I-2					
Gallery lighting (ON/OFF, status)	3	3			RB-B-P-2; RB-G-P (CNU - substation 1)
Ventilation convectors (ON/OFF, status)	1	1			RB-B-P-2; RB-G-P (CNU - substation 1)
R-B-M-2					
Ventilation convectors (ON/OFF, status)	1	1			RB-B-P-2; RB-G-P (CNU - substation 1)
RB-B-P-2					
Great Hall lighting (ON/OFF, status)	4	4			RB-G-P (CNU - substation 1)
Stairway lighting (ON/OFF, status)	2	2			RB-G-P (CNU - substation 1)
Floor heating of Great Hall (ON/OFF, status)	1	1			RB-G-P (CNU - substation 1)
Ventilation convectors (ON/OFF, status)	1	1			RB-G-P (CNU - substation 1)
TOTAL CNU-substation 1	48	45			
spare	4	4	4	4	
OVERALL TOTAL SUBSTATION 1	**52**	**49**	**4**	**4**	

RB-G-II-1					
Ventilation convectors (ON/OFF, status)	1	1			RB-RA (CNU- substation 2)
RB-G-I-1					
Gallery lighting (ON/OFF, status)	3	3			RB-RA (CNU- substation 2)
Façade illumination (ON/OFF, status)	3	3			RB-RA (CNU- substation 2)
Floor heating of state room (ON/OFF, status)	1	1			RB-RA (CNU- substation 2)
Ventilation convectors (ON/OFF, status)	1	1			RB-RA (CNU- substation 2)
RB-B-M-1					
Ventilation convectors (ON/OFF, status)	1	1			RB-RA (CNU- substation 2)
PB-B-P-1					
Great Hall lighting (ON/OFF, status)	4	4			RB-RA (CNU- substation 2)
Floor heating of Great Hall (ON/OFF, status)	1	1			RB-RA (CNU- substation 2)
Ventilation convectors (ON/OFF, status)	1	1			RB-RA (CNU- substation 2)
PS-2					
Hydro plant of faecal canalisation (status)	1				RB-RA (CNU- substation 2)
PS-SV					
Hydro plant of sanitary water (status)	1				RB-RA (CNU- substation 2)
PS-PV					
Hydro plant of fire water (status)	1				RB-RA (CNU- substation 2)
AGGREGATE					
Plant status	1				RB-RA (CNU- substation 2)
GRB					
Measuring el. power consumption			21		RB-RA (CNU- substation 2)
TOTAL CNU-substation 2	20	16	21		
spare	4	4	4	4	
OVERALL TOTAL SUBSTATION 2	**24**	**20**	**25**	**4**	

SOURCES OF DANGER AND FORESEEN PROTECTION MEASURES

1. SOURCES OF DANGER

Usage of electric power (during construction and exploitation of the building) certain dangers are present, and they occur because of:
Unskilled and poor handling
Accidental touching powered parts
High touch voltage
Big voltage drop in the installation
Overheating elements of installation caused by overload and short circuit current
Static electricity appearance
Unfavorable environment conditions (humidity and dust)
Inadequate lighting
Atmospheric discharge

2. PROTECTION MEASURES

Unskilled and poor handling

This potential danger can not be totally avoided, but it can be minimized with good work organization, staff education (especially personnel involved in building and installation maintenance), and issuing handling manuals.
All distribution boards, according to the design, must have visible signs warning of electrical power dangers and the danger of electrical shock.

Accidental touching powered parts

This potential danger can not be totally avoided as well.
Current technical regulations suggest, and this design foresees, that all parts powered parts must be appropriately protected and unapproachable with adequate tools or a key.
All distribution boards are equipped with a lock and key.
Cable connection in them is done with adequate clamps, and the powered parts are adequately protected from accidental touch.
Cable branching is done exclusively in distribution boards.

High touch voltage

High touch voltage appears with errors and damages that lead to connecting phase conduits with cases of devices and equipment which results with the appearance of dangerous voltage on them.
For the purpose of eliminating this danger, the design includes a protection system with a separate protection conduit (TN-S distribution system).
Because of that, all feeding and installation cables have a special strain (yellow-green color), at the end connected to metal masses of devices that are not a part of a current circuit, and protection pin on schuko sockets.
In distribution boards, these strains are connected to a separate bus bar (protection bus bar), and in the main distribution board GRB that bus bar is connected to zero bus bar and grounded.
Connection of protection and zero bus bar is done only in the main distribution board and is not allowed later in the installation.
Besides that sanitary knots also have a potential equalization installation.
All metal masses in the toilets (toilets, drains etc.) are connected with conduit P/F 6 mm2, through box PS-49, with a protection bus bar in the corresponding distribution board.
Conduit runs realized with cable shelves (formed in a way that each section represents a separate galvanic unit), with conduit P/F 6mm^2 are connected to a protection bus bar in a corresponding distribution board.
Ventilation and heating system pipes, cooling system and gas distribution pipes, form galvanic units by bypassing all connection points in those systems.
Formed galvanic units are than connected to a protection bus bar in the corresponding distribution board.
That way all metal masses in the building are leveled with protection conduit potential (zero potential), so in the case of connecting phase conduit with them, a jumper reacts and the circuit where the error occurred is shut off.

Big voltage drop in the installation

Voltage drop occurs as a result of electric power flow through installation cables.

Too big voltage drop causes incorrect function of devices which leads to damage.
Permitted voltage drop are regulated with current technical regulations, and the design foresees cables that secure that voltage drop does not go under critical value (see voltage drop and short circuit calculation)

Overheating elements of installation caused by overload and short circuit current

Overheating of elements occurs because of:

a) overload
b) short circuit current

This danger is avoided by choosing appropriate protection elements (jumpers, protection automatic)

IN OVERLOADS
currents that occur are not significantly larger than nominal current, so this overload will last for a while and at the end protection elements will activate and turn off the circuit that is overloaded.
Reaction time depends on the scope of the overload

IN SHORT CIRCUIT
currents are significantly higher than nominal current, so the protection elements will react immediately, in other words in a time period less than 0,4sec-for single-pole circuit and 0,2sec-for inter phase short circuit (see voltage drop and short circuit calculation).

Static electricity appearance

Static electricity occurs as a consequence of mutual friction of non-conducting elements in certain conditions (because of high voltage that fallows and spark discharge) can be a source of danger.
Because there are no processes in the building that lead to collecting big amounts o0f static electricity, no special protection measures are foreseen.
If eventually static electricity should appear (synthetic floor covering etc.), it will discharged by protection conduit system, foreseen for high touch voltage protection.

Unfavorable environment conditions (humidity and dust)

Humidity and dust have a negative impact on installation elements.
Humidity leads to corrosion, and dust to reducing distances between powered parts which can result with short circuits and power breaks.
Danger from unfavorable environment conditions is avoided with the right choice of protection level in distribution boards and the choice of equipment.

Inadequate lighting

Inadequate lighting has a negative influence on the atmosphere in a room, and the working capabilities of people working in that space.
Design includes lighting of all spaces in the building, and it is done according to defined professional lighting technical recommendations.

Atmospheric discharge

For protection from atmospheric discharge, the building has a lightning protection installation, made on the principle of Faraday cage – THIS WORK IS NOT PART OF THIS CONTRACT.

3. FIRE

Electric power can be the source of fire, in the case of improper installations and unskilled and poor handling.
For detecting fire in its initial phase, the design foresees a fire signaling installation with automatic (smoke and thermal) and manual notification devices, placed on chosen places to identify heat and burning products as fast as possible.
Information about fire emerge is seen on fire alarm central station, and it is passed on to fire alarm sirens and to a fire station or to building protection service.
Fire extinguishing apparatus (CO2-5kg) is foreseen beside each distribution board.

PROCEDURE WHEN FIRE ALARM OCCURS ON FIRE ALARM CENTRAL STATION

In the case of activation any of automatic notification devices (fire or false alarm)
- activation of sound and light signals on central station
- previously set pre-alarm time stars to run (time T1)

Person on duty is obliged to confirm signal reception and go to the signaled location. Confirmation of signal reception leads to:
- shutting down the sound signal in the central station
- pre-alarm time reset (time T1)
- inspection time starts running (time T2)

If alarm signal reception is not confirmed (person on duty is not present), after pre-alarm time runs out (time T1), system automatically goes in to alarm stage:
- alarm sirens are activated according to previously defined protocol
- alarm signal is forwarded to a fire station

If the person on duty determines that there is no fire on the signaled location (false alarm), the staff member returns to the alarm central station and resets the system (back to pre-alert state).
If the person on duty determines that it is a real fire, he/she activates the nearest manual notification device, and the system unconditionally goes into alarm state.
If the person on duty does none of the above, the system goes into alarm state, when inspection time runs out (time T2).

ELECTRO INSTALLATIONS

GENERAL

- Electrical installation must be realized according to the plan and technical description, and any thing that is not included in this design must be done according to current technical regulations for these kinds of installations.
- Contractor of electro works must keep a construction log. All communication on the site, between the Supervisor and the Contractor is done through the log. Before starting installation works, check civil engineering works, write a report in the log and confirm that there are appropriate conditions for realizing installation works.
- Civil engineering works must be in the phase that enables normal and uninterruptible realization of electrical installations. All regulations on protection on the site must be respected.
- All material used in electro installations must be top-quality and correspond to current regulations and standards.
- When the material is brought to the site, the supervisor will check it and determine the state of the material in the construction diary. If the contractor uses other material that is not suitable, on the demand of the supervisor, that material must be demounted and appropriate material must be used.
- All works must be top-quality and according to the professional norms. Anything that is not done according to these standards must be later corrected on the contractor's expense.

DISTRIBUTION BOARDS

- All distribution boards should be fabricated or high quality workshop handiwork, made of steel tin, appropriately protected and colored with the hard lacquer.
- Boards should be equipped with proper doors with a unified lock and key (same key for all of the distribution boards).
- Level of board protection should be IP-40 to IP-54 (shown in single-pole diagrams).
- Boards are (depending on conditions at the place of the installation) freestanding, built-on-top or built-in case.
- If the batteries are freestanding or built-on-top cases insertion of all cables should be done through corresponding cable insertions with correct sealing.
- If the batteries are built-in cases cable openings should be closed after the cables are laid so that needed level of protection is provided.
- In the case when one board supplies two or more systems or logical entities of the structure, boards should be multi-partial and every part should be equipped with a separate door with a lock and key.
- Because every board will be equipped with fire alarm sensors, there should be no compartments in the board that could prevent the sensor from detecting heat or burn products. .
- All boards should foresee c.c.a. 20% of the free space for the eventual equipment upgrade.
- TN-S feeding system will be used in the building, so it is necessary to place separate zero and protection bus bars.
- All equipment, which is to be installed in the boards, must be new, first class quality and a product from one of the known manufacturers of that equipment

- Equipment in the boards should be labeled with appropriate and noticeable signs. On the distribution boards, place their signs and warning signs, and in the boards place their single line diagrams in a plastic cover.
- All powered parts must be properly protected from accidental touch contact, in a way that they can not be accessed with adequate tools.
- After the works are finished, the contractor is obligated to give warranty for the done works and installed equipment. Guarantee can't be shorter than one year.
- After the works are finished, the contractor is obligated to prepare realized design documentation (single-pole diagrams and command circuit with impeccable numeration of connection clamps)

CONDUIT RUNS AND CONNECTION POINTS

- Conduit runs are formed in cable shelves and partly in parapet installation canals.
- Cable shelves are perforated carriers made of galvanized steel sheet. They are fixed to the construction by corresponding mounting equipment, so that it's "front" side is left open for the insertion of cables.
- Parapet canals are two-parted aluminum canals, dimensions 175x50mm with a suitable inner partition that separates the canal in two parts. One for power current and the other for low voltage current.
- Wall and floor connection boxes are made of self-extinguishing plastic and they should be prepared for insertion of modular elements (sockets 220V and communication sockets)
- After the works are finished, the contractor is obligated to give warranty for the done works and installed equipment. Guarantee can't be shorter than one year.
- After the works are finished, the contractor is obligated to prepare realized design documentation

FEEDING AND COMMAND-SIGNAL CABLES

- Distribution will be done with 0,4KV cables, type PP-Y of corresponding cross section
- Cables will be laid partly in cable shelves (in suspended ceilings), partly on distance sling brackets (attic, lift pit, ventilation central station) and partly the cables will be built-in walls and floors in installation pipes of corresponding cross section
- Cable must be in one piece between two connection points. Juxtaposition of cables is forbidden.
- Every cable must have one blue and one green-yellow strain. The blue strain should always be used as zero line and yellow-green as protection line
- On all el. energetic distribution cables, on their beginning, end and every 20 m along the conduit run, place adequate signs that contain information about:

- type and cross-section of the cable
-beginning point
- terminal point
- year of cable laying

- On every 15-20 m along the conduit run, as well as on all passing between floors and fire sectors of the conduit run, it is necessary to make protection from fire spreading by adding a incombustible coat (FLAMASTIK, LIMPET, JUMPET or equivalent)
- After the works are finished, the contractor is obligated to give warranty for the done works and installed equipment. Guarantee can't be shorter than one year.
- After the works are finished, the contractor is obligated to prepare realized design documentation

INSTALLATION DISTRIBUTION

- Distribution will be done with 0,4KV cables, type PP-Y of corresponding cross section
- Cables will be laid partly in cable shelves (in suspended ceilings), partly on distance sling brackets (attic, lift pit, ventilation central station) and partly the cables will be built-in walls and floors in installation pipes of corresponding cross section
- Cable branching to be done only in distribution boxes, and the cable must be in one piece between two connection points (juxtaposition of cables is forbidden).
- Every cable must have one blue and one green-yellow strain. The blue strain should always be used as zero line and yellow-green as protection line
- In connection points, cable strains should be marked with appropriate signs (identical to signs on connection clamps)
- On every 15-20 m along the conduit run, as well as on all passing between floors and fire sectors of the conduit run, it is necessary to make protection from fire spreading by adding a incombustible coat (FLAMASTIK, LIMPET, JUMPET or equivalent)
- After the works are finished, the contractor is obligated to give warranty for the done works and installed equipment. Guarantee can't be shorter than one year.
- After the works are finished, the contractor is obligated to prepare realized design documentation

COMMUNICATION NETWORK INSTALLATION

1.1. GENERAL

design was carried out on the basis of:

- design task
- annotations and suggestions from the concept design revision report
- annotations and suggestions from the expert assessment (inspection and testing the lightning installation)
- architectural and civil engineering
- requirements from other design phases
- current technical regulations, recommendations and standards.

design solutions:

- Telephone system and computer network installations
- Fire alarm installations
- Acoustics system
- Video surveillance system
- RTV installation
- Access control installation system

1.3 TELEPHONE SYSTEM AND COMPUTER NETWORK INSTALLATION

Object is equipped with telephone and computer network installation (communication network), and the wiring is zoning cabling realized with cables and connecting equipment cat.6

Installation in each zone (floors, business units, functional units) is represented by a zoning communication board (labelled on designs as KO) placed on suitable places and there finished with a connecting panels.
Main concentration of the communication network is in the communication node placed in a foreseen in the basement of the object.
Connection between the communication node and zoning communication boards is realized with telephone cables Iy(St)y of adequate capacity as it is given in the telephone installation diagram and optical cables with the necessary number of optical fibbers.
All communication boards (zoning and communication node) are 19" cases of adequate size with necessary equipment for connecting cables and enough free space for mounting the active computer and telephone network equipment.

Telephone system is based on ISDN home telephone central, capacity 6+30/24/160 + DECT system

a) connection with the public telephone network
6 analog transmitters with built in metering pulse receivers
30 ISDN base access BRA 2B+D (60 canals)

b) internal connections
24 analog internal connections
160 ISDN internal connections So

c) DECT connections
3 connections for base stations DECT system
3 pcs of appropriate base stations

This central station, besides standard modern functions, enables:
receiving mattering pulse from public telephone network
charging all out-going calls
direct dialling function (DID) for every local connection
connection of wireless telephone system (DECT) inside the building

Active equipment and software of the computer network is not the subject of this design, and that equipment will be procured and installed by each user according to their needs communication connectors are foreseen in all working spaces.
Two connections per work station

NOTE:
The building is supposed having two independent users (CITY AND LIBRARY) so the building has two networks connected through the main communication board (see design CM8 – BLOCK DIAGRAM OF PRIMARY COMMUNICATION NETWORK DISTRIBUTION)
Telephone central station is common for both users, but the expenses are deferred by a tariff centre.
Corresponding equipment and software package of the tariff centre will be delivered together with telephone central station and installed on the user's computer.

1.4 FIRE ALARM INSTALLATION

Fire alarm installation serves for early detection of smoke, heat and fire in an early stage of fire, for fast and effective reaction, before it spreads.
For detecting fire in its initial phase, the design foresees a fire signalling installation with automatic (smoke and thermal) and manual notification devices, placed on chosen places to identify heat and burning products as fast as possible.
Fire alarm system is based on analogue addressable fire alarm central station, elements for fire detection, elements for sound warning, elements for monitoring and managing other systems (ventilation, stable extinguishing system, electro-energetic installation)

1.4.1 Equipment

For fire detection, automatic addressable detectors are used:

- Optical detectors (detection of smoke and burning products)
- Multi-functional detectors (detection of smoke and temperature)
- Temperature detectors (detecting high temperatures and fast temperature change)

Type and kind of the automatic notificator are determined according to conditions in each room.

The system also uses:

- Manual addressable notificator whose activation leads automatically to alarm state
- Addressable input/output modules for monitoring and managing other systems (ventilation turn off, el. power turn off, monitoring the sprinkler system and the stable extinguishing system in the book depot)
- Audio alarm signalization is realized through alarm sirens placed on every floor and outside of the building.

1.4.2 Fire alarm central station

For analysing signals and managing the system, analogue addressable microprocessor central station is used. The central station is placed in the basement of the building (porter room).
Fire alarm central station has 3(three) addressable fir alarm nodes.
Fire alarm central station enables:
Fire alarm based on the stage of fire (smoke, heat, fire...) in the earliest stages, but also registration of any change, pre-alarms 1 and 2 for certain parts of the building
Information on kind and type of the alarmed detector, with messages on Bosnian language and action recommendations
Information about disturbing values, bellow alarm threshold (location and type of detector) that were induced by something that is not fire-related, and the possibility of removing them.
Programmable- selective sound signalization (siren).
Adequate transmission of the messages to a distance alarm centre (fire brigade)

1.4.3 Installation distribution

Fire alarm installation is realized with inflammable or self-extinguishing cables IyB(St)y 3x2x0,8mm which are inserted inn installation pipes of adequate cross section.

1.4.4 Prcedure when fire alarm occurs on fire alarm central station

In the case of activation any of automatic notification devices (fire or false alarm)

- activation of sound and light signals on central station
- previously set pre-alarm time stars to run (time T1)

Person on duty is obliged to confirm signal reception and go to the signalled location. Confirmation of signal reception leads to:

- shutting down the sound signal in the central station
- pre-alarm time reset (time T1)
- inspection time starts running (time T2)

If alarm signal reception is not confirmed (person on duty is not present), after pre-alarm time runs out (time T1), system automatically goes in to alarm stage:

- alarm sirens are activated according to previously defined protocol
- alarm signal is forwarded to a fire station

If the person on duty determines that there is no fire on the signalled location (false alarm), the staff member returns to the alarm central station and resets the system (back to pre-alert state).
If the person on duty determines that it is a real fire, he/she activates the nearest manual notification device, and the system unconditionally goes into alarm state.
If the person on duty does none of the above, the system goes into alarm state, when inspection time runs out (time T2).

1.5 SOUND SYSTEM

The design foresees a general sound system which enables transmission of sounds and massages to all parts of the building, and a high quality transmission of music in to public rooms and halls.
Speakers are grouped as functional units and connected to a central sound station placed in a room in the basement of the building.
Sources of sound signals are: microphones speaking module, alarm panel, DVD, and FM radio-receiver).
Sound system enables sending messages to specific rooms, and different music signals to different rooms.
There is also the possibility of reproduction with different levels in different rooms.
Conception of the system is automatic closure, so alarm messages can be heard in all rooms regardless of the regulator position.
The system foresees a unit for generating alarm signals whose activation will be initiated by the alarm central station (fire alarm), and will be done manually by a trained person.
Installation is realized with cables PP as shown in the enclosed diagrams.

1.6 VIDEO SURVAILLANCE SYSTEM

Building has a video surveillance system, for visual monitoring of the space around the building as well as monitoring common rooms in the building.
System is realized with color cameras with verifocal (manually adjustable) lens, and signals from them are passed to digital recorders that will store the camera records, and they will enable reproducing the recorded tracks.
Digital recorders are also connected to video matrix of adequate capacity which is also connected to 3 LCD monitors for controlling the current situation in the building.

Monitors are equipped with 4-canal multiplexers which enable simultaneous viewing of 12 pictures monitoring the situation in the building with 12 cameras
All video surveillance system equipment (except cameras) is placed in a surveillance room in the basement.
Installation is realized with coaxial cables 75□ (RG59-B/U) and cables PP-Y as shown in the designs and installation diagram.

1.7 SYSTEM FOR DISTRIBUTION TV AND RADIO PROGRAM

Building has a RTV installation, relaying on cable television in coming signal.
Distribution of the signal is realized with coaxial cables 75□ through appropriate mufti-branch distributors as shown in enclosed designs and installation diagrams.
Insertion of cable TV conduit is done through a metal case placed in the basement of the building.
Leave free space for mounting equipment that will be delivered and mounted by the cable TV distributor.

1.8 ACCESS CONTROL SYSTEM

Building has an access control system, which covers the entrance to the depot, entrance to the attic floor.
Microprocessor door controllers are foreseen with additional accumulator feeding.
System is conceived as distributed with autonomic units which are mutually connected with communication conduit and connected to the central unit.
Central unit enables control over the whole system.
Central unit of access control is placed in a foreseen room in the basement of the building.

NOTE:
Before purchasing and installing the access control system, it is necessary to consult with the user and define access protocols, and if necessary extend the system to other rooms that need access control.

THERMOTECHNICAL PLANTS

DESCRIPTION OF THE BUILDING

Detailed description of the building with contents, surfaces, facades etc is contained in the main architectural design and this part of the design refers only to main characteristics of the building that are relevant for developing HVAC design and installations.
The building is comprised of three levels – basement, ground floor, mezzanine, 1 and 2 floor and attic with central hall – auditorium that stretches through all levels and ends with glass dome.
According to architectural design of renovation, i.e., designed disposition solution unlike previous single purpose of the building that served as National and University Library, premises in the building will get new function such as:

- City administration
- National library
- Common and public areas that are comprised of Central hall – auditorium, Museum of City Hall destruction, catering and energy block.

With respect to the existing structure and existing disposition of the building comprised of equilateral triangle with three domes, hexagonal auditorium in the middle and other restrictions resulted from cultural-historical significance of the building, architectural solution provided for autonomous and comfortable functioning of all areas.
Headquarter of the City Administration, including state room and City Council's room occupies certain premises at all floors of the building what can be said for National Library as well.
Central hall - auditorium besides everyday usage as the passage area for visitors to public areas, City Administration, National Library and Museum enables temporary usage for promotions, exhibitions, concerts etc.
Museum area with attaching premises in the basement occupies the central under the dome area of the auditorium.
Also, the area for catering services – coffee shop and restaurant with kitchen is planned in the basement of the facility.
Within energy block there is the area for locating the equipment for producing hot and cold water for heating and cooling, with other energy equipment, located in the part of basement on the southeast part of the building.
Chambers for preparing and transport of air to premises that are ventilated shall be located on three separate locations – two in the basement and one in the attic area.
Besides the central auditorium and some of representative areas with large glass surfaces, the facility with its massive structure and three-sides orientation may be considered as energy satisfactory.
Such facility could have been heated with local stoves and air heating with natural circulation that, according to available original documentation was appropriate for central auditorium and halls on the first floor.
Until recent war destruction the building had the boiler room solid fuel operated and located in the basement (on the position of designed energy block) and hot-water installation with radiators for space heating that in the period when this design was developed was found just in traces.
No such installation for cooling or mechanical installation existed.

Although the renovation and reconstruction of the facility has historical significance, its purpose and present living standard require application of modern technical solutions that will enable as comfortable as possible conditions for the stay and work.

BASIC DATA FOR DESIGNING

As initial data for developing main mechanical design of HVAC served:

- *Terms of reference of the Contracting Authority* that defines design requirements demonstrated through local climate and internal parameters,
- *architectural design* of renovation that defines the size and purpose of the space, type and quality of exterior openings , type and dimensions of all cooled surfaces,
- *Initial design* including proposals and suggestions by the reviewing group,
- *existing condition* of the building and preserving authenticity,

As specified in the *terms of reference* of the Contracting Authority, exterior design parameters for location in which City Hall is located are:

- winter : design temperature -16 □C, wind speed 2 m/s,
- summer: temperature of dry thermometer 32 □C,
- temperature of damp thermometer 18,9 □C,

and interior design parameters are:

- temperature during winter: summer = 18-22 ±2 □C : 24-26±2 □C,
- relative moisture 30-70 %
- numbers of air exchange for premises that are ventilated according to standard criterion with the number exchanges or by person,

Architectural design
of renovation determines the purpose of all premises in the facility that served for determining interior design parameters in accordance to conditions from terms of reference.
Besides, this design defines all other parameters needed for calculating thermal and cooling load of specific premises.
Initial design ,
including proposals and suggestions of the reviewing group served as the milestone for developing main design in the sense of principle solutions, location for placing equipment, selecting the system etc.
Existing condition
in the building as very important limiting factor, influenced both the selection of , technical solutions and sometimes achieving required conditions of comfort in specific parts of the building.
Besides, maybe the most influential limiting factor is striving to *preserve authentic look* of the building both outside and inside what significantly influenced final choice of technical solutions that differ from initial design

CALCULATION OF THERMAL AND COOLING LOAD

By using the data from architectural design and design parameters from the terms of reference needed calculation that precede selection of the system and equipment for heating and cooling were performed such as:

- Calculation of coefficient of heat flow for multilayer building structure and for exterior openings (doors and windows) adopted standard values for quality of opening defined by architectural design (U=3,0 W/m2K),
- Calculation of heat loss performed according to standard DIN 4701 for all heated premises,
- Calculation heat inflow performed according to VDI 2078 for all cooling premises,
- Calculation of air heater and cooler in air handling units.

All carried out calculations are enclosed to the design as a constituent part of technical description and this part refers only to some more significant results of these calculations without coincident usage factor that will be taken into account in the process of selecting equipment:

- Energy needed for heating of premises Qg_1 = 419.834 W, (64,35 W/m^2 heated area),
- Energy needed for heating of air Qg_2 = 206.300 W,
- **total energy for heating Qg = 626.134 W**
- energy needed for cooling of premises Qh_1 = 250.674 W, (50,37 W/m2 cooled area)
- energy needed for cooling of air Qh_2 = 104.000 W,
- **total energy for cooling Qh = 354.647 W.**

DESCRIPTION OF TECHNICAL SOLUTIONS

HVAC and facilities addressed in this design have the task to ensure micro-climate conditions in areas for for staying and working.
That includes heating of space in winter period, cooling of space in summer period, mechanical ventilation and/or air-conditioning of space that require it according to its purpose.

HEATING AND COOLING OF SPACE

Heating of most of the space in winter period and cooling in summer period will be done with unique devices – ventilation-convectors (VK) with installed coiled radiators that enables heating of space without operation of fan during minimum 80% heating season. Such device offers far more better comfort in relation to standard VK, specially in regard to the level of noise.
Deviations from such solutions are given in spaces mentioned below.

In premises on the second floor, due to lover height of parapet, installed will be ventilation-convectors of the same type as mentioned but without installed radiator that requires bigger height of the device.

Entrance areas, stairways and some areas in the basement will be heated with steel radiators manufactured as specified in bill of quantities and technical specification.
Due to specific geometry, purpose, floor structure and preserving the authenticity of interior, central auditorium will be heated by floor heating placed on the edge and “special” radiators next to the entrance doors.

Besides, on the landing of the main stairways also being the constituent part of the central auditorium, installing of floor convectors is planned.
In the Ceremony Hall on the 1. floor, due to large height, besides ventilation-convectors that will serve for heating and cooling of premise for access to the balcony.
Intensive cooling of auditorium is not anticipated primarily due to its purpose and temporary usage for some unusual manifestations, but floor heating is provided with water having a temperature 16/20 □C in a range that will disallow accumulation of heat due to sun rays through the dome, specific capacity up to 35 W/m^2, and if needed air cooling from air handling unit in the basement.
For protecting against condensate on the floor surface, with the equipment for temperature regulation provided maximum temperature sensor (Tmin = 20 □C), built into upper zone of floor structure.
Museum area, in the basement will be heated with warm air having the temperature up to 20-29 □C.
Media for transport and transfer of thermal and cooling energy is hot ans cold water of temperature regime 70/60 □C for heating and 7/12 □C for cooling in the system of ventilation-convector and for the system of floor heating – cooling is 47/40 □C - 16/19 □C.
The system of pipe distribution is double-barreled, primarily because of limited space and plaited concrete beams performed in the 1 stage of building reconstruction.
Because of impossibility of implementing four-barrel system, pipe distribution is envisaged as such that installation is divided in three groups – zones with verticals on the top of triangle (domes).
Horizontal distribution from energy block to verticals is made of steel prior-insulated pipes laid in the floor, and on floors there are steel pipes below the ceiling for VK on the next floor except for ground floor and basement where the pipe network is laid in floor.
Pipes in suspended ceiling are insulated in a manner described in the bill of quantity and technical specification.
Division of installations into groups – zones create a possibility for one zone to be heated and the other to be cooled or it is not operated meaning neither heated nor cooled.
All ventilation- convectors are with built in electronic controllers and stop valves with thermal electrical head, with a possibility of group remote switching on and off through the CNU system.
The most distant ventilation-convectors on each vertical is with three-armed valve through which water circulation is performed in case that all VKs are turned off and pump is operating.
Besides, on VK connections and branches of pipe network installing of valves for metering and regulation of flow is planned.
Building in thermostat valves is provided for all radiators and on branches of pipe network for radiators valves that will be closed in the cooling regime will be installed.
Floor heating will be regulated with space thermostats and valves with thermal-electric head on branches of floor heating circles.
The complete pipe network of hot/cold water with position of verticals is shown on drawings and schemes..

SPACE VENTILATION

The criteria for designating the space for ventilation, air-conditioning of the system is primarily its purpose and the criteria for determining quantity of air is number of persons (if known) or number of exchanges.
Thus, the design provides for few air systems purpose of which is to intake fresh air and outtake of waste air from the following premises.

Due to limited space for locating the equipment, possibilities for distribution of air ducts are limited and finally due to realistically anticipated regime for usage of specific ventilated area, the number and size of the system for ventilation is reduced in relation to preliminary design.
Namely, this design anticipate that some of systems may serve for multiple areas that will not be used at the same time and selection of the regime for system operation will be performed through CNUS.
According to such solution, the following systems were designed for processing, transportation, distribution and outtake of air:

- system 1 : City Council Hall and Center for education on 2. floor, 2400 m^3/h -40 m^3/h per person
- system 2 : Book storage in the basement, book store and restoration of books in the ground floor, 4220 m^3/h, 4-5 i/h
- system 3 : Ceremony hall 1. floor, 3.600 m^3/h, 40 m^3/h per person,
- system 4 : Museum/Auditorium, hall for lectures in the basement and info center in the ground floor, 6500 m^3/h, 40 m^3/h per person,
- system 5 : Coffee-pastry shop, restaurant, kitchen, 6000 m^3/h, 5-10 and/h,
- system 6 : Air outtake from kitchen, 3000 m^3/h,
- system 7 : Air outtake from coffee-pastry shop and restaurant sanitary, 520 m^3/h

TOTAL quantity of fresh air: **22.720 m^3/h**

All the above mentioned systems are ventilation systems and includes air filtering, heat recuperation with tile recoveries heating/cooling, besides system 5 in which, besides the above mentioned air processing, maintaining of moisture in limits that require storage technology and book restoration is provided.

DESCRIPTION OF SYSTEM VENTILATION

System 1 – City Council Hall and Center for Education on 2. floor

Given that these areas will never be used at the same time, one air handling unit is provided for them and it is located at the attic area of the building with elements dimensioned for City Council hall as the area with greater requirement for fresh air.. Selection of the direction of air flow will be done according to CNU system and preformed by electronic flow regulators.
Due to the need for system operation with different air flow, frequent regulation is provided due to number of electric engine ventilators rotations.
Distribution of air ducts is done partly at attic, and partly in suspended ceiling of 2. floor, while distribution of air in City Council hall is done with linear diffusers, and whirlpool diffusers in center for education.
Fresh air intake and waste air outtake is done above the roof.

System 2 – Book storage in the basement, bookstore and restoration of books in the ground floor

Air handling unit of this ventilation system is located in the basement, intake of fresh air is performed above the roof, and outtake of waste air to the attic space.
Considering the purpose of premise that requires maintaining air moisture in the range of 40-60 %, air handling unit with electrical steam damper is provided, and the cooler is dimensioned for cooling and drying of damp outdoor air.
This system, besides above mentioned areas in a manner as described under 5.3.1., may serve for ventilation of area in front of the cabinet of the Chairman of City Council at 1. floor, if required (receptions, ceremonies etc.).
That includes turning off ventilation for area of bookstore and restoration of books and re-directing of air to the area of 1. floor.
Air distribution in book storage is done by flexible ducts and grille below the ceiling and in other areas within suspended ceiling, while grille and whirlpool diffusers are provided for distribution
Ducts for intake and outtake of waste air are located in existing vertical shaft walls of which should be demolished due to mantling and than brick laying.

System 3 - Ceremony hall 1. floor

Special system for processing and transport of air – air handling unit located in the basement along with air handling unit of system 2. is provided for the ceremony hall that will be used from time to time. Intake of air to the hall is performed with ducts that are located in existing vertical shafts.
Given it is ceremony hall it was strived to preserve authenticity of interior, and this design provides for placing the new grille of similar look like previous on the position of old grille for intake of hot air.
Mechanical exhaust system is not provided, and the waste air will flow through to the dome due to overpressure and chimney effect.
For reasons of temporary use of the space, interior, position of air handling unit, complex duct distribution and relatively small quantity of air, this system does not provide for heat recuperation.

5.3.4. System 4 - Museum/Auditorium, hall for lectures in the basement and info center on the ground floor.

Due to previously mentioned difficulties related to locating equipment, ducts distribution and realistic regimes for usage of space and this system of ventilation is provided for supply with fresh air of multiple premises that will not be used at the same time.
The main purpose is ventilation and air heating of the museum and partially auditorium and if needed it is possible to re-direct air flow and use it to ventilating halls for lectures in the basement, info center on the ground floor and in extraordinary events the space in front of mayors office at the 1. floor, and all by means of electronic flow regulators and ventilators with electric engines operated by frequency transformers.
Anyway, air handling unit with all belonging elements is dimensioned for permanent ventilation of museum and one of lecture hall, for the event of using of all three halls (it is not expected) and area

in front of mayor's office, intensity of ventilation of the museum will be decreased or even fully terminated.
Central auditorium with balcony at 1. floor represents the area for every-day internal communications and only temporary can be uses for other purposes.
It was strived to find a solution that can meet requirements for every-day and temporary purpose and at the same time preserving the authenticity of interior.
According to that solution the area will be ventilated indirectly so unpolluted air can pass through existing cast iron grille in floor and outtake back to air handling unit through two exhaust grille and exhaust duct.
In addition to that, the auditorium will be mainly natural ventilated thanks to chimney effect, and air will flow through grille at attic ceiling and through existing grille on the top of the dome.
Such an intensive natural ventilation, and the structure of dome with two glass surfaces – one flat and other dome shape will not allow condensation of water steam on dome glass surface and in summer period may efficiently serve for natural "night cooling" both of auditorium and perimeter areas.
For preventing eventual condensation on the dome, besides natural ventilation, switching off of exhaust ventilator from this system is provided, so the total quantity of air from air handling unit maw flow through the dome.
Switching off the ventilator shall be performed through the sensor of dew point built in close to the surface of dome.
Air distribution shall be performed by ducts that are laid on the basement's floor, and partially in on the floor of ground floor for halls in the basement.
In premises of ground floor and 1. floor ducts will be placed in suspended ceiling. Intake of fresh air and outtake of waste one will be done through protection grille out of the building, which are, due to its specificity included in architectural part of the design.
Distribution of air is different: in museum through lateral grille with and current speed, in basement halls through hemisphere multi-jet diffusers and at the 1. floor through whirlpool and linear diffusers.
In the regime of ventilation of museum and auditorium, air is returned to tile recuperation of air handling unit and in the regime of ventilation of halls air will be taken to the attic while air from the area at the first floor will be taken to auditorium
In regime of ventilation of museum and auditorium air is returned to tile recuperation of air handling unit and in the regime of ventilation of halls air will be taken to the attic while air from the area at the first floor will be taken to auditorium.

System 5 – Coffee-pastry shop, restaurant and kitchen

System 5 that serves for ventilation of restaurant, coffee-pastry shop and kitchen is unique system provided for 24-hours operation.
Air is distributed with ducts in the floor of basement and ground floor to multi-jet hemisphere diffusers and pressure grille.
One part of air from the area is returned to tile recuperation and second part will be taken through kitchen hood and exhaust ventilator above the roof of the building.
Intake of fresh air and outtake of waste air is performed through grille described in previous item.

System 6 – Exhaust from kitchen

Air exhaust from the kitchen is done through kitchen hood that is included in the design for equipping the kitchen and through ducts in existing vertical shaft to roof two-speed ventilator.
The quantity of exhaust air of 3000 m^3/h is calculated based on the type and capacity of kitchen appliances, taking into account the size of space and limited number of air exchanges for the purpose of preventing draft.

System 7 – Air exhaust from sanitary of coffee – pastry shop and restaurant

For exhaust of air from sanitary in the basement that belong to coffee-pastry shop and restaurant special system is provided with exhaust valves in cabins, intercepting sewer and pipe ventilator that is located in attic space.
Quantity of exhausted air is 80-100 m^3/h by cabin and compensation will be done from the area of coffee-pastry shop and other neighboring areas through openings or shortened door leaves.

SELECTION OF ELEMENTS FOR VENTILATION SYSTEM

5.4.1. Air handling units

Selection of elements for air handling unit has been preformed based on the quantity of air, air temperature on the entrance and exit of air handling unit, resistance in ducts, diffusers and grille and based on water temperature for heating/cooling of air. In all systems provided are ventilators with rotation frequent regulation and tile-type heat recuperates except for the system 3 whereby waste air is not returned to air handling unit. For final selection of ventilators relevant are calculated resistances in the system out of air handling unit, attached to technical description and specified in the bill of quantities.
For selection of heater and cooler design parameters from the terms of reference were used and air temperature constants (except for system 4 that has changeable ones) on the exit of air handling unit calculated based on heating/cooling load of the space being 22-29 □C during the winter and 19-22 °C during the summer.
Water temperature for heating – cooling is 80/60 □C – 7/12 □C.
We note that while calculating cooler we haven't taken into account the total number of persons to be expected in specific areas given that one part was included in calculation of heat inflow.
Besides, air heaters in air handling units with heat recuperates are chosen to be higher than calculated (for Tu = -10 □C, for the event of air flow through "by-pass" of recuperates).
Attached calculation of heater and cooler is constituent part of technical description.

5.4.2. Diffusers and grille

Location and selection of shape of diffusers and grilles was partly conditioned by either previous and new architectural design of interior, but still it does not significantly influence distribution and exhaust of air.
Characteristics of this elements for ventilation system are described in technical specification and in final decision on the type and manufacturer it is mandatory to comply with the above mentioned values that are related to air quantity, air jet reach, level of sound pressure and maximum efficient air speed through exhaust grille.

5.4.3. Distribution and exhaust ducts

Most of ducts for distribution and exhausts of air are ducts made of pre-insulated panels with polyurethane insulation and aluminum foil on both sides, smooth inside and rough outside. Insulation is 21 mm thick and foil 80 μm for ducts in space and 200 μm for ducts below the floor.
Exceptions from the above mentioned type of duct are ducts for air exhaust from kitchen that are made of anti-rust steel sheet welded with thermal insulation coated with non-flammable gypsum slabs as well as ducts for air exhaust from sanitary that is made of aluminum sheet.

AUTOMATIC REGULATION AND OPERATION

For all described ventilation systems designed are automatic regulation systems with DDC regulators and sensors shown in schemes within graphical part of the design, with elements that are described in bill of quantity.
Each system provides for automatic operation of the process for processing and transport of air according to set program and it is simultaneously linked with CNU system..
Control cabinets are located in the area of air handling unit which also enables manual operation, and for system 5 – restaurant; electrical design enables turning on air handling unit and exhaust ventilator from kitchen area.
Also, exhaust ventilator of basement sanitary is independent and turned on from kitchen area.
Control cabinet as well as all supply and signal cables within air handling units are included in this design, while cables out of these areas are included in electrical design installations.
Cables are laid on shelves and in protection flexible pipes.

DATA FOR SELECTING HEATING AND COOLING FACILITIES

Facility for heating and cooling – boiler room and cooling generator are addressed in separate design.
The data required for selection of size for those facilities, taking into account assumed factors for coincident usage and heat recuperate in heating regime is addressed here:

HEATING FACILITY		f	W
Basic heating		1,00	419834
Preparation of air:			
Attic air handling unit	19000	0,50	9500
Depot air handling unit	25500	1,00	25500
Ceremony hall air handling unit	45600	0,40	18240
Museum/auditorium/hall air handling unit	70200	0,50	35100
Restaurant air handling unit	46000	1,00	46000
TOTAL:	206300		**554174**

COOLING FACILITY		f	W
Basic cooling			225529
Basic cooling x f		0,80	180423
Preparation of air:			
Attic air handling unit	11700	0,50	5850
Depot air handling unit	17800	0,80	14240
Ceremony hall air handling unit	18500	0,40	7400
Museum/auditorium/hall air handling unit	33200	0,50	16600
Restaurant air handling unit	22800	1,00	22800
TOTAL:	104000		**247313**

VENTILATION OF SANITARY FOR WORK AREAS

Ventilation of work area sanitary from basement to the 2. floor is resolved with local exhaust centrifugal ventilators with built in non-returnable cover and time relay and collecting vertical ducts with aluminum sheet that end with protection caps above the building roof.
Ventilators are connected to lighting switch of the space that is ventilated by them.

GENERATOR STATION

Diesel power generator is included in electrical installation design and this design includes intake and outtake of air and outtake of smoke.
For the area of generator station that at the same time serves as a workshop designed is the system of intake and outtake of air for cooling of generator engine, and ventilator with spatial thermometer for space ventilation in case of exceeding the ambient temperature as defined bay generator manufacturer.
The system for intake and outtake of air for engine cooling is comprised of protection and electrical engine grille, and hot air duct from cooler ventilator.
Size of opening for building in intake and pressure grille is limited, thus prior to procurement the supplier of generator should be informed about these conditions.
Besides the above mentioned, this design provides for pipeline for outtake of smoke gases, cross section 150 mm that is insulated and taken out from the roof of the building. The supplier should also be informed about planned cross-section and length of the pipeline.

COOLING OF UPS AREA

Special premised at the mezzanine are provided for locating the device for back-up supply of computer systems UPS, for which special cooling devices – air condition capacity 5,0 kW split performance are planned with external inverter units at the roof of the building and interior wall mounted units in UPS premises.
Connecting pipeline and cables are led in vertical shafts along with ventilation ducts.

FIRE RESISTANCE PROTECTION

In order to prevent possible fire in some areas in the building, all fire sectors as well as areas for locating air handling units as special fire sectors are separated with fire resistance covers with electric engine operation or thermal fuses, depending of their location.

REVIEW OF ANTICIPATED POSSIBILITIES FOR ENERGY SAVING

Due to material that the building is build of – in most part full brick with walls that are 60-90 cm thick, the building belongs to the category of "heavy building" with low coefficients of heat passing through and large accumulation capability.
In addition it should be noted that exterior openings are relatively small in relation to surfaces of the area.
Those facts result in low specific consumption of energy for heating and cooling.
Besides, geometry of the building with central auditorium and grille on the top of the dome provide for effect of "night cooling" of auditorium and surrounding premises.
Devices for automatic regulation of air temperature and frequency convectors for regulation of number of ventilator rotation are provided in all systems for ventilation.
Also in all systems, except for system 3 heat recuperation is planned with tile-type recuperates.
Ventilation convectors are equipped with electronic controllers, and electrical design provides for group turning off at the close of business..
Radiators have thermostat valves, and floor heating and floor convectors are equipped with spatial thermostats.
All systems are connected to central monitoring and control system from where it will be possible for perform required corrections of set parameters, turning on and off depending on the need.

OTHERS

Technical description was intended to show main technical solutions of specific segments of the design, while details can be seen in drawings and schemes, attached calculations, bill of quantity and technical specification.

The constituent part of the technical description is:

- calculation of heat flow coefficient
- calculation of heat loss
- calculation of heat inflow
- selection of heating and cooling device
- calculation of floor heating
- calculation of heaters and coolers for air handling unit
- calculation of hot water ducts
- calculation of cold water ducts
- calculation of air ducts

GENERAL CONDITIONS FOR EXECUTION

1. All equipment, materials and works must be in accordance with foremost BAS standards, and in case that for certain equipment standards do not exist, use JUS; DIN or EN.
2. Accordance with standards controls and settles supervisory service.
3. Use only new materials and equipment, and for those that require certificates secure appropriate documentation.
4. For equipment for which certification is secured on the field the constructor is responsible to secure adequate conditions, invite appropriate institution and cover all related costs.
5. Transport and storage of equipment must be done in accordance to manufacturer's instructions which must be supplemented to delivered equipment.
6. Procured equipment must have manufacturer's mark, serial number and other recognizable signs relevant for control.

HEATING INSTALLATION

Vertical and horizontal distribution

which is done with steel pipes will be connected with the procedure of autogenous welding with previous preparation of weld.
Before installation pipes have to be cleaned inside and outside. Inside cleaning is performed by dragging brush and striking and outside cleaning is performed with steel brushes.
After cleaning pipes will be protected with anti-corrosive protection.
Cleaning of pipes and anti-corrosive protection will be monitored by supervisory department and they will approve its installation.
Welding of steel pipes can be done by certified welder which is proved by certificate issued by appropriate institution.
All passages of pipes through walls must be performed with pipe conductors.
While placing pipes through mezzanine structure, pipe conductors will be placed which from the lower side have to be flat with the structure and from the upper side higher than floor structure not less than 30 mm.
The space between the pass and pipe will be closed with plastic putty that is resistant to high temperature.
With that removal of this material due to movement of pipes with thermal dilatation has to be disabled.
Pipe conductors have to be fastened to the structure (welding to reinforcement).
Before mantling of central heating pipes their position has to be harmonized with the position of other installations and equipment.
Pipes that are laid without previous harmonization, which objectively disturb execution of other works or placing and utilization of equipment have to be removed at the cost of contractor.
Position of pipes in relation to walls as well as their mutual position must be parallel and aesthetically satisfactory.
Welded joints must be performed in a quality manner and aesthetically satisfactory.
Bearer of pipeline supports that are installed in walls and other structures must be fastened and pipe support itself has to be of such diameter as to enable movement of pipes.
On the connection of inside installation to outside distribution, installation of bolts and thermometers is obligatory as well ad connections for measuring differential pressure.

This domestic set may contain a meter for consumption of thermal energy, with dirt retainer and other necessary equipment.
One of covers should have a possibility of accurate flow regulation and be located in accessible space and protected against access of unauthorized personnel.
Installing of meter for thermal energy consumption should be in accord with special requirements for their installation.
All equipment must be installed without tensions in cold condition and tensions that occur in operational condition must not influence sealing of joints and must not cause equipment damages.
All flange joints will be done with sealing material and screws for fastening must be appropriate with its quality and diameter to openings in flanges and should not stick out of flanges more than 15 mm.
Installing of instruments and sensors for measuring and control of fluid parameters should be such to enable obtaining accurate size of condition.
It is necessary to facilitate replacement therein without releasing operational fluid.
Compensation of horizontal and vertical pipe lines must be performed in accordance to design and care must be taken about the following:
- pipe guides should be installed around compensator,
- maximum movement of pipe in any point of the route should not exceed 30 mm,
- to avoid braking of joints and over tension in parts of pipelines at the position of forking,
- supporting building structures should be capable of using for the purpose of fastening hard points.

Connection of heaters/coolers with pipelines for distribution of fluids should have sufficient length and shape in order to prevent damaging of joints or tensions of fittings or heater as the consequence of movement of pipeline due to thermal dilatation.
All fittings on domestic installation should be located in premises that are accessible for interventions.
Each branch of distribution network must have fittings for closing whereby one of the covers must be regulation one.
All branches must be capable of water draining next to closing fittings on the side towards heaters.
These drains must be insured with special cover with coil in order to prevent interventions by unauthorized persons.
If the central exhaust pipeline is done than on each vertical closing element will be installed, and exhaust pipeline is reduced to exhaust pot.
Installed valve on exhaust pipeline should be accessible at any time i.e., in residential buildings it has to be installed out of the apartment.
Installing exhaust pot with required fittings will be done on accessible places.

Pressure test

in order to check sealing and hardness test is performed with cold water under the pressure which is higher for 30 % than maximum operational pressure at the position where pressure gauge is placed and not less than 4 bars on the lowest position of internal installation.
Duration of pressure test is 8 hours from the moment of establishing trial pressure.
While testing in conditions of possibility for water freezing, care should be taken so the damage of installation is avoided what includes releasing water from parts of installation with squeezing water from parts of pipeline which could not be emptied by gravitation. Squeezing out is performed with air under pressure.
After establishing trial pressure installation joints must be separated from water supply source or device for raising the pressure.

The instrument for measuring pressure must be certified and sealed, and diameter of indicating scale minimum 150 mm, with measure that show maximum 0,2 bars.
During testing closure of installation is controlled with direct control of joint humidity.
Pressure test can be performed partially by certain units of installation and in particular with one-tube heating system.
The contractor and supervisory department should make a report on testing and the report should comprise of:
- Designation of part of installation that is being tested,
- Date of testing,
- Pressure and duration of testing,
- Description of pressure behavior in the testing period,
- Environment conditions,
- Behavior of compensation elements,
- Names of responsible persons and supervisory department.

Hot test of installation is performed within nominal operational conditions of pressure and heating fluid temperature.
Pipeline supports will be controlled with it as well as movement of compensator, function of fittings function and exhaust status of heaters etc.
A report that contains findings about above mentioned and other elements will be prepared.
After pressure test, installations will be washed with fast releasing of water on the lowest points of installation.
Washing is performed until it is fully clean.
Final cleaning is done after hot test.
After washing, nets of dirt retainer should be cleaned.

Regulation

heating installation includes regulation of flow for overall installation by specific branches of installation and by specific circulation circles within one-tube heating and temperature regulation of heated premises.
Regulation of temperature for the space is performed with previous placing of thermometer heads and fixing their position that provides temperature of space which is in accord to designed one.
Temperature regulation may be performed only during heating season, regardless the period of delivery of the building to the user, and it is being performed within temperature of outside air lower than 5 °C.
If the facility is delivered out of heating season, the contractor is obliged to perform regulation of temperature of premises.
The control of performed regulation is done by measuring and the report will be done.
Damages of previously placed anti-corrosive protection due to welding should be repaired with repeated placing with mechanical cleaning if dirtied.
All fittings have to be painted with paint resistant to temperature of operational fluid.
Dirt should be removed before painting.
Radiator heaters and pipelines that are not insulated will be painted with oil paint which is resistant to operational temperature in color shade as determined by supervisor.
Painting will be done in two layers
During painting of radiators, bolts and exhaust valves should be dismantled and openings on radiator should be closed.

Insulation of pipelines

which pass through unheated premises and pipelines that are laid in floor structure should be done. Insulation of pipeline is preformed after completed tests and repair of anti-corrosive protection.
Usage of molded insulation whose external cover has to be resistant to moisture and mechanical damages shall be allowed.
Insulation has to be properly connected to lengthening and transverse joints and it has to be aesthetically performed specially on arches and ends.

INSTALLATION OF VENTILATION

All elements and assemblies of installations should be placed exactly on positions planned for that purpose in the design.
Thus, before commencing execution of works it is necessary to do harmonization with contractors for other installations. If there are some discrepancies for mantling of different installations, supervisory department shall be obliged to do harmonization of installations that are in collision as soon as possible in the agreement with designers and contractors for all installations.
Particularly important aspect of cooperation is with construction works contractors. Contractor on installation of ventilation, or air-condition shall be obliged to promptly (before carrying out certain construction works) review appropriate plans for openings and compare them with requirements for installation and indicate possible defects.
Supervisory department shall be obliged to resolve all possible problems in agreement with representatives of designers and contractors and that will be included in log-book and signed by all participants.
Ventilation or air conditioning chambers for preparation of air before placing into premises will be installed on positions as anticipated in the design in special premises earmarked exclusively for that purpose.
These premises should be treated from the standpoint of protection of building against spreading of noise or vibrations which can be caused by rotation elements of installations. Chambers can be supplied in sections or as complete unit, factory tested and balanced. If it is supplied in sections, all tests have to be done after complete jointing.
During accepting chamber on the place of installing, the contractor is obliged to check if supplied unit fully complies with characteristics given in the design and whether it has all required certificates in order to meet installation requirements.
Placing of chamber can be done on concrete floating base or on special shock absorbers planed for these purposes.
They are made of hard rubber or other appropriate material.
While placing chambers by hanging them to the structure, elements for flexible hanging must be used. While placing the chamber it is important to prevent transporting possible vibrations from chamber to construction elements of the building.
Chambers should not be in touch with building structure.
Ventilation, or air conditioning chambers must be placed in such a manner to enable unhindered review and servicing of certain elements and sections of chamber (filters, exchangers).
Thus it is crucial that on the side of service which is planned in the design, required space is left that is approximately equal to width of chamber.
Connecting the chamber or specific elements with elements of channel distribution must be done with flexible joints, using cloth or any other appropriate material.

This material for jointing should have proper elasticity and be resistant to changes of temperature and moisture of surrounding air.
Connecting of exchanging sections (heater, cooler) to the appropriate pipe distribution network of hot and cold water should be done according to the design with as less as possible local resistances.
Elements of fittings and equipment for automatic regulation should be located to places with transitional pieces and flexible connections.
Each exchanging section must be separated with suitable sealing element from the other part of distribution part.
Distribution of air is done by channels as provided in the design.
Certain parts are performed according to given measures or in contractor's workshop or at the site.
Material for making the channel must be in accordance to requirements for certain types and purposes of installations.
Each change of material for making channels must be approved by representative of supervisory department and included to log-book.
Thickness of material that is used for making channels for distribution of air depends on the type of material and the dimension of the channel itself.
For rectangular channels made of galvanized sheet, that is commonly in use galvanized sheet will be used with following thicknesses:
(DIN 24 152)

- for larger dimension of channel up to 250 mm sheet thickness 0,50 mm
- for larger dimension of channel 250 to 490 mm sheet thickness 0,62 mm
- for larger dimension of channel 500 to 990 mm sheet thickness 0,75 mm
- for larger dimension of channel 1000 to 1490 mm sheet thickness 0,88 mm
- for larger dimension of channel 1500 to 1990 mm sheet thickness 1,00 mm
- for larger dimension of channel 2000 to 2490 mm sheet thickness 1,13 mm
- for larger dimension of channel over 2500 mm sheet thickness 1,25 mm

For round channels made of galvanized sheet will be used with following thicknesses:

- for diameter	63 to 125 mm	sheet thickness 0,75 mm
- for diameter	140 to 250 mm	sheet thickness 0,88 mm
- for diameter	280 to 500 mm	sheet thickness 1,00 mm
- for diameter	560 to1000 mm	sheet thickness 1,13 mm
- for diameter	1100 to 2000 mm	sheet thickness 1,25 mm

For channels made of aluminum sheet galvanized sheet will be used with following thicknesses:

- for larger dimension of channel to 250 mm sheet thickness 0,60 mm
- for larger dimension of channel 600 do 990 mm sheet thickness 1,00 mm
- for larger dimension of channel 300 to 590 mm sheet thickness 0,80 mm
- for larger dimension of channel over 1000 mm sheet thickness 1,25 mm

Thickness of sheet for making channels for distribution of air given in previous paragraphs are related to channels in the system of ventilation, or air-condition that belong to class I (up to 400 Pa).
For channels in systems of class II (400 to 1000 Pa) thicknesses that are larger for one dimension than for class I and in systems of class II (over 1000 Pa) thicknesses that are larger for two dimensions than for class I.
For air ducts made of hard PVC-a, thickness of material must not be less than 3 mm (4 mm is recommended), due to possibility of welding joints and connecting certain parts of channel.

Thickness of material for "spiro" channels and flexible pipes will be determined by pipe manufacturers, depending on material that is used for making and dimensions of pipes according to own norms.
These pipes must have appropriate certificates.
Connecting of certain parts of air ducts made of galvanized sheet can be done by using flanges or drawing in depending on dimensions of channels and technology that is available to contractor for installations.
Connecting of air ducts with flange joint will be done with angle profiles whose size depends on dimensions of ducts. According to larger dimension of channels minimum dimensions of profiles are planned.

- for dimensions up to 1000 mm L-profile 30 x 30 x 3 mm
- for dimensions over 1000 mm L-profile 40 x 40 x 4 mm

While connecting channel with flange joint special attention should be paid to closing of joints. Closing must be done properly with special tape for sealing or plastic putty for sealing.
The quality of sealing must be perfect so on joints is not lost mode than 15 of total quantity of air that should be provided by ventilator planned in the design.
While connecting sliding joint, the type of joint depends on technology employed by the contractor for making channels.
There are multiple types of sliding joints (sliding joint, "S" joint, fillet joint, joint with vertical flexion, longitudinal flexion, "S" joint with vertical flexion, angle flexion, standing flexion, "Pisburg" joint or equivalent, etc.), however for any typo of joints that will be used necessary requirements related to toughness of channel and sealing of joints must be complied with.

Connecting channels and specific parts for air ducts made of other materials will be performed in a following manner:

- connecting channels made of aluminum sheet will be done in a same manner as for galvanized sheet channels.
- connecting channels made of black metal sheet will be done by welding and it can be done with flange joints,
- connecting channels made of hard PVC-a or other similar materials, will be dome by welding or gluing; while gluing it is important to know that such joints are not reliable with lower temperatures and glued elements can be detached.
- connecting parts of "spiro" or flexible pipes mutually or with other elements will be done with special jointing elements that are recommended and usually produced by manufacturers of these pipes.

In order to eliminate vibrations of air duct flat surfaces, those surfaces have to be properly stiffened.
Rigidity of certain parts of the channel must be longitudinal and vertical.
The manner of rigidity of channel depends on material from which it is made, its thickness and dimensions.

The manner for cross stiffening of air ducts made of galvanized sheet:

- for channels whose longer side is up to 500 mm, cross stiffening are planned for every 2 m,
- for channels whose longer side is 500 to 1500 mm, cross stiffening are planned for every 1 m,
- for channels whose longer side is higher than 1500 mm, cross stiffening are planned for every 0,5 m.

Cross stiffening of channels are performed with angle profiles of minimum dimensions 30 x 30 x 3 mm.

The manner for longitudinal cross stiffening of air ducts made of galvanized sheet depends on longer side of channel:

- for channels whose longer side is up to 1000 mm, longitudinal stiffening is performed with longitudinal standing flexion inside or with angle profiles.,
- for channels whose longer side is higher than 1000 mm, longitudinal stiffening is performed with angle profiles of minimum dimensions of 40 x 40 x 4 mm.

Cross and longitudinal stiffening of air ducts for aluminum channels will be preformed in a same manner as for channels made of aluminum sheet.
Cross and longitudinal stiffening of air ducts made of black sheet will be done with gale profiles of minimum dimension of 40 x 40 x 4 mm.
Stiffening of air ducts made of hard PVC or similar material, usually is done by a selection of proper thickness of material and other possible stiffening will be done with angle profiles, made of same material as the channel.
Hanging of channel for distribution of air is done with special adjustable tapes for hanging or iron bar with a coil of appropriate size.
If multiple channels are placed at the same time, it is possible to hang them jointly with suitable "L" or "U" profiles to which channels will be placed.
Each channel in this case will be individually fastened to the profile.
The size of profile is calculated according to number and size of placed channels.
On the border of fire sectors as well as on places where channels penetrate through roof structure, fire covers will be placed.

FINAL WORKS

Final works include cleaning of site from waste, functional tests, adjusting of all adjustable elements with control of designed parameters, preparation of documents for technical review.
In the frame of final works, the contractor shall be obliged to develop design of completed works (if necessary) schemes, instructions for handling with certain parts of plants and installations.

1. <u>Fan coils pos. B1:</u>

Two –pipe parapet fan coil with heat exchanger, three-speed fan and integrated flat radiator.
Delivered together with built-in electronic control unit which, besides other functions, contains also summer/winter switch.
Fan coils have legs for ground mounting and suspension equipment, the facings are painted into RAL according to the choice of the interior architect.
Characteristics of the fan coils are given in the tables below.

2. <u>Fan coils pos. B2:</u>

Two –pipe parapet fan coil with heat exchanger, three-speed fan, without integrated flat radiator.

Delivered together with built-in electronic control unit which, besides other functions, contains also summer/winter switch.
Fan coils have legs for ground mounting and suspension equipment, the facings are painted into RAL according to the choice of the interior architect.

Characteristics of the fan coils are given in the tables below.

VENTILOKONVEKTORI-TEHNICKI PODACI/FAN COILS-TECHNICAL DATA

SA RADIJATOROM/WITH RADIATOR

VEL/SIZE	Spd	Air		Hladjenje/Cooling								Grijanje/Heating					Noise	Dim(mm)
				Capacity		Water				Air		Capacity	Water					
		ESP	Flow	Total	Sens.	Tin	Tout	Flow	PdC	Tout	UR	Total	Tin	Tout	Flow	PdC		
		Pa	m3/h	kW		°C		l/h	kPa	°C	%	kW	°C		l/h	kPa	dB(A)	
VKR-01	Min	0	55,0	0,36	0,26	7,0	12,0	61,2	2,2	10,8	95	0,91	70,0	60,0	75,8	1,8	35,0	697x719x126
	Med	0	113,0	0,62	0,48	7,0	12,0	106,5	5,6	12,4	91	1,70	70,0	60,0	145,0	4,8	43,0	
	Max	0	162,0	0,72	0,59	7,0	12,0	122,9	7,1	14,1	88	2,30	70,0	60,0	197,8	7,5	51,0	
VKR-02	Min	0	155,0	0,75	0,60	7,0	12,0	129,5	2,3	13,4	90	1,91	70,0	60,0	139,1	2,4	38,0	897x719x126
	Med	0	252,0	1,22	0,98	7,0	12,0	209,6	5,3	13,4	90	2,88	70,0	60,0	240,8	6,3	46,0	
	Max	0	320,0	1,42	1,17	7,0	12,0	243,8	7,0	14,1	88	4,12	70,0	60,0	343,8	12,0	53,0	
VKR-03	Min	0	248,0	1,11	0,91	7,0	12,0	190,9	5,5	14,0	88	3,31	70,0	60,0	257,0	6,9	39,0	1097x719x126
	Med	0	367,0	1,69	1,37	7,0	12,0	290,4	11,3	13,8	89	4,35	70,0	60,0	348,1	11,7	47,0	
	Max	0	461,0	1,96	1,63	7,0	12,0	336,1	14,6	14,4	88	5,10	70,0	60,0	413,2	15,8	53,0	
VKR-04	Min	0	370,0	1,63	1,34	7,0	12,0	279,0	6,9	14,2	88	3,37	70,0	60,0	235,5	4,1	40,0	1297x719x126
	Med	0	453,0	2,23	1,77	7,0	12,0	383,2	12,3	13,3	90	5,05	70,0	60,0	406,1	11,3	48,0	
	Max	0	576,0	2,40	2,01	7,0	12,0	411,8	14,1	14,6	87	7,21	70,0	60,0	580,9	22,0	54,0	
VKR-05	Min	0	426,0	1,78	1,49	7,0	12,0	306,1	5,9	14,5	87	6,68	70,0	60,0	509,4	11,4	40,0	1497x719x126
	Med	0	494,0	2,79	2,12	7,0	12,0	478,2	13,7	12,2	92	7,45	70,0	60,0	576,4	14,4	49,0	
	Max	0	648,0	3,23	2,56	7,0	12,0	554,2	18,2	13,2	90	9,10	70,0	60,0	720,4	22,0	55,0	

BEZ RADIJATORA/WITHOUT RADIATOR

VEL/SIZE	Spd	Air		Hladjenje/Cooling								Grijanje/Heating					Noise	Dim(mm)
				Capacity		Water				Air		Capacity	Water					
		ESP	Flow	Total	Sens.	Tin	Tout	Flow	PdC	Tout	UR	Total	Tin	Tout	Flow	PdC		
		Pa	m3/h	kW		°C		l/h	kPa	°C	%	kW	°C		l/h	kPa	dB(A)	
VK-01	Min	0	55,0	0,36	0,26	7,0	12,0	61,2	2,2	10,8	95	0,86	70,0	60,0	75,8	1,8	35,0	697x659x126
	Med	0	113,0	0,62	0,48	7,0	12,0	106,5	5,6	12,4	91	1,65	70,0	60,0	145,0	4,8	43,0	
	Max	0	162,0	0,72	0,59	7,0	12,0	122,9	7,1	14,1	88	2,25	70,0	60,0	197,8	7,5	51,0	
VK-02	Min	0	155,0	0,75	0,60	7,0	12,0	129,5	2,3	13,4	90	1,58	70,0	60,0	139,1	2,4	38,0	897x659x126
	Med	0	252,0	1,22	0,98	7,0	12,0	209,6	5,3	13,4	90	2,74	70,0	60,0	240,8	6,3	46,0	
	Max	0	320,0	1,42	1,17	7,0	12,0	243,8	7,0	14,1	88	3,91	70,0	60,0	343,8	12,0	53,0	
VK-03	Min	0	248,0	1,11	0,91	7,0	12,0	190,9	5,5	14,0	88	2,92	70,0	60,0	257,0	6,9	39,0	1097x659x126
	Med	0	367,0	1,69	1,37	7,0	12,0	290,4	11,3	13,8	89	3,96	70,0	60,0	348,1	11,7	47,0	
	Max	0	461,0	1,96	1,63	7,0	12,0	336,1	14,6	14,4	88	4,70	70,0	60,0	413,2	15,8	53,0	
VK-04	Min	0	370,0	1,63	1,34	7,0	12,0	279,0	6,9	14,2	88	2,68	70,0	60,0	235,5	4,1	40,0	1297x659x126
	Med	0	453,0	2,23	1,77	7,0	12,0	383,2	12,3	13,3	90	4,62	70,0	60,0	406,1	11,3	48,0	
	Max	0	576,0	2,40	2,01	7,0	12,0	411,8	14,1	14,6	87	6,61	70,0	60,0	580,9	22,0	54,0	
VK-05	Min	0	426,0	1,78	1,49	7,0	12,0	306,1	5,9	14,5	87	5,80	70,0	60,0	509,4	11,4	40,0	1497x659x126
	Med	0	494,0	2,79	2,12	7,0	12,0	478,2	13,7	12,2	92	6,57	70,0	60,0	576,4	14,4	49,0	
	Max	0	648,0	3,23	2,56	7,0	12,0	554,2	18,2	13,2	90	8,20	70,0	60,0	720,4	22,0	55,0	

Inl. Temp. Air - Cooling	25	°C	Inl. Temp. Air - Heating	20	°C	Standard Airflow
Inl. Rel. Hum. Aria - Cooling	50	%	Heating Coil			Fluid WATER

3. <u>Radiators pos B4:</u>

Steel radiator made of sheet metal, composed of two collectors Φ 30 mm with flat pipes 70x8 mm welded upon it, one-sided (width 95 mm) or two sided (width 160 mm) with distance of 30 mm.
Radiators are factory protected with anti-corrosive substance and painted in finish layer in RAL according to the choice of the interior architect.
Together with the radiators, the following items must be delivered: exhaust and drain cocks and wall girders for the radiators.

DIMENSIONS AND TECHNICAL CHARACTERISTICS OF THE RADIATORS

H mm	N mm	A m^2	V dm^3	M kg	s_k %	q_{ms} kg/h	Exp. n	Φ_L=ΔT 50 K EN 442 Watt
210	170	0.039	0.12	0.451	21	1.42	1.20	16.5
280	240	0.050	0.15	0.572	18	1.75	1.20	20.4
350	310	0.060	0.17	0.682	22	2.08	1.21	24.2
405	365	0.066	0.19	0.759	19	2.32	1.21	27.0
500	460	0.080	0.22	0.913	20	2.74	1.21	31.9
600	560	0.095	0.25	1.079	20	3.17	1.22	36.9
700	660	0.110	0.29	1.243	20	3.60	1.22	41.9
800	760	0.125	0.32	1.419	20	4.02	1.23	46.8
900	860	0.140	0.36	1.584	20	4.45	1.23	51.8
1000	960	0.155	0.40	1.749	20	4.88	1.24	56.8
1200	1160	0.185	0.47	2.090	20	5.76	1.25	67.0
1400	1360	0.215	0.55	2.442	20	6.66	1.26	77.5
1600	1560	0.245	0.62	2.761	20	7.59	1.26	88.3
1800	1760	0.274	0.69	3.091	19	8.56	1.28	99.5
2000	1960	0.304	0.76	3.432	19	9.54	1.29	111.0
2200	2160	0.334	0.84	3.762	19	10.58	1.29	123.0
2400	2360	0.364	0.92	4.114	19	11.69	1.30	136.0
2600	2560	0.394	0.99	4.444	18	12.81	1.31	149.0
210	170	0.069	0.17	0.759	14	2.52	1.28	29.3
280	240	0.090	0.24	1.023	14	3.12	1.28	36.3
350	310	0.111	0.29	1.254	14	3.69	1.28	43.0
405	365	0.127	0.33	1.419	13	4.13	1.29	48.0
500	460	0.155	0.40	1.760	13	4.86	1.30	56.5
600	560	0.185	0.47	2.090	13	5.61	1.30	65.2
700	660	0.215	0.54	2.431	13	6.34	1.30	73.7
800	760	0.245	0.62	2.761	12	7.06	1.31	82.1
900	860	0.275	0.69	3.102	12	7.77	1.31	90.4
1000	960	0.305	0.76	3.432	12	8.49	1.31	98.7
1200	1160	0.364	0.91	4.103	12	9.89	1.30	115.0
1400	1360	0.420	1.07	4.763	12	11.33	1.32	132.0
1600	1560	0.484	1.20	5.445	12	12.81	1.33	149.0
1800	1760	0.543	1.34	6.116	12	14.27	1.34	166.0
2000	1960	0.603	1.49	6.787	12	15.73	1.34	183.0
2200	2160	0.663	1.64	7.458	12	17.28	1.35	201.0
2400	2360	0.719	1.80	8.119	12	18.83	1.35	219.0
2600	2560	0.747	1.94	8.800	12	20.44	1.36	237.7

In the Bill of quantities the following marks are used:

xx-xxx/xx/xx – number of sections-height/width/spacing between sections

4. <u>Pre-insulated pipes pos. B7:</u>

Steel pre-insulated pipes according to DIN 2440 and DIN 2448 with polyurethane heat insulation density thickness 27-32 mm with the following features:

- density 70-80 kg/m3,
- thermal conduction coefficient 0,027 W/mK,
- compression strength at 10% deformation 0,26-0,4 Mpa

Outer casing is a high density polyethylene (PEHD) pipe with the following features:

- medium density 0,96 g/cm3,
- thermal conduction coefficient 0,42 W/mK,
- softening temperature 125 □C,
- completely impermeable and corrosion and shock resistant

System for monitoring of moisture in insulation is comprised of conductor in insulation and parts which are installed during assembly of pipes.

Type and scope of the monitoring system to be chosen in cooperation with pipe manufacturer and the designer/architect.

5. Pipeline insulation

Insulation of pipelines laid inside the facility should have technical features not less than the minimum listed below:

- temperature scope: -40 □C do +105 □,
- heat conductibility (DIN 52 612) : 0,034 – 0,038 W/mK,
- resistance to water steam diffusion (DIN 52 615): >7000 μ
- behavior during fire/fire characteristics (DIN 4102): class B1 – "difficult to ignite", self-extinguishing, non-dripping, does not transfer fire
- chemical resistance: resistant to chemicals used in construction works,
- material: sponge-like material based on synthetic closed-cell caoutchouc/rubber, with no asbestos, FCKW, HFCKW, formaldehydes and cadmium

AIR-HANDLING UNITS

Air-handling units must be made and assembled in a way which will prevent air permeability during anticipated pressures, which will be proved by testing in sub pressure of 400 Pa.

Housing

for air handling units is an isolated panel, steel sheet plastic-coated on the outer side and zinc-coated on the inner side, according to the EN 10142.
With the maximum static pressure of the fan the panel must not be distorted more than 1/120 of its normal size.
The insulation that has min 50 mm thickness must be fastened with no possibility for movement, and during operation the insulation material must not fall off and mix with airstream.
The framework for the housing is self standing.
The housing should have openings which are large enough to enable control of the elements inside the housing.

Filter section

should be box-type, minimum class G3 with zinc-coated housing enforced with zinc-coated net, be stable on the temperature up to 90 □C

Fan section

must ensure uniform air flow through the unit, be delivered with flexible connections, shock absorbers and connections for measuring of differential pressure.

Heaters and coolers

are made of copper pipes according to EN 12451 with copper blades, openings for drainage and exhaust, tested with pressure 1,5 times larger than the nominal one.

Plate type recuperator

composed of load bearing framework made of zinc-coated steel profiles and honeycomb aluminum panels, usage level min 50%

Water drop eliminator and condensation container

made of steel sheet with double layer of epoxy paint or other similar protection.

Grilles

with axle for mounting of electric drive with reverse blades and sealers.

Control unit cabinet

contains all elements for charging/feeding, control and automatic regulation in accordance with design/design pattern.

Pre-insulated panels for air channels:

Pre-insulated panels made of PU foam, lined with aluminum foil on both sides, with the following characteristics:

- insulation type: PU foam without asbestos, FCKW and HFCKW thickness 21 mm,
- heat conductibility 0,02 W/mK,
- density 48 kg/m3,
- maximum pressure: 1750 Pa,
- surface of Al foil: inner side smooth – outer side rough,
- inner/outer foil thickness: 80 μm/80 μm for internal channels , and 200 μm/200 μm for channels laid below floor,
- aluminum foil protected with polystyrene varnish, weight 3 g/cm2,
- fire-resistant class B1 according to DIN 4102

All panels from which channels are made must have manufacturer sign and production date.

Diffuser, pressure and exhaust grilles

Whirlpool diffusers with air jet spoilers/routers and connection box with regulatory valve. Connection box and front facing are made of galvanized steel sheet and spoilers/routers are made of plastic.
Front facing in the color chosen by the architect.
Line diffusers are made of aluminum sections with air jet spoilers/routers and connection box made of galvanized steel sheet.
Front facing in the color chosen by the architect.
Hemisphere shaped multi-jet diffusers made of synthetic material with movable device for adjustment of quantity and adjustment disk for air jet direction.
Connection piece and ring mask/facing are made of painted steel sheet.
Color of the diffuser is black or white, according to the choice of the interior architect.

Pressure and exhaust grilles are made of extruded aluminum sections according to EN 485, EN 515 and EN 573, color according to the choice of the architect, with flow regulator with pivoting reverse or sliding blades.
Diffusers and grilles must have technical characteristics listed on the drawings and Bill of quantity with the level of sound pressure which must not exceed 30-40 dB in the areas where people reside, depending on the purpose of the room.

Note:
The equipment that was not listed in HVAC is described in detail in the Bill of Quantity.

BOILER ROOM

1.INTRODUCTION

Within the development of the design of architectural renovation of City Hall – Sarajevo there is mechanical design of HVAC installations-heating, cooling and ventilation that serves as the base for developing the design of boiler room and cooling facility.
The design of boiler room and cooling facility for production of hot and cold water for the needs of HVAC installations is separate unit and the space itself is defined by the above mentioned design.
According to that design, boiler and cooling facility will be located in the area that stretches through the ground floor and basement and it represents unique area with interior stairways, with direct access from entrance part to the facility and back-up access from the outside.
Pursuant to Terms of Reference, mechanical design of the boiler room and cooling facility includes boiler facility that will use as operating fuel natural gas from city network and as reserve liquid fuel – extra light heating oil, and cooling facility with compressor and vaporizer in the area of facility and air condenser at the roof of the facility.
During the development of the design the Contracting Authority obtained an information on a possibility to connect to the city network that was enclosed by the gas distributor and technical solution for connecting the boiler room through regulation – metering station 100(200,40)/25 mbar that will be built in the area of the boiler room.

Based on the HVAC installation design, estimates of the designer on required reserve capacity, data from technical solution by gas distributor and architectural design, developing of mechanical design of the facility for production of hot water for heating and cold water for cooling of the space has commenced.
The area of facility from the standpoint of location, type of building structures, position of exterior walls and openings meets the requirements set forth in the Rulebook what is separately addressed in the general part of the design.

A. BOILER ROOM

1.MAIN DATA ON FACILITY

- capacity: 800 kW,

- operation medium: hot water 80/60 °C,
- fuel: natural gas and heating oil,
- lower heat capacity of fuel: 33.380 KJ/Nm^3 for gas and 41.000 KJ/kg for liquid fuel,
- gas pressure in the network: Pnom(Pmax/Pmin) = 100(200/40) mbar,
- gas pressure in the boiler room : Pnom = 100 mbar
- position of the boiler room: in the building,
- position of liquid fuel storage: buried,
- monitoring: constant,
- onnection to gas network: polyethylene pipe according to requirement of gas distributor

2.CAPACITY OF THE BOILER ROOM

Capacity of the boiler room has been determined based on HVAC installation design of the building and estimate for required reserve. According to the design of installations in the building, the need for thermal energy is **641 kW**, out of which the main heating is **420 kW**.
In determining the capacity of facility and individual boilers adopted was the principle whereby single boiler may meet demand of the main heating at the designed temperature, which results in **total capacity of the boiler room 2x400 = 800 kW.**

3.BOILERS

Q = 800 kW, capacity of the boiler room

Load of single boiler is:

$$Qo=Qs/\square = 400/0,93 = 430 \text{ kW}$$

Load of the boiler room: **Qk = 430x2 = 860 kW.**

Other characteristics of the boiler room are:

- overpressure in fireplace ..... 0,30 kPa
- resistance to water flow ..... 0,5 kPa
- temperature of smoke gases.. …..... 180/130 □C
- nominal load ..... 430 kW

4. BURNERS

designed burners are combined – for combustible natural gas and extra light heating old and have the following characteristics:
- sliding two level regulation in operation with gaseous fuel,
- two level regulation in operation with liquid fuel,
- fan energy in rating of 400 kW greater than resistance in fireplace that is 0,3 kPa,
- flame head is open,
- in front of burner gas fittings will be placed R 6/4" that is comprised of:
- closing valve – ball tap,
- gas filter ,
- pressure regulator Pul/Piz = 25/17 mbar)

- double electromagnetic valve class "A",
- automatic control of impermeability as,
- pressure wickets for minimum gas pressure,
- pressure wicket on valve for gas (starting load),
- pipe connecting elements and manometers.

The structure of gas fittings and equipment meets requirements of applicable regulations for gas ventilator burners for connecting pressure up to 0,1 bars.

5.SELECTION OF GAS EQUIPMENT

According to technical solution of gas distributors the boiler room will be connected to gas pipeline with gas pressure 100/200740 mbars.
Same technical solution which is attached to this design provides for gas equipment such as:

- Emergency valve on connection gas pipeline,
- Connection gas pipeline made of polyethylene in the ground and made od steel through the building,
- Regulation – metering station with meter G 65 and other equipment according to scheme from technical solution.

The route of gas pipes towards regulation – metering stations (RMS) is defined by technical solution of the gas distributor, and from RMS to gas ramp of the burner is shown in the attached drawings.
Assembly and testing of gas pipes is performed according to technical conditions from this design.

6. LIQUID FUEL INSTALLATION

Liquid fuel – extra light heating oil will be stored in buried tank with volume 10000 liters what according to calculated maximum consumption with 10 – hours daily operation may serve as reserve fuel for operation of boiler room for the duration of 11 days.
The tank is with double wall, with hydro insulation, equipped with connections for filling, outtake and return of fuel, exhaust line with the device for leakage control.
Above inspection opening of the tank build in concrete manhole with lid, dimensions 800x800 mm, and under the lid there will be tray with fine sand.
Oil lines from the tank to burner are made of copper insulated pipes that are laid partially in ground and partially within the existing channel. For maximum capacity of oil pumps of the burner of 140 l/h, speed in oil pipeline Φ 15x1 mm is 0,3 m/sec.
In front of burner oil filters will be built in with stop and non-returnable valves and in the tank non-returnable floor valve.

7. CHIMNEY SYSTEM

Outtake of smoke gases will be done through chimney made of fire-clay pipes with insulation and coat. Connection of the boiler to chimney will be done through smoke pipe made of stainless steel sheet with insulation. Cross section and the height of a chimney are selected from the catalog of manufacturer and it totals 300 mm, and the total height is 27 m, and considering neighboring buildings it exits from the zone of “forbidden exit”.

Controlling calculation of the chimney for adopted cross section and height, for both types of fuel was performed and demonstrated in tables attached at the end of technical description.

8. TEMPERATURE REGULATION AND PROTECTION OF BOILERS

It is anticipated that boilers be in constant operation and that heating fluid – hot water in boilers be on permanent temperature of 70-80 □C, and regulation for individual systems in the facility is performed applying regulation circles with mixing valves.
For protection of boilers against low temperature of returnable line provided is the system with protection pumps that are thermostat operated on returnable lines.
Pumps are dimensioned on 30% flow through boiler and resistances in boiler circle. Besides, electric engine switches that are operated by boiler regulator

9. WATER CIRCULATION

In the area of boiler room planned are circulation pumps for water circulation in specific systems, dimensioned based on the data from the design of installation in the building and resistance in installation within the area of boiler room as follows:

System - branch-	flow	dPinst	dPmj.v.	dPreg.v.	dPkot	dPuk	Pump	Performance
	l/h	kPa	kPa	kPa	kPa	kPa	(l/h/kPa)	
Ventilator convectors verticals GH1	12805	42,0	10,0	3,0	13,0	68,0	15000/70(*)	electronic
Ventilator convectors verticals GH2	10084	40,5	5,0	3,0	13,0	61,5	13000/65(*)	electronic
Ventilator convectors verticals GH3	10849	40,8	5,0	3,0	13,0	61,8	15400/75(*)	electronic
Floor heating	6817	49,1	4,2	3,0	13,0	69,3	6900/73	electronic
Heaters of chambers	8867	42,2	-	7,26	13,0	62,5	8900/75	electronic
Boiler	4000	25	-	4,34	13,0	42,3	4000/45	standard

(*) – pumps in the hot water system for verticals GH1-GH3 selected same as in the cold water system so they would serve as a reserve to each other.

10. EXPANSION SYSTEM

10.1. Expansion tank

Expansion system is with closed “low placed” membrane expansion tanks, specially for each boiler. Volume of expansion tanks is calculated based on estimated content of water in installation that is approximately **7.000 liters,** whereby expansion of water during heating is approximately 200 liters.

Two expansion tanks are adopted with following characteristic.:

- Total volume of the tank is 500 **liters**,
- Initial pressure 2,0 bars,
- Pressure required for activating safety valve 3,0 bars,
- operation pressure of installation 2,5 bar.

Besides expansion tank, boilers are ensured with spring valves R 6/4" with opening pressure 3,0 bars.

10.2. Other safety equipment

In accordance to DIN 4751-2 boilers are equipped with:
- temperature regulator,
- double temperature stop,
- maximum pressure stop and
- ensuring water level.

11. CHEMICAL PREPARATION OF WATER

For protection of the system against occurrence of scale it is anticipated to install ionic water softener capacity 3,0 m^3/h, with automatic regeneration.

12. SPACE VENTILATION

Pursuant to Rulebook for gas boiler rooms the size of ventilation openings is:
$Ao = 5.8 \times Q = 5,8 \times 800 = 4640\ cm^2$
$At = 1/3\ Ao = 1/3 \times 4640 = 1546\ cm^2$
Air intake is through exterior grille and existing duct and over grille in floor of basement part of the boiler room over fire resistance cover flap and metal sheet duct towards above the roof of the building.
Efficient surfaces of grille are at least equal to calculated ones.

13. OPERATION OF BOILER ROOM

Operation of boiler is automatic.
Besides control and regular maintenance other type of service is not required.
Thus, in accordance to Rulebook for gas boiler rooms, the boiler room will be defined as facility with AUTOMATIC OPERATION AND CONSTANT MONITORING.

B. COOLING FACILITY

Cooling facility is dimensioned according to data from HVAC installations according to which the total cooling load, with factors of coincident usage, is **248 kW**.

Due to limited conditions for locating cooling generator of compaction performance, selected is "split" system with condenser in the area of facility and air cooled condenser at the part of flat roof of the building.

1. CHARACTERISTICS OF FACILITY

Pursuant to cooling load of the facility and intention to realize certain reserve the facility with following technical characteristics is provided:
- nominal cooling capacity of the compressor 265 kW,
- screw "low noise" compressor with step less capacity regulation 30-100 %,
- usage rate (EER) min 3,4,
- condenser capacity 342 kW at t=35 □C,
- cooling medium R 134a,
- resistance on water side of vaporizer 40 kPa

2. OTHER PART OF INSTALLATION

2.1. Installation of cooling medium

Pipe connection between compressor and condenser will be realized by copper pipes according to principle as indicated in drawings and schemes, and final solution will be given by manufacturer of cooling generator.
Pipes are led by existing vertical duct, joined by welding in protective atmosphere of inert gas and insulated steam resistant insulation.
Assembly and testing of these pipes should be done in accordance to manufacturer's instruction.

2.2. Cold water installation

Cold water installation is partially autonomous and partially common with hot water system.
Given the intention to realize the possibility as to heat one part of building and cool another at the same time as well as for "calmer" operation of compressor planned is to build in compensation tank of cold water with primary pump, and secondary pumps on connections of specific branches.
Pumps of ventilator convector system may serve both for heating and cooling, that is they can serve as a reserve to each other.

Characteristics of pumps are selected based on the data from HVAC installations in the building, and resistances that occur in the pipeline, equipment and fittings in the area of facility, as shown in the following table:

System - branch-	flow	dPinst	dPmj.v.	dPreg.v.	dPkot	dPuk	Pump	Performance
	l/h	kPa	kPa	kPa	kPa	kPa	(l/h/kPa)	
Ventilator convectors verticals GH1	14590	57,0	-	3,0	7,0	67,0	15000/70	electronic
Ventilator convectors	13029	52,8	-	3,0	7,0	62,8	13100/65	electronic

verticals GH2								
Ventilator convectors verticals GH3	15416	61,5	-	3,3	7,0	71,8	15400/75	electronic
Floor heating	2000	20,0	10,0	3,0	7,0	40,0	2000/45	electronic
Heaters of chambers	17897	63,7	-	3,0	7,0	73,7	17900/75	electronic
cooling machine	45600	5,0	-	-	40,0	45,0	45600/50(*)	electronic

(*) check after selecting cooling machine

Temperature regulation cooling regime will be realized locally – on the air side of ventilation convectors and mixing valves on coolers of air conditioning chambers.
For compensation of heat dilatation of cooling water membrane expansion tank is provided of volume 200 liters, with initial pressure of air /nitrogen 2,0 bars, all calculated provided that under-pressure occurs in the system.
Besides the tank, on connecting pipes of vaporizer installing of membrane safety valve is planned.

3. CENTRAL MONITORING AND DIRECTING

Greater part of the device that belong to the facility for producing hot and cold water will be connected to central monitoring and directing system with the goal of monitoring the status of specific segments of the facility, changes of set parameters, switching on/off etc. Principle scheme of regulation and direction is attached to the design.

DECORATIVE PAINTING RESTORATION DESIGN

INTRODUCTION

Research was based on the probe examination of painted and, to some extent, mortar surfaces, and it objective was to disclose original and authentic layers of painted decorations in different places.
The design documentation leans on all available material from the archives, as well as the earlier reconstruction designs.
The research results define the original paint technology and painting techniques, which was necessary for the restoration of the painted decorations.
Besides that, the paints and binders were analyzed.
The execution of this design included a number of qualified experts in this field.
Based on the functions of different areas in the Town Hall that are decorated and their characteristics, the design is divided into chapters, as follows:

DECORATIVE PAINTING RESTORATION – PROCEDURE

The results and findings of the research, micro-stratigraphic and chemical analysis of the decorative painting in the interior of the Sarajevo Town Hall were used as basis for the complete documentation and record drawings for the restoration, reconstruction and conservation of the decorative painting.
The design was done in classical and digital form.
Planning documents contain descriptions of all positions divided by rooms and mark all elements and details of decorative painting in the given rooms.
All sketches that will be used for the reconstruction include color schemes.
Positions that will remain (fragments of the original painted decorations) will be conserved and restored using the usual conservationist procedure.

CONSERVATION AND RESTORATION WORKS

Conservation procedures will be applied on the original positions of the painted decorations that can be kept, as described in the research works, which includes the following treatment:

MECHANICAL CLEANING (DRY)

Cleaning decorations from dirt – carefully with cotton tampons, sponges and soft brushes. If necessary, vacuum cleaned over protective nets. If some painted surfaces prove stable, medical scalpels and similar tools can be used in the cleaning process.

CHEMICAL CLEANING

This treatment includes cleaning painted surfaces with mild solutions, such as alcohol diluted in distilled water. It needs to be done very carefully (only tapping) to remove the dirt that could not have been removed mechanically.

DECORATIVE PAINTING FIXATION

All painted decoration need to be fixated as the research showed that the paint can be wiped off.
Fixation is done with Polaroid solution B72 in xilol or Primal AC33 emulsion or equivalent diluted in water.
The fixative concentration is 3-5 %.
- filling minor damages on painted decorations
Filling is done with fine gypsum-lime plaster.

REMOVING OLD "GILDING"

Moldings and other designed elements decorated in fake gilding, which are currently cracked or damaged, should be restored to replace larger damaged part with new ones made of gypsum-lime plaster and sanded to achieve smooth surfaces necessary for the application of new "gilding".

APPLICATION OF NEW GILDING

The elements that had gilding finishing are currently in poor shape. Due to exposition to elements, they either oxidized or are damaged, dented, cracking or can be wiped off, so they cannot be kept as they are, but need to be coated in new "gilding".
Gold leaves are applied to well prepared surface by mixture paste and finished by lacquer coating.

FINAL CLEANING

This procedure is a combination of dry and chemical cleaning.
Its objective is to remove all possible remaining dirt or traces of the procedures done on the surfaces.

DECORATIVE PAINTING RESTORATION

This procedure includes restoration and retracing repaired cracks or minor damages, and preserved surfaces without paint.
The restoration will be done in acrylic paints of well-known suppliers, such as *Maimeri, Lefranc & Bourgeois* and *Winsor & Newton* or equivalent, in colors matching the chromatic abundance of the original design sketches and preserved fragments.
Only with these paints or strictly equivalent is it possible to achieve the full restoration of the original decorations done in paste tempera.
There is another reason to use these paints and is the fixatives they use – Paraloid B72 and Prima AC33 Kopolimeri Akrivati therefore any eventual replacing product shall ensure equal or better characteristic respecting the criteria or the restoration.
Used as fixatives on the original decorations, they replace the original binder – paste, which has diluted in time and lost binding component.

DECORATIVE PAINTING RECONSTRUCTION

Most of the wall decorations in the interior of the Sarajevo Town Hall are missing.
They can be reconstructed based on the design documentation.
Painted details are executed on the prepared gypsum-lime plaster surface according to the following procedure:

- Basic color paint coat according to the sketch in the design or preserved sample with on previously prepared surface coated in Primal AC 33 4-5 % solution, or adequate surface according to the instructions of the selected paint supplier, such as *IDROPAINT ART. F.LLI RACCANELLO S.P.A or equivalent.*
- Surface for the gilding need to be smooth to achieve the golden effect.
- Gilding is done with gold leaves applied with mixture adhesives on "*bolus*" surface with final sheer lacquer coating.
- Transferring decorative motives from sketches to the walls and ceilings is done according to 1:1 drawings.
- Decorative motives will be hand painted with adequate brush. Stencils and painting one color over the other should be avoided as they would diminish the value of the decorations.
- Decorations should be painted according to the color scheme present on the preserved fragments of painted decorations, with trial sample approved by the head conservationist.
- Paints to be used are acrylic wall paints by renowned suppliers, such as *Maimeri, Lefranc & Bourgeois* and *Winsor & Newton or equivalent*.
- The restoration of wall surfaces painted to resemble stone can be done in other paints adequate for this type of work, according to the technology instructed by the paint producer.