

**VOLUME 3**  
**TECHNICAL SPECIFICATIONS**

## Table of Contents

No.	Item	page
<b>1.</b>	<b>TECHNICAL SPECIFICATIONS FOR ARCHITECTURAL AND CIVIL ENGINEERING WORKS</b>	<b>9</b>
<b>1.1.</b>	<b>Architecture and history of the building</b>	<b>9</b>
1.1.1.	Introductory notes on history and importance of the building	9
1.1.2.	Protection status	12
1.1.3.	Reasons for interventions	12
1.1.4.	Existing data	13
1.1.5.	Importance of the monument	14
1.1.6.	Present state of the building and overview of necessary interventions	15
1.1.7.	Conservation suggestions	16
<b>1.2.</b>	<b>Main design of remodeling and revitalization of the Fortress „Kastel“ – architectural phase</b>	<b>17</b>
1.2.1.	Introductory notes on the design	17
1.2.2.	Functions and organisation of the buildings	17
1.2.3.	Overview of built areas	19
1.2.4.	Scope of the foreseen works	19
1.2.5.	Overview of the standards applied for the works and materials used	21
<b>1.3.</b>	<b>Main design of remodeling and revitalization of the Fortress „Kastel“ – constructive phase</b>	<b>21</b>
1.3.1.	Introductory notes on the design	21
1.3.2.	Analysis of the present state of construction	22
1.3.3.	Scope of the foreseen works	22
1.3.4.	Technical conditions for execution of works	22
1.3.5.	Overview of the standards applied for the works and materials used	28
<b>1.4.</b>	<b>General technical conditions and specifications for execution of building works, specialists' trades and restoration works</b>	<b>29</b>
1.4.1.	General technical conditions for execution of works	29

1.4.2.	Preliminary works	36
1.4.3.	Clearance works	38
1.4.4.	Ground works	41
1.4.5.	Concrete and reinforced concrete works	44
1.4.6.	Reinforcement works	50
1.4.7.	Masonry and stone works	50
1.4.8.	Carpentry works	55
1.4.9.	Roofing works	57
1.4.10.	Insulation works	59
1.4.11.	Joinery works	62
1.4.12.	Ceramic tiling works	64
1.4.13.	Floor installation works	67
1.4.14.	Sheet metal works	68
1.4.15.	Locksmith's works	70
1.4.16.	Interior painting works	73
1.4.17.	Façade painting works	75
1.4.18.	Injection works	76
1.4.19.	Plasterboarding works	78
<b>2.</b>	<b>TECHNICAL SPECIFICATIONS FOR WATER SUPPLY AND SEWAGE WORKS</b>	<b>80</b>
<b>2.1.</b>	<b>Introductory notes</b>	<b>80</b>
2.1.1.	General notes	80
<b>2.2.</b>	<b>Scope of the foreseen works</b>	<b>80</b>
2.2.1.	Water supply installation	80
2.2.2.	Sewage installation	81
2.2.3.	Hydrant network	81

2.2.4.	Manholes	82
2.2.5.	Sanitary fixtures, fittings and accessories	82
2.2.6.	Supervision and authorization for each phase of works and installing material	82
<b>2.3</b>	<b>Technical conditions for execution of works</b>	<b>83</b>
2.3.1.	Preliminary measures	83
2.3.2	Laying down pipelines	83
2.3.3	Pipes in the ground	83
2.3.4	Pipes in structures	84
2.3.5	Pipes protection	84
2.3.6	Joints	85
2.3.7	Pipes fastening	85
2.3.8	Pipe fittings	85
2.3.9	Sanitary fixtures and accessories	85
2.3.10.	Installation testing	85
2.3.11.	Contractor's obligations	87
2.3.12.	Overview of regulations and standards applied	87
<b>2.4.</b>	<b>General technical specifications for the works on the water supply and sewage</b>	<b>88</b>
2.4.1-2.4.37.	Materials and equipment	88
<b>3.</b>	<b>TECHNICAL SPECIFICATIONS FOR ELECTRICAL INSTALLATIONS WORKS</b>	<b>95</b>
<b>3.1.</b>	<b>Introductory notes</b>	<b>95</b>
3.1.1.	General notes	95
3.1.2.	Technical regulations	95
3.1.3.	Control regulations	96
<b>3.2.</b>	<b>Scope of the foreseen works</b>	<b>97</b>
3.2.1.	General notes	97

3.2.2.	Scope of the foreseen works	97
3.2.3.	Supervision and authorization for each phase of works and installing material	99
3.3.	<b>Technical conditions for execution of works</b>	99
3.3.1.	Overview of regulations and standards applied on designing and performing works and for installed materials	99
3.4.	<b>General technical specifications for the works on the electrical installations – high voltage</b>	100
3.4.1.	Specification for installed and applied materials	100
3.4.1.1.	General notes	100
3.4.1.2.	Main distribution cabinet and distribution cabinets	100
3.4.1.3.	Lights for general purpose	101
3.4.1.4.	Lights – panic lights	102
3.4.1.5.	Conductors	103
3.4.1.6.	Jacks (outlets) and switches	104
3.4.1.7.	The conductors for the heating and ventilation	105
3.4.1.8.	Lightning rod installation	105
3.5.	<b>General technical specifications for the works on the electrical installations – low voltage</b>	106
3.5.1.	Technical conditions	106
3.5.2.	Technical conditions – fire alarm system installation	106
3.5.2.1.	Fire alarm system installation	107
3.5.3.	Technical conditions – telephone installation	107
3.5.3.1.	Telephone installation	109
3.5.4.	Video surveillance installation	109
3.5.5.	Intrusion and fire detection installation	110
4.	<b>TECHNICAL SPECIFICATIONS FOR HVAC INSTALLATION WORKS</b>	111
4.1.	<b>Introductory notes</b>	111
4.2.	<b>Scope of the foreseen works</b>	111

4.2.1.	Heating and cooling installation	112
4.2.2.	Ventilation installation	113
4.2.3.	Heating substations	114
4.2.4.	Supervision and authorization for each phase of works and installing material	115
4.3.	<b>Technical conditions for execution of works</b>	115
4.3.1.	Overview of regulations and standards applied	115
4.3.2.	General technical conditions for air conditioning and ventilation installations	115
4.3.3.	Special technical conditions for air conditioning and ventilation installations	117
4.4.	<b>General technical specifications for the works on the HVAC installations</b>	119
4.4.1.	General	119
4.4.2.	Heating devices	120
4.4.3.	Pipe network	122
4.4.4.	Automatics	125
4.4.5.	Electrical installations	126
4.4.6.	Installing of installation	126
4.4.7.	Installation testing	126
5.0	<b>TECHNICAL SPECIFICATIONS FOR EXECUTION WORKS ON ELEVATOR AND LIFTING PLATFORM</b>	128
5.1.	<b>Introductory notes</b>	128
5.1.1.	General notes	128
5.2.	<b>Scope of the foreseen works</b>	128
5.2.1.	Hydraulic passenger elevator	128
5.2.2.	Lifting platform for disabled persons	128
5.2.3.	Supervision and authorization for each phase of works and installing material	129
5.3.	<b>Technical conditions for execution of works</b>	129
5.3.1.	Overview of regulations and standards applied	129

<b>5.4.</b>	<b>General technical specifications for the works on the elevator and lifting platform</b>	<b>129</b>
5.4.1.	Preliminary measures	129
5.4.2.	Elevator installation and lifting platform	130
5.4.3.	Driving shaft	130
5.4.4.	Generator room	131
5.4.5.	Lighting, el.installation and main switch	131
5.4.6.	Driving shaft door, cabin and platform cabin	132
5.4.7.	Drive	133
5.4.8.	Electro-hydraulic generator hydraulic installations and pressure relief valve	133
5.4.9.	Control panel	134
5.4.10.	Thermal protection of electric motors	134
5.4.11.	Alarm device	134
5.4.12.	Service control elevator device	134
5.4.13.	Necessary light	135
5.4.14.	The equalization of electric potential on the metal masses	135
5.4.15.	Protection against electric shock, electrical faults and overloading	135
5.4.16.	Maintenance, signs, notices and labels	136
5.4.17.	Main distribution cabinet for the lifting platform	137
5.4.18.	Managerial - control cabinet for the lifting platform	137
5.4.19.	Testing - technical control	137
5.4.20.	Contractor's obligations	137
<b>6.0.</b>	<b>TECHNICAL SPECIFICATIONS FOR THE WORKS IN THE FUNCTION OF FIRE PROTECTION</b>	<b>139</b>
<b>6.1.</b>	<b>Introductory notes</b>	<b>139</b>
6.1.1.	General notes	139
<b>6.2.</b>	<b>Scope of the foreseen works</b>	<b>139</b>

<b>6.2.1.</b>	Fire protection	<b>139</b>
<b>6.3.</b>	<b>Technical conditions for execution of works in the function of fire protection</b>	<b>139</b>
<b>6.3.1.</b>	Overview of regulations and standards applied	<b>139</b>
<b>6.4</b>	<b>General technical specifications of the works in the function of fire protection</b>	<b>141</b>
<b>6.4.1.</b>	Preliminary measures	<b>141</b>
<b>6.4.2.</b>	Sources of danger	<b>141</b>
<b>6.4.3.</b>	Mobile fire extinguishers	<b>142</b>
<b>6.4.4.</b>	Warning signs	<b>143</b>
<b>6.4.5.</b>	Prohibition of use of open fire	<b>143</b>

# **1. TECHNICAL SPECIFICATIONS FOR ARCHITECTURAL AND CIVIL ENGINEERING WORKS**

## **1.1. ARCHITECTURE AND HISTORY OF THE BUILDING**

### **1.1.1. Introductory notes on history and importance of the building**

Kastel Fortress is the historical core of Banja Luka and through the historical epochs it was the backbone of urban development. This representative, large and in many ways unique city fortification, does not deserve a state in which it is today - with ruined and overgrown walls, dilapidated towers, laden passages, wall structures covered with waste, crud and unlighted paths. The authority for the protection of cultural property has tried for decades to provide Kastel better output, a variety of programs and the place in the urban image of Banja Luka belonging to it because of its historical, urban and architectural significance.

A short review of the Kastel history will show the necessity of a comprehensive approach to its rehabilitation, reconstruction, conservation and revitalization, and assistance in selecting the most appropriate future facilities in the fortress and the appropriate forms in which they will be realized.

Archaeological researches of Kastel in 1974 revealed the remains of prehistoric settlements from the Neolithic period and the Bronze Age - 2000 -1800 BC. Its location is characteristic of the so-called Baden culture, which is often found in elevated parts of the river terraces.

The prehistoric settlement in the area of Banja Luka Fortress was followed by ancient civilization, the Roman conquest of Illyrian territory in I and II century BC. Today's Kastel can be identified with the toponym *Castre* logged on a map of the ancient route *Salona - Servitium* (*Salona - Gradiška*). The Roman walls from evenly cut stone blocks and parts of the former Roman fortress of significant proportions are visible in the coastal area of the fort. Some walls of the fort, especially the front wall with the entrance tower, were built of Roman spolia walls and more examples of late Roman bronze coins, ceramics, and a late antique bronze fibula were found inside the fort. The central area of the fortress has the remains of a larger late Roman building, with a semicircular apse - the basilica, probably for administrative purposes.

Archaeological researches in the northeastern part of Kastel, published in 1972, revealed findings from VIII to XII century, which show that the ancient culture in Kastel was followed by early medieval civilizations of Slavic tribes, a typical early Slav urban settlement. The younger layers at the same archaeological site reveal the material characteristic of the Middle Ages, but to a smaller extent.

The name of Banja Luka was first mentioned in 1494 in the Charter of the Hungarian King Vladislav II Jagelović. Fortress of Banja Luka was then in the Hungarian Jajce Province (*banovina*), created after the fall of the Turks in 1463. The charter mentions only one castellan - *Juraj Mikulašić* - in Banja Luka Fortress, which means that in 1494 it was a fort smaller than *Zvečaj* or *Bočac* in which two military commanders were appointed. The Charter did not specify the exact area on which the fortress was located, but a number of researchers believe that it was on the spot of today's Kastel. According to the document from 1527/1528, the fort commander *Andrija Radatović* "... due to indecision and terrified to burn the fortress of Banja Luka, where he was headed ... and hides to a safe place. "

Some travelogues from XVI and XVII centuries, kept the descriptions of Banja Luka and the fortresses that existed in this area. All travelers from XVII century provide information that the city consisted of two fortresses, whose names and exact location are not given, and the data on their mutual distance are imprecise. These travelogues do not clearly indicate

whether both fortresses existed before the Turkish occupation, or else - Lower Banja Luka, today Kastel – was founded in the time of Ferhad - Pasha at the end of XVI century. His vakufnama (endowment charter) from 1587 states a number of buildings created as part of his endowment activities. Some of them are related to the fortress - for example, a bridge on the Vrbas river, originally of wood, later reconstructed with stone supports, was probably connected with the tower on the Vrbas river, an integral part of the fortress, and arsenal, the so-called tophana, was probably located in front of western walls of Kastel. There is a fact that the urban marketplace - market - was moved in 1766 from Donji Šeher to the so-called Donja Banja Luka, but the area below the Castle, by its width and shape, could serve as a market even before this date.

After 1638 Banja Luka was no longer the seat of the Bosnian governor, it stagnated in its urban development, which was very expansive in the period from 1545 to 1638 when it was an administrative and military center of the Bosnian pashaluk (province). In XVIII century, special attention was paid to military facilities inside the fortress. Although the fort also developed in XVII century, it got its final dimensions only during the reconstruction of 1712-1714 during Numan-Pasha Ćuprilić, in the break between two Austrian-Turkish wars. It was expanded after the model of the lowland forts across the Sava river. It was the time when Kastel got its current form of an elongated trapezoid bounded by walls, bastions with towers, and underground passages, while the water trench surrounded it on the north and west side.

The appearance of the fortress in the first half of XVIII century is shown in Austrian maps made during the Austro-Turkish war and the battle of Banja Luka, which took place on 4 August 1737. Maps, written by Austrian officers, show eight bastions and six towers on the peripheral walls. The south-west bastion is the largest, it has not a hexagonal basis as it is today, but is elongated, of rhomboid shape, and another wall was plotted next to it on the west side. Positions of entrance tower and the tower on the Vrbas river are generally consistent with the current situation. At the center of the west wall another tower was plotted between two bastions, and other ones in the middle of the south wall and in the east wall. Three bridges are plotted over the trench - one that leads to the former building of the Residence, or near the present town bridge (Patre bridge), the second in the direction of Patrijarha Makarija Sokolovića street and the third in the direction of today's Čelar street. Ferhat Pasha Bridge over the Vrbas river and a few bridges over Crkvena were plotted as well. At the confluence of the Crkvena into the Vrbas, on the left bank, a čardak is indicated.

More reliable descriptions and drawings of the fortress originate from the eighties of XVIII century, which state that in the interior of the fortress there were casemates, 30 barns for grain and the emperor's barn, they give the length of the ramparts, mention the hexagon bastion on the southwest and on the west side of the wall enclosing a courtyard. Besides eight bastions, two entrances are plotted: one on the west side, between the first and ninth bastion, crossing the trench over a wooden bridge, continuing through the castle and out onto the Ferhad-Pasha bridge. The interior of the fort is divided by a wall in which two towers are plotted. It is indicated that two towers located on the western rampart were built during the battle in 1737.

In the period from the end of XVIII century until 1880, when the Austro-Hungarian rule started geodetic surveys of the town, Turkish authorities were not capable to invest in the construction and expansion of Kastel. The so-called military bathroom was built in the fort in 1826. The only building of military purpose of larger dimensions from this period was built along the south-western walls of the fort around 1865. It is the barracks building, located in the area in front of the ninth bastion, on the bank of the Vrbas, with a retaining wall of tuff, which could represent the remnants of an older building because the building

was built of weaker stones. The foundations preserved remains of reinforcing wooden beams, so it was assumed that the old arsenal was at this point. The building, later called the Barracks for the artilleryman, has a ground floor and first floor, rectangular base with a small projection on the west side and is typologically classified as military building specific to the mid-nineteenth century fortresses. The initial rectangular windows got a semi-circular shape in the Austrian period, through treatment with brick. Judging from the remains of wooden beams on the facade, it can be assumed that the building had wooden verandas, or pathways-watchtowers.

In mid XIX century, the fortress was pretty damaged, but travelers report that it contained many military buildings - warehouses, prisons, powder magazines. At that time, the fortress had more than 50 guns, which indicates that it did not completely lose its military significance.

Austro-Hungarian administration was not interested in the modernization of the fort. There are a few photos that show Kastel from early years after the occupation. They show a moat, a small tower and so-called Captain's lodgings within the south walls, a bastion and a watchtower at the mouth of the Crkvena in the Vrbas. After the demolition of the old fortress bridge, whose appearance is preserved in the engraving from the seventies of XIX century, a wooden bridge was built between 1880 and 1904 in place of today's bridge of Patra. There are also photographs of swimming schools for soldiers and officers - wooden facilities built before the end of the last century, so called *Schwimmschule*.

After the end of World War II until the sixth decade of this century, Kastel was still used for military purposes, but with the loss of its defensive importance, the fortress was more and more neglected. In the past four decades Kastel was used for various purposes - the Museum of NOB (People's Liberation War), a summer theater, catering facilities, children's playground, but the comprehensive works in terms of its revitalization were not carried out.

The Kastel fortress complex encompasses the area within the ramparts of the fortress and the spaces outside the walls which are bordered to the west and north by the street Kolokotronisa, on the east side by the left bank of the river Crkvena, from the bridge to the confluence and from the south by the right bank of the Vrbas to the Patra bridge.

Protection zones were determined in urban structure of the Kastel fortress in the downtown, i.e. protected zones, the first zone of protection, which includes the historic zone and zone of Kastel and influence zone, which directly affects the views and living spaces of Kastel as a cultural good.

The Decision of the Commission to Preserve National Monuments is based on the following criteria:

- A. Time definition
- B. Historical value
- C. Artistic and aesthetic value
  - Quality of workmanship
  - Proportions
  - Value of details
  - Value of construction
- D. Legibility (documentary, scientific and educational value)
  - Material testimony of historical changes
  - Testimony of less known historical periods
  - Testimony of a particular type
- F. Environmental value

- Relation of forms against other parts of a unit
  - Meaning in the structure and image of space
  - The building is a part of the area as a whole
- G. Originality
- Form and design
  - Tradition and techniques
  - Position and placement in place
- H. Uniqueness and representative character
- Unique or rare example of certain type or style
- I. Integrity (ensembles, sites, collections)
- Physical integrity
  - Homogeneity
  - Completeness

The spatial unit 9 is situated within the fortress walls, in its northeastern part. The Eastern yard area with pertaining bastions and the Stone building belong to the Unit 9. The total area pertaining to the Unit 9 amounts to 13 257 m<sup>2</sup>. The Unit 9 is divided into two sub-units: sub-unit 1 is the Stone building itself, with area of 489 m<sup>2</sup>, while the yard foreseen for exhibitions and parts of fortress walls with bastions belong to the sub-unit 2. Their total area amounts to 12 768 m<sup>2</sup>.

The use of Unit 9 is currently inadequate. Only a part of the area is used for a children's open playground, while the resto of plateau remains undeveloped, poorly maintained and unusable. The Stone building, currently out of use, is situated in the Eastern yard, together with other buildings and objects, such as: the Roman milestone, the well, the underground arsenal, the remains of two towers (Tower 5 and Tower 6) and the Captain's house. The foundations of the Captain's house have been preserved and small scale interventions were undertaken there in 1982. Currently, only remains of the foundations of Tower 5 are preserved. The interventions undertaken: the foundations were conserved in 1992. Remains of the Officers' bath and exit to the beach are situated next to the southern fortress wall.

### **1.1.2. Protection status**

In 1950, Kastel was designated a cultural property of the first category, under the Decision no. 02-696-3/62.

At the session of the Commission to Preserve the National Monuments of BiH held from 4-10 May, 2004, the Kastel Fortress was designated a national monument of BiH.

### **1.1.3. Reasons for interventions**

The City of Banjaluka has already invested significant efforts into repair and revitalization of Kastel. After the damaging earthquake of 1969, when many buildings of Kastel were destroyed, the following activities were undertaken:

- The works in the period between 1970 and 1975 were focused on repair of the destroyed and endangered remains in the northern and western part of the fortress;
- Between 1976 and 1984, repair and revitalization works were performed in the following areas of the fortress: southern part of the fortress walls, Tower 2 (new function – café), southern arsenal was transformed into a restaurant, power substation integrated in the western fortress wall was built , the electrical, plumbing and sewage infrastructure were partly built.

However, all those efforts weren't sufficient, so that current state of many building is alarming. The city of Banjaluka has organized an international competition and obtained the preliminary design for reconstruction and remodeling of the fortress Kastel. The design documentation for structural stabilization, restoration and adaptation of the fortress Kastel was compiled based on the results of competition. The present state of the buildings in the Unit 9 is diverse, and ranges from very poor to good.

#### 1.1.4. Existing data

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6. *Idejni projekat rekonstrukcije i revitalizacije tvrđave Kastel u Banjaluci* (Preliminary project for the reconstruction and revitalization of Kastel Fortress in Banjaluka), "Građenje" Joint Stocked Company, Eastern Sarajevo, January 2008

### 1.1.5. Importance of the monument

The Kastel Fortress is a historic town center of Banja Luka, the place of its foundation and backbone of its urban development. The authority for the protection of cultural property has tried for decades to provide Kastel with better output, a variety of programs and the place in the urban image of Banja Luka belonging to it, because of its historical, urban and architectural significance. The material findings, and later written sources and cartographic records enable us to perceive all stages of the origin and development of the fortress. The first archaeological traces go back to the Paleolithic, Neolithic and Bronze ages until the age of the Roman conquest of Illyrian territories. Thus, according to some scholars, the Roman fort, Castro, was an urban area on the place of the existing Kastel. Archaeological research in the northeast part of the Kastel fortress reveal that the ancient culture on the ground of present Banjaluka was replaced by early medieval civilization of Slavic tribes. Many Latin and other texts testify that medieval life around Banjaluka flourished, but do not provide information on the functioning of settlements or fortress in Banjaluka. The very name of the city name was not mentioned until at dusk of middle ages, in 1494. Although the fort developed in XVII century, it obtained its final dimensions in the reconstruction of 1712-1714. In 1826, one of Banjaluka public baths, the so-called Military Bathroom, was built within the fort of Kastel. Majority of changes in the urban part of Banja Luka that happened during last 4-5 decades of Turkish rule, were recorded by travelers, and more accurately, by geodetic maps, developed by the new Austrian government in the period

1880-1884. In the eve of the Austro-Hungarian occupation, the fortress was not modernized. It seems that it was quite damaged in mid XIX century.

The Austro-Hungarian government was not very much interested in the modernization of the old fortress and its use for their own military purposes. One of the few larger buildings of important dimensions that the new government built was a so-called stone building. Since the end of World War II until 1959, Kastel served for military purposes, but with the loss of its defensive importance it was increasingly neglected. The fortress has architectural, artistic, aesthetic, environmental and spatial value.

#### **1.1.6. Present state of the building and overview of necessary interventions**

Ever since it was founded, the fortress has been constatly endangered by various natural and athropogenous damaging effects. The unfavourable natural conditions depend on location, placement, micro-climatic and topographic orientation, insolation and influence of winds, seismic zones etc. Stability and durability of the fortress were often endangered by human influence. The low-quality masonry material, especially weak binder, mortar, can certainly be counted into degradation causes. Influence of wild vegetation at vertical wall surfaces can also be highly negative, especially throughout longer period of time. The most drastic damage occurs as a consequence of natural disasters and land subsidence.

All the factors mentioned were of influence to the present state of Kastel fortress, including wild vegetation influence, damage caused by atmospheric conditions, human influence and strong earthquakes.

#### **STONE BUILDING**

The building is in relatively good state. It was actively used until 2008, and after that only occasionally. The highest level of damage was registered at the zone of crown cornice. Plaster has fell off huge parts of the cornice, the concrete layer has also been partly damaged and the reinforcement was uncovered. The building was after-treated by pointing, but the set-back joints of cement mortar are inadequate in sense of both pointing technique and material.

The long-lasting leakage, coming from poor maintenance of the gutters, caused humidity and staining by fungi. At a few areas, the flaking occurs at stone surfaces.

The intervention level is medium and includes the following works:

- Restoration of the façades (including removal of existing joints and re-pointing works, replacement of singular stone blocks in the wall front, etc);
- Adaptation of interior;
- Removal of the partitions and interior staircase that were added to the original building;
- Repairing the reinforced concrete beams;
- Partial replacement of ceiling and roof constructions.

#### **SOUTHERN RAMPART – SEGMENT FROM THE CASEMATE TO THE BASTION 6**

##### **(segment pertaining to the Unit 9)**

A part of the southern fortress wall that is situated between the Casemate and the Bastion 6 belongs to the Unit 9. The visual observations indicate that the rpresent state of this fortress

wall segment varies at different parts, from satisfactory to very poor. Taken in general, the state is getting worse.

No conservation and restoration interventions have been undertaken from Tower 5 eastwards, i.e. towards the Bastion 6, and this fortress wall is in much poorer state.

Crown parts of the fortress walls are missing at both outer and inner sides, and at some parts entire wall segments above ground are missing. Those spots are at the location of former Captain's house and the neighbouring building, as well the furthest eastern parts of the wall.

- Throughout the long period of fortress wall existence, the joints between the stone blocks were washed out, so that it caused fallout of singular blocks;
- The wild vegetation on the walls penetrated deeply into the wall structure, which contributed to faster fallout of the stone blocks;
- At several places, parts of the wall collapsed. The collapse was a consequence of vegetation influence as well the impact of frost and water. The damage is wide spread so that it is impossible to foresee exactly where the next collapse will occur, since great part of the walls is in poor condition.
- Wooden batch boxes are missing at some parts, which is visible at lower zones of the exterior fortress wall front. State of the batch boxes in the wall interior can only be determined upon additional examinations.
- At some spots, vertical structural cracks are visible. They stretch from the ground level towards the top.
- A part of medieval fortress wall has "slided" towards the Vrbas river. It is necessary to dismantle the entire medieval wall, with prior marking of each stone block, so that the exact position of foundations and the shape of fortress at that part can be determined.

The intervention level is high and includes the following: partial reconstruction of authentic walls, according to existing documentation and analogy with other fortress walls, re-pointing and structural stabilization.

### **ENTRANCE GATE**

The Entrance gate is a part of northern rampart. The greatest damage is structural destabilization of its vault. Weakening of the binder (mortar) at the gate walls is visible, as well as negative impact of smaller vegetation.

### **TOWER 5**

The Tower 5 belongs to the southern fortress wall. Only a part of ground floor level was preserved, which is in a very poor condition. The remains are structurally destabilized, and at parts there is a possibility of collapse. Reconstruction of the tower is foreseen, based on the photographic documentation and analogy with existing towers.

#### **1.1.7. Conservation suggestions**

The reasons for the conservation of the building:

- Stopping further decay of the Kastel and prevention of the total collapse of the part of Fortress;
- Raising public awareness on cultural heritage and historic identity;

- Future use of the Fortress for cultural purposes would improve cultural and touristic capacities of the town.

### **CONSERVATION PRINCIPLES**

The authentic appearance of the Fortress must be restored. The main principle commands minimal intervention that would violate authenticity based on the existing documents and photo documentation. This also implies that original materials and techniques are to be used to the highest extent possible.

### **LEVEL OF INTERVENTION**

Necessary restoration on construction level, retaining authentic appearance based on documentation and photographs.

### **RECONSTRUCTION**

The ideal solution would be to restore original purpose of the building; however original function was for military purposes. It is necessary to give new purpose for Fortress. Given that the building served multipurpose cultural role for a long time, new alternative multipurpose cultural and touristic contents are foreseen (museum, exhibition space, painting studios...)

### **USABILITY AND SUSTAINABILITY**

Some of the uses for the Fortress would be museum, hotel, restaurant, tourist office etc.

### **PUBLIC ACCESS**

It is necessary to prepare a program of tourism development and create touristic contents that include all cultural resources of the area.

### **OTHER BENEFITS**

Improvement of the cultural life of the town and promotion of cultural tourism.

## **1.2. MAIN DESIGN OF REMODELING AND REVITALIZATION OF THE FORTRESS „KASTEL“– ARCHITECTURE PHASE**

### **1.2.1. Introductory notes on the design**

The main design of remodeling and revitalization of the Fortress „Kastel“ has been compiled in accordance with the existing legal regulations – Law on conducting the decisions of Commission to preserve national monuments (Official Gazette of Republic Srpska no. 9, 2002), Law on cultural goods of Republic Srpska (Official Gazette of Republic Srpska 11/95). Photographic documentation from the archives of the Republic institute for protection of cultural, historical and natural heritage of Republic Srpska, Museum of Republika Srpska, as well as the documentation made during determination of the present state of the Fortress have been used for the purposes of design compilation.

Research works were performed before compilation of the design. History of the monument was followed from its building up to the present, and particular attention was paid on the most important building phases. Horizontal and vertical dimensions of the original buildings were fully respected, as well as authentic materials and building techniques.

### **1.2.1. Functions and organization of the buildings**

#### **MUSEUM**

Main purpose of the building is historical museum. In addition to the exhibits inside the building, project predicts realization of main function in public space - the courtyard in the form of exhibitions in open.

Provided solution is flexible and allows maintenance of different exhibitions (conventional, ambiental, promotional, commercial), supporting conferences, ceremonies, events, etc. Designed space has great potential with all necessary infrastructure. Permanent exhibition setting provides conventional - classic exhibition with possibility to change the setting depending on the theme of the exhibition.

Entrance hall with info desk, toilet block with wardrobe, exhibition space and handy storage are designed at the ground floor. It is possible to enter to the exhibition space from the entrance hall by two ways – from two different entrances. Exhibition space is flexible, it can be divided for simultaneously use for two independent exhibitions or as conference hall, in one part of the room, and exhibition space in other.

The attic is organised as administrative and curatorial offices, and sanitary facilities for employees. In this phase is predicted that the attic is not used as a classic administrative space only. It primarily needs to fulfill the educational role that the modern museum spaces have, as a research center and special exhibition space. Having this in mind, spatial modules are projected, with installations sets on the way that is possible to use this space as administrative, educational or exhibition area. In order to use the space to the maximum exhibition space is not defined in separate areas necessary for preparation and organization, but it is provided that certain segments can flexibly allocate with movable panels. This way exhibitions for smaller groups of visitor can be set during the preparations for some other exhibition. At the end, when everything is ready, these separate areas could be united in one space.

Although spatial capabilities are limited, in accordance with the applicable standards, all necessary backing and technical areas are provided.

Cache workshops are not provided inside the building. It is possible to create space for storage and similar ancillary facilities for smooth functioning in a technical sense within the module on the attic or in the ground floor using movable partition panels.

The space is designed so that it is accessible to persons with limited movement capabilities. All rooms on the ground floor and attic are well equipped and dimensioned in order to provide easy access for people with special needs.

## **EASTERN YARD**

### **Tower 5, Landcaping, Southern Rampart**

All buildings (Tower 5) and open spaces are projected as exhibition areas in accordance with main purpose of Unit 9. In addition to the exhibits inside the building, project predicts realization of main function in public space - the courtyard in the form of exhibitions in open.

In accordance to the limited spatial capacities of the towers it is possible to set the thematic exhibition of smaller format. In addition to presentations, the function of contemporary museums is educational, so that it is intended displaying intangible cultural values, overviews of some traditional crafts and customs, workshops with the youngest.

The open spaces in Eastern yard are designed to retain as much of its current environmental values, with lots of greenery and tall vegetation. Retention of existing tall trees and formation of cultivated green areas are predicted. In order to provide good visibility for certain objects, sculptures, etc placed on the green plateaus it is not designed planning new areas with low greenery. Maintenance of conventional, ambiental, promotional or commercial exhibitions is predicted.

The area around the Stone building is scheduled to be paved with stone cubes on larger surface which allows a great number of people to spend time in open, since the Stone building allows the maintenance of conferences, events, etc.

Space for retaining and rest of visitors is designed in the part of the Eastern yard located behind the Stone building. Urban fitting placing is predicted: benches allowing visitors to have a break in the tour through the complex. In other parts of the yard fixed set of urban fitting has not provided. It is possible, in accordance with the program, type of show that takes place, set up mobile elements, panels, pedestals, benches, etc.

In Eastern yard space is not provided for parking and maintaining vehicles. Access for utility vehicles and emergency vehicles, as well as for delivery of exhibition is possible through vehicular pedestrian path on the north side under the special terms. The size of vehicles which could access in the Easter yard is limited by the height of the north gate.

### 1.2.2. Overview of built areas

BUILDING	PRESENT STATE		PROJECTED STATE	
	Net area (m2)	Gross area (m2)	Net area (m2)	Gross area (m2)
Stone building	600.60	903.00	620.82	903.00
Tower 5	45.47	106.95	45.47	106.95
<b>TOTAL:</b>	<b>646.07</b>	<b>1009.95</b>	<b>666.29</b>	<b>1009.95</b>

DIFFERENCE BETWEEN PRESENT AND PROJECTED STATE		
BUILDING	Net area (m2)	Gross area (m2)
Stone building	20.22	0
Tower 5	0	0
<b>TOTAL:</b>	<b>20.22</b>	<b>0</b>

### 1.2.4. Scope of the foreseen works

#### MUSEUM

##### Shaping and materials

The main architectural concept was determined by the need to keep the existing appearance of the Stone building to the greatest extent possible. All interventions were only done with the aim of improving the state of building construction and infrastructure.

As it was necessary to plan additional auxiliary areas (technical rooms) in order to fulfill the complex functional requests, yet also to maintain the ambiental values, it is foreseen for the roof slope to be slightly adjusted, and the parapet height in the attic to be increased, in a way that proportions of the present building aren't violated and at the same time technical requests are fulfilled.

The façade of the building is planned to be kept, with necessary interventions – restoration of the façade (that includes removal of existing joints and repointing, change of singular stone blocks of the wall fronts etc). The visible parts of the entrance plateaus, the ramp and the retaining walls are lined with stone blocks, or pebble dashing, or trowel finished (polished) concrete. All exterior window glasses are low-emission, with convenient thermal properties for this type of building. It is not allowed to install any advertisements on the

building itself or the public place around it without prior approval of the city administration body and the Republic institute for protection of cultural, historical and natural heritage of Republic Srpska.

#### Interior of the building

##### Floors

At the ground floor level, the floors are of stone slabs, set in cement mortar over concrete base, thickness 3 cm, size over 0.5 m<sup>2</sup>. The staircase is of reinforced concrete, lined with wooden treads, treated with convenient fireproof coatings. The floors of technical and sanitary areas are of ceramic tiles, of quality granite anti-slippery ceramics. It is also foreseen to set the stainless steel marginal strips at joints of different kinds of floor surfaces.

##### Walls

The existing stone walls dominate the space. They are presented in their natural structure, with the necessary restoration works. All other partition walls are made of plasterboards (type "Rigips", "Knauf" or similar) with sub-construction of profiles protected against corrosion, total thickness 20 cm, with infilling of mineral wool, with legislated acoustic, fire resistance and waterproofing properties. In the architectural physics design, such linings are foreseen for the walls that ensure the adequate thermic and acoustic protection, according to functional need of every area.

##### Ceilings

The suspended ceilings are foreseen in a part of entrance hall, vestibule and sanitary areas. The suspended ceilings are lined with plasterboards with sub-construction of profiles treated with anti-corrosion finish. Moisture proof plasterboards are foreseen for the bathrooms and sanitary blocks. All joints are bandaged with strips and finished with pure gypsum.

##### Doors

The entrance doors to the building are of glass in a frame made of locksmithing profiles, equipped with all systems necessary to control the entrance. All doors and partitions are of quality materials, easy to maintain, in order to obtain high aesthetic standards adequate to the main function of the building.

##### Construction

The construction is either kept or replaced in existing construction system, structure and materials, except the new reinforced concrete elevator shaft and the reinforced concrete staircase. The roof construction is of wood, the roofing is beaver tile.

##### Elevator

In order to make possible the approach of persons with special needs, the hydraulic elevator was designed, and a convenient hydraulic platform is foreseen next to the exterior staircase.

##### Installations

Plumbing and sewage installations, low and high voltage electricity, HVAC installations in accord with regulations and standards for this building type are foreseen. The details can be found in a separate part of the design.

## **EASTERN YARD**

### Shaping and materials

The main architectural concept was defined by the request to reconstruct the appearance of Kastel, the ramparts and the bastions. Based on analogy with existing towers, it is foreseen to reconstruct the Tower 5 on its authentic foundations.

Based on existing documentation available, it is foreseen to build the tower with massive stone walls, width cca. 80-130 cm, double faced, of new stone blocks, based on authentic

manner, using gauged lime mortar. The stone wall infilling is of rip-rap (small scale stone - crushed stone in lime mortar with additives). The stone masonry works must be performed according to the authentic manner, with proper bonds and overlaps in accord with regulations and with joints of 1-1.5 cm. Bigger and regularly shaped stone blocks are to be built at the angles.

The designed levels of the eastern yard areas are in accord with its natural configuration. All delevellings, except for the entrance to underground arsenal, were designed with angled planes, without any steps, with convenient slopes so that entire eastern yard area is made accessible to people with particular needs. All areas both at the ground floor level and in the attic were equipped and designed taking into account accessibility to this group of people.

It is not allowed to install any advertisements on the building itself or the public place around it without prior approval of the city administration body and the Republic institute for protection of cultural, historical and natural heritage of Republic Srpska.

#### Interior of the building

Interior of the tower is designed based on analogy with existing towers, as a space with wooden ceilings, wooden staircase and wooden floors. Stone walls, presented in their natural structure, dominate the interior. All structural elements will be visible in the interior, since no suspended ceilings were foreseen.

The entrance doors to the building are of glass in a frame made of locksmithing profiles, equipped with all systems necessary to control the entrance. All doors and partitions are of quality materials, easy to maintain, in order to obtain high aesthetic standards adequate to the main function of the building. Plumbing and sewage installations, low and high voltage electricity, HVAC installations in accord with regulations and standards for this building type are foreseen. The details can be found in a separate part of the design.

### **1.2.5. Overview of the standards applied for the works and materials used**

The works are to be performed in accord with applicable local codes and standards for building works in Bosnia and Herzegovina as well as the international codes and standards.

The source book for overview of local building codes is the *Codes of practice and standards of works in building construction 1-3 – Normativi i standardi rada u građevinarstvu – Visokogradnja, knjige 1-3, Građevinska knjiga, 2008* (12th issue).

For each type of works on remodeling and revitalization of the Kastel fortress, the particular codes and standards to be applied are listed below, in the chapters from 1.4. and further.

## **1.3. MAIN DESIGN OF REMODELING AND REVITALIZATION OF THE FORTRESS „KASTEL“– CONSTRUCTIVE PHASE**

### **1.3.1. Introductory notes on the design**

This part of technical documentation is aimed at constructive stabilization of the Fortress Kastel. The following activities were taken before compilation of this technical documentation:

- visual inspection of the building and examination boreholes;
- soil mechanics research works;
- geodetic works with the aim to obtain accurate geodetic plans.

This part of technical documentation was compiled based on the above mentioned activities.

### **1.3.2. Analysis of the present state of construction**

#### **STONE BUILDING (MUSEUM)**

The building is in good condition in structural sense, so that no reinforcements of the walls are planned. The existing ceiling is built of wooden beams connected by grooving into the INP180 steel beams. The steel beams are supported by the façade walls, thickness = 80 cm, interior longitudinal wall, thickness = 45 cm, and the reinforced concrete beams.

The walls have strip foundations made of stone. Excavation of the foundations was performed as a part of survey works, in order to determine depth of foundations and their state. Conclusion was made that state of the foundation is good.

The existing roof construction is of wood.

#### **TOWER 5**

A part of the ground floor was preserved, including preservation of the southern wall to the greatest extent. The preserved parts are structurally unstable and partly tending to collapse. The tower will be fully reconstructed. The design was compiled based on the existing photographic documentation and analogy with the existing Kastel fortress towers.

### **1.3.3. Scope of the foreseen works**

#### **MUSEUM**

Following interventions on building construction of existing facility are planned during adaptation:

1. removal of roof construction
2. detection the structure of the existing ceiling
3. constructing lift's core and stairs
4. strengthening of existing reinforced concrete beams
5. constructing a new floor joists
6. constructing a new roof construction

#### **TOWER 5**

Only foundations and ground parts of walls of the Tower 5 are preserved. Complete reconstruction is predicted for tower in accordance with authentic appearance. As a result of this approach very solid stone walls has to be build.

The ceiling joists are designed as timber.

Vertical communication is realized with wooden staircase.

The project includes constructing a stone wall without the use of reinforced concrete. Function of the ring beam take wooden surround put into the mass of the wall in the ceiling level, as shown in the drawings of architectural phase.

### **1.3.4. Technical conditions for execution of works**

It is obligatory to follow the current legislation, rules and standard during performance of building works, as well as the instructions given by this design. Taking into account the particularities of the construction in question and the fact the interventions are performed on existing building, all dimensions and measures given in this technical documentation are to be controlled on site. In case unclear issues or changes to the structural design occur, it is necessary to consult the responsible designer for structural phase or the supervisor.

## **MUSEUM**

### **Uncovering the construction of the existing ceiling**

After removal of the roof construction, it is necessary to remove all layers of the attic floor, as well as the layers of the ground floor ceiling so that the ceiling construction remains completely visible. After that, the existing elements of the ceiling – wooden beams and steel INP beams are to be carefully inspected, and it is to be determined which elements can be kept and which are to be replaced. As many elements of the present ceiling construction as possible should be kept. Taking into account that the existing ceiling could not be fully uncovered during the survey works, the present state of the construction and the exact distribution of beams are not fully known, and they are assumed to some extent for the purposes of this design.

Position, dimensions, supporting and other characteristics of the structural elements of the ceiling are to be recorded. Then the accuracy of the assumed elements of the design is to be controlled. In case there are significant discrepancies, the responsible designer is to be consulted. It is supposed that all wooden beams will have to be replaced with new ones, while the majority of the steel beams will be kept.

### **Construction of the elevator shaft and the staircase**

The elevator shaft and the staircase are made of reinforced concrete, concrete grade CG30, and reinforced with ribbed reinforcement bars RA400/500 and mesh reinforcement MA500/560. Plans of formwork and reinforcement are given in the Book of drawings.

### **Strengthening the existing reinforced concrete beams**

In this technical documentation it is foreseen to introduce carbon strips to strengthen the existing reinforced concrete beams. The necessary amount of carbon strips was defined with a number of assumptions, which must be revised and controlled upon uncovering the ceiling construction.

In case there are significant discrepancies between the design and the state determined on site, the responsible designer is to be contacted. Placement of three S512 strips at the bottom sides of each reinforced concrete beam is foreseen.

The sketch of placement of the reinforced concrete beams has been given in the Book of drawings. Placement of carbon strips is to be done at the moment of maximum relieve of load, i.e. after uncovering of the existing ceiling and removal of all elements of the construction that are not planned to be kept. The carbon strips are to be set in following way:

- mortar is to be stripped off the bottom side and concrete to be cleaned;
- the clean concrete surface is to be polished and dusted-off; it is recommended to use industrial vacuum cleaner;
- before setting the carbon strips, it must be checked if conditions regarding temperature and dew point are fulfilled, and conclude that in writing;
- the glue is to be applied over the prepared surface, and strip to be set in accordance with the manufacturer's instructions.

### **Building the new ceiling construction**

The ceiling construction foreseen in the design is the same as present one in sense of distribution of the steel beams. Wooden beams, haunched into the INP180 beam, are placed between the steel beams. Over the beam created in that way, a 5 cm thick reinforced concrete slab is placed, which is braced with wooden and steel beams.

The necessary operations are as follows:

- all steel beams to be kept must be cleaned of corrosion up to metal shine;
- new beams are to replace the existing beams planned for removal;

Steel metal sheet, thickness = 8 mm, is to be welded on the lower sides of steel beams, to improve load bearing capacity of the existing beams. The metal sheet is to be attached to the existing INP beams by angular welding, thickness = 5 mm. It is remarked that the reinforcement of the existing INP beams is necessary in case their distribution matches the supposed distribution in this technical documentation. In case it turns out that all existing steel beams are in poor condition and need to be replaced, then it is suggested to replace them with bigger INP profiles, so that the described strenghtening can be avoided.

- it is also needed to weld the dowels at the upper part of steel beams. The dowels are made of T-beams. The T-beams are made by cutting the INP160 beam in half. The hight of the dowels amounts to 35 mm. The dowel is to be attached to the INP180 beam by a welding of 3 mm thickness. The distribution of the dowels along the lenth of the beam is given in the Book of drawings.

All steel elements must be protected with ati-corrosion agents.

The wooden beams are to be set between the steel beams. Dowels are also to be set in the wooden beams. Distribution and type of those dowels are given within the Book of drawings.

The space between the wooden beams is to be flashed with boards. Care is to be taken to install the boarding in the interspace between the wooden beams, and not over the beams.

After completion of board flashing, the Q188 reinforcement mesh is to be placed and concrete slab of 5 cm thickness is to be placed. Concrete of CG30 must be used.

### **Loads**

All relevant local rulebooks were used for the purpose of determining loads for static and dynamic calculations. The list of codes and regulation used can be found under Point 1.3.5.

### **Material**

#### **Concrete**

Two kinds of concrete are used for constructive elements, depending on the nature and properties of each element.

#### **Concrete grade CG10**

Concrete CG10 is used for building the leveling layer under the foundation slab. This concrete can be made on site. Concrete cathegory B.I.

#### **Concrete grade CG30**

Concrete of CG30 is used for building all elements of construction. The concerte cathegory is B.II. The concrete is to be made of cement, aggregate and additives certified in accord with current standards, and pure water. During placing of concrete, care must be taken regarding compactnedd of the concrete in its formwork, no air cores are allowed, nor

segregation of the fresh concrete mass. After placing, particular attention is to be paid to curing of the concrete. Number of samples for the compressive strength test is to be defined in accord with current regulations and standards.

#### **Water resistance**

No additional requests.

#### **Frost resistance**

No additional requests.

#### **Reinforcement steel**

The steels of following qualities can be used for building: ribbed bars RA 400/500 and mesh reinforcement MA500/560. The steels used must be certified. The reinforcement meshes and bars must be free of corrosion. In case corrosion appears, it must be removed prior to building-in the elements. In case reinforcement meshes or bars are fatted up, the must be cleaned with petrol or similar agent prior to building in.

#### **The steel INP beams**

Manual electric-arc welding is to be applied for the constructions encompassed by this standard. The shapes of welding grooves must be adjusted to the welding procedure, and measures must be in accord with those given in the drawings, the groove edges must be sharp during gas cutting. Remains of metal at the cut surfaced of the grooves finished with scissors must be removed. JUS C.T3.030. is applied for groove finishing. Position and connection of the parts welded must allow adjustment of parts to deformations from welding. Care must be taken regarding keeping proper distances at the roots of singular weldings. It is not allowed to expose parts of construction to stress. Straightening of parts is allowed at cool state. Shape of the parts after welding must match the shape and measures given in the drawings. Deviations can be allowed in accord with regulations on tolerance of measures and shapes for load bearing constructions. To avoid the behind-hand stresses, welding and joining start from the beginning and end at the end of the connected parts. The surfaces where welding is performed and the electrodes must be completely dry. The electrode coating must be undamaged. The adjacent surfaces for direct transmission of forces from one to another end of the bar, for connected bars, must be properly finished after welding the bar shaped components.

#### **The welded joints**

The welding works are to be performed in a most convenient position for a welder. A mechanic turning device is used for heavier elements that can't be turned manually. During all types of turning, care must be taken to avoid overload and weld breaking. The surface to be welded must be cleaned of all dirt, before commencement and after completion of every singular welding. Type and diameter of the welding electrode must be compatible with base material that is to be welded. Creation of an arc during electric-arc welding is only allowed at surfaces which are to be welded. The drops from the molten pool that spread around the welding as well as the molten pool drops created during welding must be grinded. The appending seams considered as seams of equal importance as definitive seams must be performed in equal way as definitive seams. It is not allowed to accelerate cooling of the seams artificially. Roots of the square joint seams that were bothsidedly welded are supposed to be grooved, except in case a good welding is achieved by particular welding procedure. The finish of the welded joints must be done in a way to make the seams as homogenous as possible. Fissures and disconnections are not allowed. As a rule, grinding can be done up to the 5% of the welding thickness. The auxiliary features that were

necessary during connecting and welding are to be removed without any damage to the construction material. All seams must be well cleaned and eventual errors corrected before painting. The welding spot must be protected of atmospheric effects. Lower temperature limit for regular welding of 0361 steel is 0 degrees of Celsius. Negative impact of the wind to faster cooling of the seams must be taken into account. Cooling of the seams with water is not allowed. Control of the welded joints is to be conducted based on the regulations on quality of welded joints of load bearing steel constructions.

The welded joint of quality II must be:

- Created under favourable working conditions;
- Created with weldable and proper additional material, in accord to the standard regarding load bearing and temperature conditions;
- Made by certified manufacturers;
- Controlled along entire length by external control before, during and after completion of welding.

Under static load, the welded joint must transmit mechanic loads in a same way as the base material.

### **Protection against corrosion**

The steel construction protection is foreseen as passive, using protective coating. To perform quality protection against corrosion, it is necessary to prepare the steel construction surfaces. The preparation includes removal of fat, dirt, remains of rolling and annealing, rust etc. Protection with two base coatings and two cover coatings are foreseen. The first base coating must be applied in a workshop, while others can be applied at the construction site after placement of the steel construction. The coating can be applied either manually (using brushes, paint gun or roller) or mechanically. Thickness of the coating is to be controlled according to JUS C.A1.558.

### **TOWER 5**

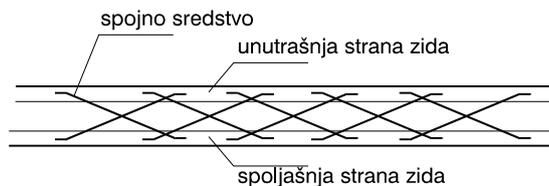
Taking into account that the foreseen reconstruction works on towers include building walls using old building techniques (building two wall fronts connected only with the infilling – rip-rap), additional technical conditions apply in order to fulfill criteria for building in active seismic zones.

The following instructions apply for building of walls:

1. Rules for building stone walls:
  - maximum three joints can meet at a same spot on the wall front. The meeting point must be covered with a solid stone of the upper layer.
  - As many bonders as possible must be incorporated in the wall; every two stretchers (if possible depending on stone type) must be followed by a bonder, or layers of bonders and stretchers are to be alternated.
2. A connection between the inner and the outer wall front is to be established during construction. This bond is to be created using connection elements, “dogs”, that have function to connect the two layers of the wall into a whole, as well as to improve the seismic resistance of the building. The connection elements are made of ribbed construction steel, quality RA 400/500, diameter 8 and 10 mm.
3. Taking into account the aggressive neighbouring materials (lime mortar), it is necessary to protect the connection elements with anti-corrosion coating prior to building them in the wall. The connection elements must be completely covered with protective paint at all sides. The protection is of high importance, so that it

must be performed responsibly and carefully. After the protective coating has dried, the connection elements are to be dipped in cement slurry. Only after the cement slurry has dried, the connection element can be used and built in.

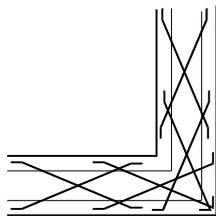
4. The connection elements are to be built in the wall in a two-fold manner:
  - The connection elements of 10 mm diameter are set in a way that they form horizontal bracings in single planes along the perimeter of the tower. These bracings are placed at certain interval starting from the terrain level, so that their maximum vertical distance amounts up to 120 cm. The following sketches indicate the way bracings are to be placed in the horizontal joint:



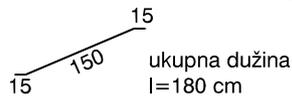
Legend:

spojno sredstvo – connection element  
 unutrašnja strana zida – interior side of the wall  
 spoljašnja strana zida – exterior side of the wall

Manner of formation of horizontal bracing in the wall



Manner of formation of horizontal bracing at the wall crossing



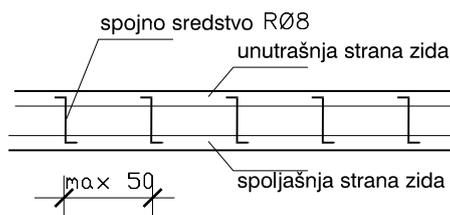
Shape of the connection element RØ10

Legend:

Ukupna dužina = total length

After establishing of the horizontal bracing in a described way, the building of the wall can be continued. Equal bracing is to be formed at the vertical distance not bigger than 120 cm.

- The connection elements made of construction steel RØ8 are to be set along entire wall, and their function is to create connection between interior and exterior wall layers. They are to be placed in a way that their maximum interspace amounts up to 50 cm (4 connection elements per m<sup>2</sup>). These connection elements are set according to the following sketch:



Legend:

spojno sredstvo – connection element  
unutrasnja strana zida – interior side of the wall  
spoljasnja strana zida – exterior side of the wall

Placement of the connection elements RØ8

15  
] zavisi od debljine zida  
15

Legend:

Zavisi od debljine zida = depends on wall thickness

Shape of the connection element RØ10

The dimensions of this connection element depend on wall thickness. They must be such that the connection element stretches from the middle of the outer side of the wall to the middle of the inner side of the wall. It must remain invisible both from inside and from outside. The connection elements do not need to be placed in a same horizontal or vertical planes. The criterion is to keep their distance in any direction less than 50 cm.

A bond between the inner and outer layer of the wall will be established this way, and seismic resistance of the tower will be increased.

High importance of careful protection of the connection elements against corrosion is repeatedly emphasised. Only after tailoring the elements, the above described protection is to be applied, so that damaging the coatings is avoided while bending the reinforcement bars.

During construction of arches and vaults, particular attention is to be paid to preparation of the scaffolding, which must be well fastened, so that movements are prevented. The masonry work scaffolding sketch is to be prepared by the Contractor, in accord with their technology available.

- the arches are to be constructed with radial joints, so that all joints are inclined. Their axes must run through the center of the circle whose part is the arch being built.
- the arches are to be built starting from the kneelers from both sides towards the mid-point, ending with the crown stone.
- after completion of building, the mortar is to be poured over the backside of the vault and pocketed up into the joints.
- the arch or vault scaffolding is to be removed when the binder in the joints reaches 80% of its compressive strength.

The wooden beams of ceiling construction are to be set in a way that they connect with wooden batch boxes within the wall mass. This means that the wooden ceiling beams are to be set simultaneously with the batch boxes. Taking into account the dimensions of the towers and their structural elements, no proof of their bearing capacity is found necessary. All drawings regarding the construction of towers are given in the architectural phase.

### 1.3.5 Overview of the standards applied for the works and materials used

The following codes and regulations were taken into account for determining loads for static and dynamic influences calculation:

- *Pravilnik o tehničkim normativima za projektovanje i proračun inženjerskih objekata u seizmičkim područjima (Rulebook on technical act standards for design and calculation of engineering buildings in seismic zones)*
- *Opterećenja vetrom. Osnovni principi i osrednjen aerodinamički pritisak vetra (Wind loads. Basic principles and medium aerodynamic wind pressure), JUS U.C7.110/1991.*
- *Opterećenja vetrom. Dinamički koeficijent i aerodinamički pritisak vetra. (Wind loads. Dynamic coefficient and aerodynamic wind pressure), JUS U.C7.111/1991.*
- *Opterećenja vetrom ostalih građevinskih konstrukcija osim zgrada (Wind loads for civil engineering constructions except buildings), JUS U.C7.113/1991.*
- *Osnove projektovanja građevinskih konstrukcija. Sopstvena težina konstrukcije, nekonstruktivnih elemenata i uskladišteno materijala koji se uzima u obzir pri dimenzionisanju. Zapreminska masa. (Bases of civil engineering construction design. Self-weight of construction, non-constructive elements and stored material to be taken into account for sizing), JUS. U.C7. 123/1988.*
- *Osnove projektovanja građevinskih konstrukcija. Korisna opterećenja stambenih i javnih zgrada. (Based of building construction design. Imposed loads for residential and public buildings), JUS.U.C7.121/1988.*
- *Pravilnik o tehničkim normativima za zidane zidove (Rulebook on technical act standards for masonry walls), Službeni list SFRJ/Official gazette of SFRY 15- 01- 149/39 1991.*
- *Pravilnik o tehničkim normativima za beton i armirani beton, PBAB87 (Rulebook on technical act standards for concrete and reinforced concrete).*

#### **1.4. GENERAL TECHNICAL CONDITIONS AND SPECIFICATIONS FOR EXECUTION OF BUILDING WORKS, SPECIALISTS' TRADES AND RESTORATION WORKS**

##### **1.4.1. General technical conditions for execution of works**

###### **Scope of works**

The Contractor shall, with due care and diligence, and in accordance with the provisions of the contract, design the works to the extent stated in the contract, and execute, complete and remedy any defects in the works. The Contractor shall provide all superintendence, personnel, materials, plant, equipment and all other items, whether of a temporary or permanent nature, required for the design, execution and completion of works, and for remedying any defects, in so far as is specified in, or can be reasonably inferred from, the contract. The Contractor shall ensure that records to the Works are kept up to date. These records shall include labour, plant, material on site, excavation, additional work ordered, price fluctuation if applicable, etc.

###### **Conservator's supervision**

As building is listed as cultural heritage, applicable legal framework for Bosnia and Herzegovina includes Law on Cultural goods of Republic Srpska (Official Gazette of Republic Srpska 11/95), The General Framework Agreement: Annex 8, Agreement on Commission to Preserve National Monuments - Law on conducting the decisions of Commission to preserve national monuments (Official Gazette of Republic Srpska 64/08) and Law on spatial arrangement (Official Gazette of Republic Srpska 84/02).

Conservator's supervision of the Institute for Protection of Cultural, Historical and Natural Heritage of Republic Srpska is to be provided and all supervision details agreed before starting of Works.

### **Execution of works**

If traffic, supply and disposal installations (Services) are located near to the ground designated for building, the provisions and regulations of the responsible authorities shall be observed. Areas designated for maintaining traffic flow shall be kept clear. Access to installations belonging to public services and utilities (e.g. power suppliers, refuse collection fire service, postal services, railways), as well as access to survey points, etc., shall not be obstructed more than is absolutely necessary for the execution of the work.

If contaminants or pollutants are encountered (e.g. in soil, water or components), the client shall be informed immediately. In case of imminent danger, the contractor shall take all necessary action immediately. Further action shall be agreed between client and contractor. The emergency action taken and any further action agreed upon shall count as Special tasks.

### **Associated tasks**

Associated tasks are work which form part of the contractual Performance without being explicitly referred in the Drawings, technical Specifications and the Bill of Quantity.

Hence, associated tasks are in particular:

- setting up and Clearing the Site, including equipment. etc.;
- provision of Site installations, including equipment, etc.;
- measurements required for the execution of the work or for calculating the quantity of work executed, including the Provision of measuring instruments, gauges, stakes or pegs, etc., the maintenance of the gauges and stakes or pegs during execution of the work, and the Provision of labour for the work;
- protective and safety measures required by accident prevention regulations and other official provisions;
- lighting, heating and cleaning of shelters and sanitary facilities for use by the contractor's employees;
- extension of water pipes and power supply lines from the connection points on Site provided by the client to where they are actually needed;
- supply of fuels;
- Provision of Utensils and tools;
- transport of all materials and components, including those supplied by the client, from their place of storage on Site to the point of use and back again, if required;
- protection of works against normal seasonal precipitation, and provision for its drainage, if necessary;
- disposal of all waste from the area of the contractor and clearance of all dirt, rubbish, and rubble resulting from the work executed by the contractor.

### **Special tasks**

Special tasks are work which cannot be regarded as associated tasks, and which only form part of the contractual Performance if explicitly referred to in the specification of works.

Examples of Special tasks are:

- supervising the work of other contractors;
- safety measures to prevent accidents in connection with the work of other contractors;
- Special measures to ensure protection and safety when working in contaminated areas, such as Isolation of workplaces, or use of monitoring Systems or Special auxiliary equipment for construction plant and equipment;
- Special protective measures against weather damage, flood water, and groundwater;
- insurance of the work and its acceptance for the benefit of the client, or insurance on an exceptional liability risk;
- Special testing of materials and components supplied by the client;
- Provision, erection, Operation and removal of equipment serving to protect and maintain the flow of public and private traffic on site (e.g. Site fences, protective scaffolding, auxiliary structures, lighting, traffic Signal installations);
- provision, erection, operation and removal of installations outside the Site serving to direct and regulate public and private traffic;
- making available part of the site equipment to other contractors or to the client;
- special protection of the work, required by the Client in order to use it prior to completion, maintenance of such protection, and its subsequent removal;
- removal of obstructions;
- supplementary measures to ensure that work can continue in conditions of ice and snow, if such measures are not already the responsibility of the contractor.

### **General remarks on building materials**

All materials to be incorporated in the Works, except the existing materials and components designated for re-use, shall be new, unused, of the most recent or current models and incorporate all recent improvements in design and materials unless provided otherwise in the Contract.

Workmanship shall be of the best of their respective kind and to the approval of the Engineer.

Testing and costs: Any or all of the materials supplied by the Contractor for use in any of the Works shall be subject in advance to such tests as may be specified in the relevant Standard, the Specification or as may from time to time be deemed necessary by the Engineer.

The cost of carrying out tests on material or workmanship shall be deemed to be covered in the rates for supply of the respective material and services.

The Contractor shall provide facilities for the Engineer to take samples for testing of any of the concrete or other materials to be incorporated in the Works. Such samples may be taken before or after incorporation into the Works or at any stage during construction at the discretion of the Engineer. Material that fails to conform to the requirements of the Specifications will be rejected, and the Supplier will be notified accordingly by the Engineer. The Contractor shall be responsible for his own quality control and shall provide sufficient competent personnel for taking and preparing samples and for carrying out the necessary tests. The Contractor shall identify and inform the Engineer in writing a recognised material testing laboratory where tests may be performed to ensure that the quality of material and workmanship specified for the Works are being adhered to.

The cost of carrying out tests on material or workmanship shall be deemed to be covered in the rates for supply of the respective material and services.

Supply, packing and storage on site: All materials shall be packed in such a manner as to prevent damage or deterioration in transit to the final destination. The packing should be sufficient to withstand rough handling and exposure to extreme temperature during transit and storage. Each box, bundle or crate shall be legibly marked identifying the contents and giving the name and address of manufacturer, consignee and date of dispatch. Construction materials shall be handled and transported in accordance with the manufacturer's instructions. Construction materials shall be stored at places approved by the Engineer and shall at all times be provided with adequate management, maintenance and supervision by the Contractor.

Contractor is responsible for all material supply and installation works until final acceptance by the Client or Engineer.

### **Trees at the building site**

All trees which are not approved for felling shall be protected against damage during the entire Contract Period using wooden boards strapped around the trunk of the tree extending up to a height of 2m. No trees with a trunk diameter greater than 10 cm measured at 1m above ground shall be felled without prior permission of the relevant authorities and the Engineer.

### **Information on building activities**

The contractor shall construct two boards, carrying information supplied by and erected in the locations specified by the Employer. The wording shall be presented in such a way as to be legible at a distance of 100 meters.

### **Work sequence and timing**

The Contractor shall draw up and submit for the Supervisor's approval a programme of performance of the contract within 30 days after commencement of the Contract. The programme shall include a detailed time schedule also taking into account the subcontractors involved, sequence and timing of inspections and specified tests, a description of the methods which the Contractor intends to adopt, as well as a detailed manpower and major equipment bar chart.

The information to be supplied to the engineer shall further include drawings showing the general arrangement of the temporary offices and any other temporary buildings or structures which he proposes to use, together with details of the constructional plant and temporary works, and all other devices which he proposes to adopt for the construction and completion of the whole of the works.

### **Measurement**

Upon the completion of the Works, the Contractor shall, if not otherwise specified, 14 (fourteen) days prior to the commissioning, submit to the Engineer the certified final report on the quality of the works. Costs for the preparation of the report shall be borne by the Contractor.

The quantities of individual kinds of work will be measured on the basis of measurement units defined in the Schedules/Bill of Quantities, the Contract Documents and the Requirements.

Work shall be measured on the basis of drawings, in cases where the completed work corresponds to the drawings. If not otherwise specified in the Technical Specifications,

reference is made to chapter 5 of the Construction Contract Procedures (VOB), Part C, DIN 18299ff.

Unless provided otherwise in the Requirements, the quantities shall be billed for the actually executed work or quantities of material actually incorporated rounded up to two decimal places at the most provided the Engineer has not chosen another way of measurement.

The Contractor shall ask the Engineer in due time to arrange for the commissioning/provisional acceptance under the provisions of the Requirements, in case it was impossible to determine quality and/or quantity. Should the Contractor fail to apply for such provisional acceptance/commissioning, he is solely responsible for any additional costs incurred in connection with the work necessary for the determination of the actual conditions.

Measured quantities and dimensions shall be recorded in the Construction Diary/Log. All measures shall be entered and all drawings made for the parts that will be covered up after the completion, or for those made differently from the design. The Contractor shall submit to the Engineer for approval the Construction Diary/Log once a month, as a rule before making the monthly statement. The data entered in the Construction Diary/Log have to be confirmed by both contractual parties in order to be admitted as the basis for effecting payment upon the monthly statement/report. All requests for payment on the basis of the data missing the approval of both contractual parties may be rejected by the Engineer i.e. excluded from the monthly statement.

The Engineer/Client Representative may refuse to approve/confirm all quantities used for the works that have not been executed in compliance with the Requirements and the Design Documentation provided the Engineer has a proof that the demands and/or requirements prescribed have not been adhered to.

The Engineer/ Client Representative may also refuse to approve/confirm all quantities used for the works covered up and/or put out of sight before giving the Engineer the opportunity to check the operational procedures, documentation on the material incorporated in the works, or in case the Contractor has been acting in the manner that could threaten the performance and safety of the permanent works.

### **Ancillary works**

All works to be paid are the actually executed work and the materials incorporated calculated on the basis of Unit Rates listed in the Bill of Quantities. The Unit Rates are the prices quoted for individual types of work comprised in the Bill of Quantities i.e. the Contract Documents.

Unless it is provided otherwise in the Contract Documents or herein, the Unit Rates shall comprise all costs for the execution of the individual kind of work.

Listed below are to be comprised:

- all installation services mentioned in the Design Documentation and the Technical Requirements;
- looking for sources of materials required for the execution of the works;
- transportation to and from the Site, as well as around the Site, labour, equipment etc.;
- supplies of all kinds of materials required for the execution of the works;
- all additional expenses such as: travel cost, per diems, allowance for field work, allowance for living separately from the family, board and lodging for workers etc.;
- organisation of work, overhead costs arising out in connection with running the Site and the company HQ including all taxes, levies and contributions,

- indemnification for land and other property, assembling and dismantling of plant, equipment and devices including transportation to the Site and back,
- construction of accommodation for workers, offices and stores/warehouses, telecommunication devices complete with installation services and material, as well as water and power supply, lighting and other facilities necessary for the smooth implementation of the Contract;
- access to and from the Site including fee to the owners of the property, maintenance and necessary improvements of the existing public roads and the other relocated public traffic surfaces until the commissioning;
- drainage for water from precipitation, ground water, and river water in the course of the execution of the Works;
- other ancillary civil work such as scaffolding at any elevation, shuttering, temporary fences and other related work often not expressly mentioned but implied;
- Reinforced concrete positions include formwork
- Before starting screed-, floor- and sealing works the subbase has to be prepared adequately, eg. cleaning, bonding layer, slip membrane, filling, shot blasting, grinding, primer, etc.
- Cladding, galvanised and painted, includes all accessories; flashings, edging strips, gutters, down pipes, brackets etc.
- Steel structures, handrailing, ladders incl. corrosion protection, painting, fixing materials, bolts, etc.
- Windows, doors incl. frames, hardware and sealant
- Excavations and trenches have to be sloped if necessary; stability has to be proven by the Contractor
- Protecting measures during excavations for foundations and trenches
- Excavated material foreseen for backfilling has to be stockpiled on the site all indemnities for the damage to persons and property, as well as costs for the reinstatement of the land used or affected after the completion of the works, with the aim to restore the land in the original, immaculate condition;
- work on providing adequate areas for dumping debris and/or waste;
- third party insurance for damages, loss or injury which may occur to any property by or arising out of the execution of the Works and not covered by any other insurance policy;
- provision of space and equipment required for the field test laboratories;
- testing and certification for materials and technologies;
- testing on regular basis and assistance provided for field inspections/investigations carried out by the Employer's Supervision Unit as in case of indemnities;
- material costs of testing;
- salaries of employees including contributions;
- transportation;
- data processing;
- preparation of progress reports;
- necessary measurement of executed work and control measurement;

- watching out for any signs of settlement/subsidence of the structures in the course of construction;
- all tests under load;
- making shop drawings;
- providing fully-equipped working space for the Employer's Supervision Unit including maintenance in the scope defined in the Particular Conditions;
- heating, electricity and phone bills indispensable for smooth operations of the Supervision Unit;
- safety measures to be implemented in accordance with the Law on Safety at Work;
- all works listed in the Grand Summary considered as a part of the Bill of Quantities supplied by the Tenderer in accordance with the Requirements;
- road closures;
- all other costs for all other work not explicitly mentioned under individual items offered by the Tenderer in the Bill of Quantities but necessary for the completion of the work.

The executed works are calculated on the basis of the interim/monthly and final statements in compliance with the provisions specified in the Requirements and the Contract Documents. Prior to the submission of the interim monthly payment, the Contractor shall hand over to the Engineer/Clients Representative the Site Diary with measurements to be examined and verified/certified by him. The Contractor may send out the interim monthly statement on the basis of the quantities logged, provided these figures have been already verified. Should the Contractor include in his interim monthly statement also the work not duly verified/certified by the Engineer/Clients Representative, the latter has the discretionary right to reject such statement for payment.

If there is suspicion regarding the quality of any materials and/or workmanship, the Engineer may suspend the verification/certification as long as testing and/or inspection is in course, until it is demonstrated that the materials and/or workmanship in question comply with the prescribed requirements.

Additional work not included in the Bill of Quantities i.e. in the Contract, will be calculated on the basis of the Conditions of Contract. Where the Contract Documents do not contain respective provisions, additional work will be calculated on the basis of the unit rates agreed on between the contractual parties during the contract negotiations. The Engineer is entitled to ask the Contractor to provide a detailed unit rate break-down.

All materials supplied for the purpose of the execution of the Works are the property of the Employer, who decides what is to be done with such supplies. Temporary installations and services The Contractor shall be responsible for providing plant, equipment, materials and labour for the provision of temporary works and services adequate for the performance of the Work under this Contract.

The Contractor shall furnish, install, maintain and operate at the Project Area all necessary construction plants to be used for all purposes necessary for the realisation of the Works as well as camps, work shops, warehouse, storage and assembly areas and other facilities including all machinery, vehicles, scaffolding, equipment, lighting, etc. required for the construction of the Works.

Temporary works and services provided by Contractor for his own use and for the Engineer shall conform to all applicable standards and codes set down by the government for this purpose, including the sanitary requirements of the city. The construction, operation and

maintenance of Contractor's temporary works and services shall be subject to inspection and approval by the Engineer/Client's Representative.

### **Safety precautions**

The Contractor shall comply with relevant safety regulations of Bosnia and Herzegovina. The Contractor shall designate a competent engineer especially trained and experienced, to act as Safety Officer, who will carry out frequent and regular safety inspections on the working areas, materials and equipment. The name and qualifications (evidenced by certificates) of the Safety Officer shall be submitted for approval to the Engineer/client Representative prior to his appointment.

The Contractor shall be responsible for enforcement of the health and safety provisions by his subcontractors, if any, to be employed at the Site.

The Contractor shall provide his personnel and visitors with appropriate safety equipment, such as helmets, safety footwear, gloves, waterproof clothing, dust masks and safety belts. The use of such safety equipment shall be compulsory. Emergency equipment such as explosion proof lamps, gas masks, signalling devices, flashlights in good working conditions, etc. shall be stored in the Contractor's office.

All working sites in the open, transit areas, excavation sites, etc. shall be adequately illuminated during night work.

Electrical cables shall be well insulated, protected and firmly fixed by means of adequate insulators. Lamps shall be well protected against damage. All equipment and appliances which are exposed to lightning shall be earthed electrically, and the effectiveness of such earthing shall be periodically checked by the Contractor's specialised personnel.

The Contractor shall provide an adequate number of fire extinguishers during the construction work. Fire protection facilities shall be of the gas, dry powder or other suitable chemical or pumped water type. Their number, type and location will be subject to the approval of the Engineer/ Client Representative.

### **Acceptance procedures**

The Acceptance means the take-over or commissioning of the parts of the Works including quality and quantity check pursuant to the provisions of the Requirements and the Design Documentation.

The Acceptance Procedure may be divided as shown below:

- interim certificate (for the purpose of effecting interim payments)
- provisional acceptance (for the purpose of payment upon the completion of the Works).
- final/operational acceptance (upon the expiry of defect liability period for the purpose of final settlement).

#### **1.4.2. Preliminary works**

### **GENERAL REMARKS**

This section of *Technical specifications for architectural and civil engineering works* sets out the requirements in regard to general activities for construction site opening.

The works will be performed in accordance with the relevant appointments of the local "Codes and standards of building works - building construction". Auxilliary tools, consumables, scaffolding, other costs and the contractor's profit are included in price.

## SCOPE OF WORKS FORESEEN IN THE DESIGN DOCUMENTATION

- staking out and placing scaffolding;
- creation, transport and setting of the site fence and information table, containing information on the Investor, Designer, Supervisor and deadline for completion of works, dimensions 80x100 cm;
- excavation of 2 trial pits for additional determination of state of foundations;
- provision of stone samples from potential quarries, together with comparing by type and characteristics with a sound sample from the placing site.

## STANDARDS APPLIED TO WORK PERFORMANCE AND MATERIALS USED

- Applicable norms and standards for Bosnia and Herzegovina:  
*Norms and standards of works in building construction 1-3 – Normativi i standardi rada u građevinarstvu – Visokogradnja, knjige 1-3, Građevinska knjiga, 2008.*
- European norms and standards:  
British standards: BS 5837, BS 3998, BS 4043  
Any work (including temporary treatment, precautionary support) associated with the existing tree shall conform, as a minimum to the above listed standards.

## SPECIFICATIONS FOR THE BUILT-IN AND USED MATERIALS AND PARTICULAR REQUESTS

### protection of existing foundations

Protect foundations to remain. Use appropriate means including shoring, protective screens, sheeting and the like. Restore and make good to an approved standard to match existing damage and defacement caused by excavation work.

### surplus excavated material

All excavated material not required shall be disposed of and removed from site at no increase to contract sum.

### protection measures

All excavations shall be barricaded and posted with warning signs for the safety of persons. Warning lights shall be provided during hours of darkness. Structures, utilities, sidewalks, pavements and other facilities immediately adjacent to excavations shall be protected against damage including settlement, lateral movement, undermining, and washout. Barriers shall be placed so that vehicle loading adjacent to excavations is avoided. Stop logs shall be placed at the edge of excavations to prevent vehicles over running when reversing up to the edge of open excavations. Sides of excavations over 1.5m in depth shall be sloped to the angle of repose of the excavated material, or shall be shored and braced where sloping is not possible either because of space restrictions or stability of materials excavated. Sides and slopes of excavations shall be maintained until completion of backfill placement in a safe condition by scaling, benching, shelving, or bracing. Precautions shall be taken to prevent slides or cave-ins when sides of excavations are subjected to vibrations from vehicular traffic or the operation of machinery or any other source.

Excavated material should not be closer to the edge of a supported trench than one-third of the trench depth. For unsupported trenches, this distance will depend on the depth of excavation, moisture content and cohesive strength of the material and profile of the

excavation. Generally, excavated material should be placed outside a 45 degree slope line passing through the bottom of the excavation.

Excavations shall be performed in a manner to prevent surface water and subsurface or ground water from flowing into the excavations and to prevent water from flooding the project site and surrounding area. Water shall not be permitted to accumulate in excavations.

### **1.4.3. Clearance works**

## **GENERAL REMARKS**

This section of *Technical specifications for architectural and civil engineering works* defines sets out the requirements in regard to standards of workmanship to be employed in all works on clearance, dismantling and decomposition of the building elements defined in the design.

The prices should involve all necessary auxilliary tools and material for use, working scaffolds and other costs. Demolition works are to be performed with skillful workmen and under constant supervision from experienced and qualified foremen. Demolition material shall be removed immediately from site (unless otherwise specified) and site left in a clean and orderly manner.

All unclear issues must be discussed and agreed between the Contractor and the responsible designers of architecture and construction phase before starting the decomposition works.

The precautions necessary are to be taken to protect the health of persons on, or within, the vicinity of the site from conditions which are or may be dangerous to health including the noxious effects of dust, fumes, liquids, infection, fire, explosion, radiation or other hazards.

Decomposition is to be done carefully, after marking the material which can be re-used by Supervising body. After decomposition or dismantling, all materials must be classified for future re-use. The material appropriate for re-use must be stored at the fortress site and protected. Other material, non-suitable for re-use, is to be taken away from the fortress site. The prices should include removal, loading and taking all detritus from dismantling and decomposition away to the waste-dump.

## **SCOPE OF WORKS FORESEEN IN THE DESIGN DOCUMENTATION**

The clearance, dismantling and decomposition works foreseen by the project include the following:

- disassembling of stone walls together with a mortar and infilling; (Southern and Easter fortress walls, Bastions 4, 5 and 6, Tower 5)
- disassembling of crown walls; (Southern and Easter fortress walls, Bastion 5)
- preparation of the surfaces at the areas that lack the wall fronts. The preparation includes dismantling the unstable stone blocks and cleaning the surface mechanically and by dusting off; (Southern, Northern and Easter fortress walls, Bastions 4, 5 and 6, Tower 5)
- removal of wild vegetation from inner and outer surfaces of the fortress walls;
- removal of detritus from the rooms of the underground arsenal;
- removal of batch box remains from the arsenal walls;
- removal detritus from all rooms;
- removal of existing roof battens;
- removal of roof construction;

- disassembling of the steel beams that belong to the ceiling construction;
- disassembling of the metal staircase construction, fence and wooden planks of the steps;
- demolition of the reinforced concrete slab on ground, d=20 cm, together with floor layers;
- dismantling of the wooden cladding from the attic ceiling, together with the sub-construction and 'tervol' insulation, d=2x4 cm;
- dismantling of the suspended ceiling made of plasterboards;
- demolition of the partition walls together with all linings;
- demolition of a chimney made of brick and gauged mortar;
- partial demolition of the interior stone wall;
- stripping the gauged mortar off the interior stone walls;
- stripping the lime mortar off the gable walls made of brick;
- careful stripping mortar off around exterior window frames and from the crown cornice;
- careful demolition of the exterior stone staircase (treads and landing);
- dismantling of the existing floor, together with floor sub-construction;
- dismantling of existing doors and windows;
- classification of all materials for re-use;
- stockpiling of the materials to be re-used, at the building site;
- loading and driving the detritus away to the waste-dump.

## **SUPERVISION AND APPROVAL FOR WORK STAGES AND APPLICATION OF MATERIALS**

Before commencing demolition, evidence is to be submitted that all precautions necessary for protection of persons and property have been taken and suitable protective devices provided to the approval of the relevant authority.

The Contractor will overview and inspect the constructive system of the building before these works, and decide on manner of securing the construction from collapse and in order to provide safety and protection of workers. If necessary, critical spots of the construction will be opened for examination. Decisions will be made together with the Supervision body.

## **STANDARDS APPLIED TO WORK PERFORMANCE AND MATERIALS USED**

- Applicable norms and standards for Bosnia and Herzegovina:  
*Norms and standards of works in building construction 1-3 – Normativi i standardi rada u građevinarstvu – Visokogradnja, knjige 1-3, Građevinska knjiga, 2008.*
- European norms and standards:  
DIN 18007 Demolition work - Terminology, techniques and applications  
DIN EN 74 Couplers, loose spigots and base-plates for use in working scaffolds and false work made of steel tubes; requirements and test procedures.  
DIN IEC 60364-7-704 Erection of low-voltage installations - Part 7-704: Requirements for special installations or locations - Construction and demolition site installations (IEC 64/1339/CD:2003)

## **SPECIFICATIONS FOR THE BUILT-IN AND USED MATERIALS AND PARTICULAR REQUESTS**

### **scaffolding**

All scaffolding shall be designed and erected in accordance with the relevant standards. Only experienced and competent scaffolding erectors shall carry out erection. The Contractor shall ensure that any necessary modifications to the scaffolding during the course of the works shall be accepted by the scaffolding erector so that scaffolds shall remain suitable for the purpose for which they are intended through out the works. The signed approval of the scaffolding shall be made visible at each ground level access point to the scaffolding. Working on unapproved scaffolding is strictly forbidden.

Care shall be taken that the load of any debris collecting on a scaffold does not exceed the loading for the design. The maximum permissible loading of the scaffolding shall be clearly visible at all ground level access points. All measures necessary shall be taken to prevent debris from being accidentally dislodged from the platform.

### **removal of detritus**

All the material resulting from demolition work, except as indicated or specified otherwise, shall become the property of the Contractor and shall be removed from the limits of the construction site. Rubbish and debris shall be removed from the site daily, unless otherwise directed by the Engineer; the accumulation of such material is prohibited both inside and outside the buildings. Materials which cannot be removed from the site daily shall be appropriately stored in areas designated by the Engineer. The Contractor shall provide suitable containers for the disposal of miscellaneous construction debris and shall empty these as often as required. All containers shall be covered at all times so as to prevent dust and debris being lifted by wind. Should the Contractor identify dry rot in wood or asbestos during demolition works he shall take appropriate health and safety precautions, notify the Engineer immediately and propose suitable disposal measures for approval by the Engineer. The Contractor shall produce evidence of the proper disposal of materials upon request of the Engineer.

### **clean-up**

The Contractor shall not utilise domestic garbage bins to dispose of construction debris or demolished material, but shall utilise appropriate containers for disposing of any and all construction related disposable materials and shall transport these off site as often as is necessary. Remove and transport debris and rubbish in a manner that will prevent spillage on streets or adjacent areas. Clean up any such spillage from streets and adjacent areas.

### **items to be re-used**

All existing items which shall be kept or reused shall be protected using temporary covers, shoring, bracing, and supports. Items which are to remain and which are damaged during performance of the work shall be repaired to their original condition or replace with new at the expense of the Contractor. Do not overload structural elements. Provide new supports and reinforcement for existing construction weakened by demolition works. Should loss of structural stability be detected (excessive deflections, collapse etc) then the Contractor shall take immediate action to secure the works and evacuate and seal off the area and inform the Engineer.

### **removal of roofing**

During roofing works the Contractor shall ensure the building remains weather tight at all times. Temporary roofing material such as weather proof sheeting shall be provided as and when required.

### **floors and ceilings**

After complete removal of existing floors and ceilings, floor and ceiling constructions are to be inspected in order to determine their exact state.

### **floor and ceiling constructions**

Floor and ceiling constructions are to be adequately secured before dismantling works. Dismantled material is to be carefully inspected and classified. Measures of constructive elements are to be taken on site, in order to make replacing elements exactly according to the authentic ones.

### **doors and windows**

All measures of doors and windows are to be checked on site during dismantling. One exemplar of each is to be delivered to the joinery workshop to record the details and make new doors and windows precisely according to the existing ones.

### **obstructions**

Redundant service lines or other obstacles over the site shall be removed by the contractor. The contractor is to carry out works with care to avoid damage to existing services in use around the site and is to support and protect same during the progress of the works and take all responsibility for and make good at his own expense any damage done.

### **stone walls disassembling**

It is necessary to secure the construction prior to disassembling. Dismantled material should be carefully examined and classified. Classification of the material by usability will be made.

### **staircase demolition**

During demolition of exterior stone staircase and interior steel staircase the Contractor should secure building stability. After completion, building stability needs to be checked. Dismantled material should be carefully examined and classified. All measures are to be taken for the purpose of construction of new elements, which must be made fully according to the authentic ones.

### **non-foreseen works**

After completion of works, construction and constructive elements are to be carefully inspected. The elements and amounts supposed to be replaced should be determined together with the Designer, Contractor and supervision body, together with the possible non-foreseen works.

## **1.4.4. Ground works**

### **GENERAL REMARKS**

This section of *Technical specifications for architectural and civil engineering works* sets out the requirements in regard to the quality of materials and standards of workmanship to be employed in ground works.

Soil excavation is to be performed in line with the building plan, supervision body directions and technical regulations. Soil excavation means that a finely planed bottom is formed in a dry or naturally wet soil by removing excessive soil with clean side cut-offs and well planned bottom. It is considered excavation under water is performed under

circumstances when the inflowing underground water needs to be drained out with water pumps during the excavation.

Before commencement of the excavation works, the building site needs to be cleaned of shrubs and other vegetation. Excavated earth should be used for filling up the hollows in the footing of the building to complete compactness and for leveling up.

## **SCOPE OF WORKS FORESEEN IN THE DESIGN DOCUMENTATION**

Ground works foreseen by this design consist of:

- manual removal and rough leveling of the surface layer;
- manual excavation of 2nd and 3rd categories soil, for the building foundations;
- compacting of excavation bottom with convenient mechanical tools;
- manual leveling of the excavation bottom under the slab on ground, foundation slab and strip foundations;
- supply, transport and spreading gravel in layer of 20 cm of thickness, under foundation slab and strip foundations; (Towers)
- making-up the excavated soil around the foundations in layers up to 20 cm thick, with compacting;
- leveling and compacting the natural gravel mixture up to the legislated compactness under the floor slab and the staircase in the building;
- spreading fertile clean earth with addition of top soil in finishing layer of 30 cm of thickness;
- spreading gravel in layer of 20 cm of thickness, under concrete water drainage channel; (Landscaping, Tower 5)
- spreading white crushed stone in layer of 10 cm of thickness; (Landscaping)
- leveling of the terrain manually and using machines;
- manual excavation of soil in the ground floor for the purposes of leveling the terrain and preparation for building the floor base;
- placing, spreading and compacting the gravel and sand layers under the slabs, pavement and paths;
- excavated soil is to be stored at the building site for re-use for ground works.

## **SUPERVISION AND APPROVAL FOR WORK STAGES AND APPLICATION OF MATERIALS**

All leveling works are to be done under constant supervision and instructions of the Supervision body.

Calculation of the excavated mass will be based on measured values before and after excavation which will be certified by the supervision body and in line with the regulations and average norms in the construction.

Unauthorized excavation consisting of removal of materials beyond indicated subgrade elevations or side dimensions without the specific approval of the Engineer shall be replaced at no additional cost to the Client.

## **STANDARDS APPLIED TO WORK PERFORMANCE AND MATERIALS USED**

- Applicable norms and standards for Bosnia and Herzegovina:

*Norms and standards of works in building construction 1-3 – Normativi i standardi rada u građevinarstvu – Visokogradnja, knjige 1-3, Građevinska knjiga, 2008 (12<sup>th</sup> issue).*

## **SPECIFICATIONS FOR THE BUILT-IN AND USED MATERIALS**

### **soil**

Topsoil shall be free of subsoil, refuse, stumps, rocks over 3 centimetres, brush, weeds, and other materials detrimental to plant growth. Topsoil shall be obtained from an approved topsoil donor area. Satisfactory soil materials used as backfill for trenches, drains and for structures shall consist of native materials classified as well graded sands, silty sands or clayey sands which are free from debris, roots, wood, scrap materials and other vegetable matter and refuse.

Soil materials for backfill and fill shall be free of clay clods, rock or gravel larger than 6 centimetres. Debris waste, frozen materials and other deleterious matter of any dimension shall be removed.

### **gravel**

Porous fill under concrete floor slabs shall consist of clean crushed stone, crushed gravel, or uncrushed gravel, 90-100 percent passing a 20 millimetres sieve and 0-5 percent passing a 4.75 millimetres sieve with sand equivalent of not less than 50. Granular fill may be composed of an appropriate combination of sand and crushed rock to meet the above gradation requirements. The capillary water barrier shall be placed directly on the subgrade. The barrier shall be constructed in layers not exceeding 10 centimetres in compacted thickness.

### **sand**

The sand shall be natural river sand, made up of hard and clean particles, clear in colour and of spherical shape. The sand shall be clean and free from organic substances, clay, silt, and other impurities. The sand gradation composition shall be from 0.5 mm to 1.0 mm.

### **protection of existing foundations**

Protect foundations to remain. Use appropriate means including shoring, protective screens, sheeting and the like. Restore and make good to an approved standard to match existing damage and defacement caused by excavation work

### **compacting**

All areas under paved areas are to be compacted. The material used in filling shall be free of deleterious material and free of clay balls. It shall be placed in even layers not exceeding 150mm loose depth and compacted to a density in accordance with relevant regulations. The compaction of soil materials for backfills and fills shall be performed by use of the specified compaction equipment that is suitable for the soil material being compacted and for use in the location of the work area. Soil compaction shall be controlled during construction for compliance with the percentage of maximum density for each area classification as specified.

Where approved compacted areas are disturbed by subsequent construction operation or adverse weather, the surface shall be scarified, re-shaped, and compacted as specified hereinbefore to the required density prior to further constructions thereon, re-compaction over underground utilities shall be by hand tamping.

### **material storage**

Excavated materials classified as satisfactory soil material shall be stockpiled, where directed, until required for backfill or fill. Stockpiles shall be placed, graded, and shaped for proper drainage, and stored in a manner to prevent contamination and segregation.

Materials required in the work shall be located and retained a sufficient distance from the edge of excavations to prevent such material falling or sliding back into the excavations and to prevent cave-ins. Waste materials, such as excavated materials classified as unsatisfactory soil material, trash, debris, and excess satisfactory soil material, shall be disposed of as directed by the Engineer.

### **surplus excavated material**

All excavated material not required shall be disposed of and removed from site at no increase to contract sum.

### **protection measures**

All excavations shall be barricaded and posted with warning signs for the safety of persons. Warning lights shall be provided during hours of darkness. Structures, utilities, sidewalks, pavements and other facilities immediately

adjacent to excavations shall be protected against damage including settlement, lateral movement, undermining, and washout. Barriers shall be placed so that vehicle loading adjacent to excavations is avoided. Stop logs shall be placed at the edge of excavations to prevent vehicles over running when reversing up to the edge of open excavations. Sides of excavations over 1.5m in depth shall be sloped to the angle of repose of the excavated material, or shall be shored and braced where sloping is not possible either because of space restrictions or stability of materials excavated. Sides and slopes of excavations shall be maintained until completion of backfill placement in a safe condition by scaling, benching, shelving, or bracing. Precautions shall be taken to prevent slides or cave-ins when sides of excavations are subjected to vibrations from vehicular traffic or the operation of machinery or any other source.

Excavated material should not be closer to the edge of a supported trench than one-third of the trench depth. For unsupported trenches, this distance will depend on the depth of excavation, moisture content and cohesive strength of the material and profile of the excavation. Generally, excavated material should be placed outside a 45 degree slope line passing through the bottom of the excavation.

Excavations shall be performed in a manner to prevent surface water and subsurface or ground water from flowing into the excavations and to prevent water from flooding the project site and surrounding area. Water shall not be permitted to accumulate in excavations.

## **1.4.5. Concrete and reinforced concrete works**

### **GENERAL REMARKS**

This section of *Technical specifications for architectural and civil engineering works* sets out the requirements in regard to the quality of materials and standards of workmanship to be employed in constructing works in both plain and reinforced concrete.

All works must be performed according to drawings, details and static calculations, with skillful and appropriate workmen and under appropriate supervision.

For all item and type of work, characteristics of concrete have been defined. The required class of concrete must be maintained, which is to be proven by the Contractor through

examination of material, as well as probation and control cubes at the Institute for examination of materials or other certified institution. The Contractor is obliged to make proof of quality for cement, water and aggregate.

## **SCOPE OF WORKS FORESEEN IN THE DESIGN DOCUMENTATION**

- placing a layer of lean concrete, thickness = 5 cm, concrete grade CG15, in pertaining marginal regular formwork; (Bastion 6)
- placing a layer of lean concrete, thickness = 10 cm, concrete grade CG15, in pertaining marginal regular formwork;
- building the reinforced concrete strip foundations, concrete grade CG30; building reinforced concrete slab, of concrete grade CG30;
- building reinforced concrete columns, square section, concrete grade CG30, in pertaining formwork;
- supply of material, transport and building reinforced concrete beams, rectangular section, concrete grade CG30, in pertaining formwork, with supporting over 3.0 m;
- placing the sloping layer for the flat roof of the Bastion 6 of concrete, grade CG15, average thickness 10 cm;
- supply of material, transport and placing the concrete for the Bastion 6 floor, concrete grade CG30, thickness d=10 cm, in pertaining marginal formwork with leveling;
- building the reinforced concrete strip foundations, concrete grade CG30; (Landscaping, Tower 6)
- building the reinforced concrete spot footings, concrete grade CG30; (Landscaping)
- building reinforced concrete walls, concrete grade CG30, in pertaining formwork; (Landscaping)
- supply of material, transport and building reinforced concrete water drain channel, concrete grade CG30, in pertaining formwork; (Landscaping)
- building reinforced concrete linear bench, concrete grade CG30, in pertaining formwork; (Landscaping)
- placing the carbon strips for reinforcement of the existing reinforced concrete beams; (Stone building)
- making the reinforced concrete slab as a base for waterproofing;
- making reinforced concrete retaining walls in the yard of the building, all with adequate formwork.

The foreseen works involve: making the reinforced concrete slab as a base for waterproofing, creating concrete paths over the prepared base layers, as well as making reinforced concrete retaining walls in the yard of the building, all with adequate formwork.

## **SUPERVISION AND APPROVAL FOR WORK STAGES AND APPLICATION OF MATERIALS**

Concrete and reinforced concrete must not be placed before adequate inspection and approval. Prior to any inspection the foreman shall check all excavation, formwork, reinforcement is correctly laid and that in-slab ducting , cables, pipes and the like have been

placed in accordance with the drawings. Shape and stability of scaffolds, formwork and supports must also be inspected and controlled during concrete and reinforced concrete works.

## **STANDARDS APPLIED TO WORK PERFORMANCE AND MATERIALS USED**

- Applicable norms and standards for Bosnia and Herzegovina:

*Norms and standards of works in building construction 1-3 – Normativi i standardi rada u građevinarstvu – Visokogradnja, knjige 1-3, Građevinska knjiga, 2008 (12<sup>th</sup> issue).*

*Rulebook on technical measures and conditions for concrete and reinforced concrete (Pravilnik o tehničkim notmativima za beton i armirani beton, Službeni list SFRJ 11/87)*

European norms and standards:

DIN EN 12350-1 : 2001 On-site Concrete Sampling

DIN EN 12390-2 Concrete Test Specimens Preparation and Curing

DIN EN 12504-1 Sampling of Hardened Concrete

DIN EN 12390-3 Destructive Testing of Concretes, Compression Test

DIN EN 934-2 Concrete Admixtures - Definition and Classification, Concrete Admixtures - Air Entrainments Suitable, Applications and Control Methods

DIN EN 206 Concrete

DIN EN 12350-2 Fresh Concrete - Determination of Consistency – Slump Test

DIN 18541-1 Thermoplastics sealing strips for sealing joints in in-situ concrete - Concepts, geometry and dimensions

DIN 18541-2 Thermoplastics sealing strips for sealing joints in in-situ concrete - Requirements, testing and inspection

## **SPECIFICATIONS FOR THE BUILT-IN AND USED MATERIALS**

### **cement**

The cement type shall be selected in accordance to DIN EN 197-1. It is not allowed to use two different types of cement for preparation of concrete construction.

### **stone aggregate**

Stone aggregate must be firm and stable with slurry sediment up to 2% of total weight. Aggregate must be washed, and appropriate granulometric composition must be used. Aggregate must be humid for concrete works, and plastic for reinforced concrete works.

Generally, all natural sands and gravel, crushed stones or other products previously proven satisfactory by practice, can be used as aggregates in mixing concrete provided the requirements specified are met. Aggregates shall not contain any substance which may be reactive with the alkalinity of the cement.

### **water**

Water used must be clean and free of organic components. Amount of water per m<sup>3</sup> of concrete must be controlled during works, taking into account the water cement ratio.

### **admixtures**

No admixtures will be allowed, unless approved in writing by the Designer.

### **ready mixed concrete**

All cast elements of construction must be made with precision, according to the dimensions give in the design. All concrete surfaces must have even structure and colour, without cracks, leaks or other deformations. Class of concrete must be in accordance with class defined in the design.

Ready-mixed concrete is defined in this specification as concrete produced regularly by a commercial establishment and delivered

to the purchaser in the plastic state. Ready-mixed concrete may be used provided that:

- a. The plant has sufficient capacity and transportation equipment to deliver the concrete at the rate desired.
- b. The interval between batches for a pour shall not exceed 30 minutes.
- c. The time elapsing between the introduction of the mixing water to the cement and aggregates, or the cement to the aggregate, and placing of the concrete in final position in the forma shall not exceed one hour.

Place concrete within 90 minutes of either addition of mixing water to cement and aggregates or addition of cement to aggregates if the air temperature is less than 30 degrees Centigrade. Reduce mixing time to 60 minutes if the air temperature is greater than 30 degrees Centigrade. Additional water may be added, provided that both the specified maximum slump and water-cement ratio are not exceeded. Do not place concrete when: (a) weather conditions prevent proper placement and consolidation; (b) in uncovered areas during periods of precipitation; and (c) in standing water. Prior to placing concrete, remove dirt, construction debris, water, snow, and ice from within the forms. Concrete shall not be permitted to free fall over a height of more than 3 m to prevent segregation. Consolidate concrete slabs greater than 10 centimetres in depth with high frequency, internal, mechanical vibrating equipment supplemented by hand spading and tamping. Consolidate concrete slabs 10 centimetres or less in depth by hand rodding, tamping and spading.

Repair formed surfaces by removing minor honeycombs, pits greater than 2 square centimetres surface area or 6 millimetres maximum depth, or otherwise defective areas. Provide edges perpendicular to the surface and patch with non-shrink grout. Patch tie holes and defects when the forms are removed. Concrete with extensive honeycomb (including exposed steel reinforcement, cold joints, entrapped debris, separated aggregate, or other defects) which affect the serviceability or structural strength will be rejected, unless correction measure is submitted and approved by the Engineer. The surface of the concrete shall not vary more than the allowable tolerances specified herein. Exposed surfaces shall be uniform in appearance and, finished to a smooth form finish unless otherwise specified. Place, consolidate, and immediately strike off concrete to obtain proper contour, grade, and elevation before bleedwater appears. Permit concrete to attain a set sufficient for floating and supporting the weight of the finisher and equipment. Do not spread dry cement over slab surface to absorb bleedwater. Do not introduce a "topping mix" over the floated finish of a slab to achieve a smooth finish. Steel trowelling shall be done over a floated finish before fresh concrete sets. Surface shall be evel to within 6 millimetres in 3 meters where floor drains are not provided.

### **reinforcement**

*Reinforcing Bars*: shall be a ribbed reinforcing steel with a characteristic yield strength of 500 N/mm<sup>2</sup> and a minimum diameter of 8mm. *Welded Wire Fabric (mesh)*: according to ENV 10080 shall be a ribbed steel with a characteristic yield strength of 500 N/mm<sup>2</sup>. It shall be electrically welded steel wire fabric for concrete reinforcement. (German BST 500M according to DIN 488) Unless otherwise indicated on the drawings, shall be 10 x 10 centimetres, 8 millimetres in diameter, for general construction.

*Tie Wires:* Shall be 1.2 millimetres in diameter, black annealed wire. Reinforcement is to be made and placed in accordance to static calculations and the drawings, all in accordance to the relevant technical regulations. At the time of placing concrete around it, all reinforcement is to be clean and free from oil, mud paint, loose scale, rust or other deleterious matter. Reinforcement is to be accurately placed in position as shown on the drawings, securely wired together at all intersections and supported on approved bar chairs at frequent centers so that concrete cover shown on the drawings can be accurately maintained.

### **carbon strips**

Strips are placed on pre-prepared and cleaned surface. Works are carried out at temperatures higher than 10 ° C.

During exploitation (after sanitation) it is required to limit voltage of carbon strips:

- $\sigma_c \leq 0.45 f_{ck}$  for quasi-permanent load
- $\sigma_c \leq 0.6 f_{ck}$  for the rare combination of load
- $\sigma_s \leq 0.8 f_{yk}$  for the rare combination of load
- $\sigma_f \leq \eta f_{fk}$  for quasi-permanent load ( $\eta=0.8$  for CFRP,  $\eta=0.5$  for AFRP,  $\eta=0.3$  for GFRP)

### **splices and laps**

Splices and laps to be in accordance with the relevant regulations. End laps of reinforcing bars shall be not less than 40 bar diameters, unless otherwise indicated. Welded-wire mesh lap splices must be minimum one full mesh plus 5 centimetres overhang on each end, unless otherwise indicated.

### **formwork**

All formwork must be stable, resistant, braced, supported enough so that they cannot weaken or deflect in any direction. Interior surfaces must be flat. Formwork shall not be removed before the concrete has attained sufficient strength to support its own mass and any loads that may be imposed on it. For cold weather periods should be increased by ½ day for each day the temperature falls between 7°C and 2°C, and one day for each day on which the temperature drops below 2°C. Formwork shall be removed carefully so that damage to the concrete is avoided.

### **construction joints**

Construction joints shall only be made at locations shown on the drawings.

### **protection and curing**

After completion of concrete and reinforced concrete works, the concrete must be protected from sun by watering for at least three days. Curing shall be commenced as soon as the exposed surface has hardened sufficiently but no later than two hours after finishing. Protection from extremely low or high temperatures is to be foreseen, as well as from damages of excessive rain.

Provide and maintain 10 degrees Centigrade minimum concrete temperature. Do not place concrete when the ambient temperature is below 5 degrees Centigrade. Cover concrete and provide with a source of heat sufficient to maintain 10 degrees Centigrade minimum while curing. Provide and maintain 32 degrees Centigrade maximum concrete temperature. Cool ingredients before mixing, or use other suitable means to control concrete temperature to prevent rapid drying of newly placed concrete. Shade the fresh concrete and start curing as soon as the surface of the fresh concrete is sufficiently hard to permit curing without

damage. Protect concrete from injurious action by sun, rain, flowing water, frost, mechanical injury, tire marks, and oil stains. Do not allow concrete to dry out from time of placement until the expiration of the curing period. Forms may be removed 48 hours after concrete placement. Prohibit foot and vehicular traffic and other sources of abrasion for not less than 72 hours after finishing operations.

#### **delivery and storage of materials**

Packaged materials shall be delivered to the project site in their original, unopened package or container. Packages will bear manufacturer's label clearly identifying manufacturer's name, brand name, material, weight or volume, and other pertinent information and stored in their original, unbroken package or container in a weather tight and dry place, until ready for use. Unpackaged aggregates shall be stored in a manner as to avoid excessive segregation or contamination with other materials or other sizes of aggregates. Store reinforcement of different sizes and shapes in separate piles, or racks raised above the ground to avoid excessive rusting. Protect from contaminants such as grease, oil, and dirt. Provide for accurate identification after bundles are broken and tags removed. Ready-mix concrete shall not be delivered until forms, reinforcement and other embedded items are in place and ready for concrete to be placed.

#### **field quality control sampling and testing**

Collect samples of fresh concrete to perform tests specified.

*Slump Tests:* DIN EN 12350-2. Take samples during concrete placement. Perform slump tests at (a) commencement of concrete placement, (b) when test cylinders are made, and (c) for each batch or every 10 cubic meters of concrete.

*Compressive Strength Tests:* DIN EN 12390-3. Make minimum of five test cubes with a measurement of 150/150/150mm for compressive test. Leave them in a water basin. Test the cubes at 28 days and hold one cube in reserve. Provide concrete cubes for compressive tests not less than once for each 30 cubic meters of concrete. Testing of specimens for compressive strength shall be in accordance with DIN EN 12390-3. Not more than 10% of the specimens tested shall have a compressive strength less than specified. When the results of the test of the control specimens indicate that the concrete as placed does not meet specification requirements or where there is evidence that quality is below specification requirements, core boring shall be accomplished in conformance with DIN EN 12504-1. The cost of such tests will be borne by the Contractor. Strength of cores from each member or area shall be considered satisfactory if their average is equal to or greater than 90 percent of the design compressive strength of the class of concrete. Remove all concrete not meeting this strength criteria and replace with new acceptable concrete at no additional cost to the Client. Repair core holes with non-shrink grout. Match colour and finish with adjacent concrete surface.

*Surface Test:* After curing, test the surface of the pavement with a straightedge (minimum length 3 metres) which will reveal any irregularities in the concrete surface. Remove and replace the concrete, mechanically grind the concrete surface, or correct the surface as approved, of any portion of the pavement which shows irregularities greater than 3 millimetres in 3 metres, or irregularities in a transverse direction greater than 6 millimetres in 3 metres.

#### **1.4.6.Reinforcement works**

##### **SCOPE OF WORKS FORESEEN IN THE DESIGN DOCUMENTATION**

Reinforcement works consist of:

- supply of the reinforcement
- transport of the reinforcement
- straightening the reinforcement
- cutting the reinforcement
- cleaning the reinforcement
- bending the reinforcement
- placing the reinforcement in framework.

The details can be found under Point 1.3. ff.

#### **1.4.7. Masonry and stone masonry works**

##### **GENERAL REMARKS**

This section of *Technical specifications for architectural and civil engineering works* sets out the requirements in regard to the quality of materials and standards of workmanship to be employed in masonry and stone masonry works.

All works must be performed according to drawings and relevant standards and rulebooks.

The prices should include all work operations, materials, auxilliary tools and scaffolds according to the relevant standards and rulebooks.

All original blocks that cannot be used for restoration purposes should be replaced with new ones, of good quality and same type of stone as the existing ones.

##### **SCOPE OF WORKS FORESEEN IN THE DESIGN DOCUMENTATION**

The masonry and stone masonry works foreseen by the project include the following:

- brick masonry of interior walls; (Stone building)
- exterior stairs lining with stone;
- cleaning the interior and exterior walls of dirt before plastering works;
- plastering the interior walls; (Stone building, Towers 5 and 6)
- building gypsum-cardboard walls on metal sub-construction;
- building walls of waterproof gypsum-cardboard boards on metal sub-construction in the lavatories;
- placing the scrimmed cement suit  $d=4$  cm, as base for parquet flooring; (Stone building)
- cropping and patching the reinforced concrete walls and ceilings using cement mortar 1:3, where concrete leaked at formwork joints; (Stone building)
- building massive stone walls, width cca. 80-139 cm, double faced, of new stone blocks, based on authentic manner, using gauged lime mortar. The stone wall infilling is of rip-rap (small scale stone - crushed stone in lime mortar with additives); (fortress walls, Bastion 6, Towers 5 and 6)

- supply of material, transport and building massive stone walls of the staircase area, width 40 - 130 cm, double faced, of new stone blocks, based on authentic manner, using gauged lime mortar; (Towers 5 and 6)
- placing the flattening layer above the constructed vault up to the ground floor level; (Tower 6)
- building massive stone foundations of the staircase, of irregularly shaped sandstone and limestone blocks, using gauged lime mortar; (Tower 6)
- plastering the exterior and interior stone wall surfaces using lime mortar in two layers; (all buildings)
- supply of stone blocks, transport and repairing the missing parts of outer and inner wall fronts; (all fortress walls and bastions)
- building the barrel vault of the entrance gate, thickness = 30 cm;
- laying the waterproofing protection screed in the groundfloor lavatories;
- laying the light-reinforced slab – thermal insulation protective screed in the ground floor;
- stone paving works in the ground floor hall;
- stone paving works in the exterior – paths, pavements, sitting areas and outer low walls;
- both-side reinforcement of interior partition walls;
- reinforcement of bearing walls;
- supply and setting the stone drain channel, according to drawings.

## **SUPERVISION AND APPROVAL FOR WORK STAGES AND APPLICATION OF MATERIALS**

Works on exterior stairs lining, repairing the chimneys together with making the chimney cap and stone masonry coating of annex walls are to be done according to drawings and Designer's instructions. Setting of the stone drain channel is to be done according to drawings, relevant regulations and instructions of the Supervising body. Composition of compound mortar for plastering façade walls and interior walls will be obtained from the Supervising body.

## **STANDARDS APPLIED TO WORK PERFORMANCE AND MATERIALS USED**

- Applicable norms and standards for Bosnia and Herzegovina:

*Norms and standards of works in building construction 1-3 – Normativi i standardi rada u građevinarstvu – Visokogradnja, knjige 1-3, Građevinska knjiga, 2008 (12<sup>th</sup> issue).*

- European norms and standards:

Brick/ Blockwork

DIN EN 771-1 Specification for masonry units - Part 1: Clay masonry units

DIN EN 771-5 Specification for masonry units - Part 5: Manufactured stone masonry units

DIN EN 771-6 Specification for masonry units - Part 6: Natural stone masonry units

Mortar

DIN EN 998-1 Specification for mortar for masonry - Part 1: Rendering and plastering mortar

DIN EN 998-2 Specification for mortar for masonry - Part 2: Masonry mortar  
DIN EN 1015-1 Methods of test for mortar for masonry - Part 1: Determination of particle size distribution (by sieve analysis)  
DIN EN 1015-11 Methods of test for mortar for masonry - Part 11: Determination of flexural and compressive strength of hardened mortar

#### Ancillaries

DIN EN 845-1 Specification for ancillary components for masonry - Part 1: Ties, tension straps, hangers and brackets  
DIN EN 845-3 Specification for ancillary components for masonry - Part 3: Bed joint reinforcement of steel meshwork

#### Plaster

DIN 18350 Construction contract procedures (VOB) - Part C: General technical specifications in construction contracts (ATV); Plastering and rendering  
DIN 4102 Fire behaviour of building materials and elements - Classification of building materials - Requirements and testing

## **SPECIFICATIONS FOR THE BUILT-IN AND USED MATERIALS**

### **mortar**

Lime mortar with specified additives will be used for all the masonry works except for the annex. Lime mortar consists of lime, sand and water. Binder is the hydrated lime which has previously laid in the maturing pit for at least two to three months, so that even the smallest parts have burnt. No lime from the bottom of the maturing pit should be used, because non-burnt parts may appear which would burn later, and thus damage the mortar in the walls. The ratio of lime to sand is 1:2 to 1:4. Several samples of mortar of various ratios should be made, and the optimal is to be chosen after several days, upon approval of the conservationist. Compound lime mortar is to be used for rebuilding interior brick walls. Cement mortar is to be applied as base for a part of exterior stone pavement and for paving the ground floor hall, according to drawings. Cement mortar is to be used for reinforcement works on interior partition and bearing walls.

### **brick**

Authentic brick from the decomposed walls is to be used for rebuilding interior brick walls.

### **lime**

Lime must be mature, at least 3 years old.

### **aggregate**

Aggregate must be of fine-grained structure.  
Sand Gradation: maximum 2 mm grain.

### **stone**

Stone slabs for paving the ground floor hall – according to the Designer's instructions.  
Stone slabs for the exterior paving works – thickness 5-8 cm.  
Dimensions of tone drain channel – width 30 cm; thickness: 8 cm.  
Make joints parallel, plumb, level, and in alignment. Make joints uniform in width.  
Dimensions of new stone blocks of limestone and dolomite accordance to existing (different dimensions, the length of SSA 15-40 cm, height 15-30 cm, width 30-50 cm).

**reed**

The purpose of reed is to bear the plaster layer. It is to be set as sheathing made of dry, healthy, non-broken peeled reed laths, of 8-10 mm in diameter, up to 2.5 m in length. The laths are to be distributed at the distance of 8-10 mm, and bonded with zinc-coated or annealed wire at the distances of 10-15 cm. The reed laths are to be set perpendicular to the direction of wooden sheathing of the ceiling. They are to be attached using special nails and the wire which bonds the reed.

**water**

Suitable for domestic consumption, and free of mineral and organic substances that affect the hardening and durability of the plaster.

**wire mesh**

As defined in part 1.4.4. of these *Technical specifications, Concrete and reinforced concrete works, Reinforcement.*

**thermal insulation**

As defined in part 1.4.8. of these *Technical specifications, Insulation works.*

**masonry wall cleaning**

During cleaning operations, protect work which may be damaged, stained, or discoloured. Clean exposed masonry surfaces with clear water and stiff fibre brushes and rinse with clear water. Where stains, mortar, or other soil remain, continue scrubbing with warm water and detergent. Where soil still remains on brickwork, continue cleaning as follows: Thoroughly wet exposed surfaces of dark-coloured brickwork with clear water and scrub with stiff fibre brushes and a solution of not more than 1 part of muriatic acid (HCl) to 9 parts of water applied to an area of 1 to 2 square metre at a time. Immediately after cleaning each area, rinse thoroughly with clear water. Do not use caustic solutions or sandblasting to clean surfaces. Masonry shall be free of stains, efflorescence, mortar or grout droppings, and debris. Restore damaged, stained, and discoloured work to original condition or provide new work.

**surface preparation for plastering**

Clean surfaces before application of plaster of, dust, loose particles, grease, bond breakers, and foreign matter. Do not apply plaster directly to surfaces of masonry or concrete that have been coated with bituminous compound or other waterproofing agents, or that have been painted or previously plastered. Before plaster work is started, wet masonry and concrete surfaces thoroughly with a fine spray of clean water to produce a uniformly moist condition. Check metal grounds, corner beads, screeds, and other accessories carefully for alignment before starting work. Cover all adjacent permanent works which may be soiled during plaster works. Corner beads shall be provided on all corners up to a height of 2m above finished floor level and shall be plastered into position.

**internal plastering**

The plaster is to be applied in two coat work – rough and fine plastering. Rough plastering is to be done after surface preparation: scraping the joints, cleaning and washing the walls and moistening. Lime mortar is to be applied with curt movements using trowel, and slightly leveled. This coat is to be done with sand of bigger grading and rich lime. It should well adhere and penetrate the joints Fine plastering is to be done over this coat using fine raded sandSecon coat is to be applied after complete hardening of the first layer. The

surface is to be moistened with water and the second layer is to be applied. Vertical strips should be set in order to obtain flat surface – plaster leaders made of wooden battens set at the distance of about 1.0 m. First layer is about 1.0 cm thick, while second is about 0.5 cm thick.

Window sills, pipes and other such ancillaries shall be plastered in so that damage to the plaster through differential expansion is avoided. Wall plastering shall continue up to the fixed ceiling height and shall be finished cleanly off at the ceiling. Any plaster splattering on the ceiling shall be immediately removed. The same shall apply to floors unless otherwise required by particular flooring systems. Rooms shall be brushed clean before hand-over of plaster works.

For plastering in wet rooms, binder material without gypsum shall be used.

### **external plastering**

The hard strength of plaster shall be less than the strength of the underground. Working outwards, each layer of plaster shall have a decreasing strength.

Each layer of plaster shall be allowed to dry prior to application of the next layer. Normal drying time is taken as 1 day per mm layer thickness.

In situations when the underground consists of different materials then in order to create a homogeneous underground a rough base plaster shall be applied and permitted to harden fully (minimum 1 week) before applying the plaster.

At least 10 kg of plaster shall be reserved for small repairs to the façade after the removal of scaffolding. Care shall be taken to ensure consistency in colour, texture and thickness of external plaster. Irregularities shall be classified as major defects. If colour in plaster shall be used then care shall be taken that the plaster comes from a single charge.

Plaster on the skirting around the lower section of facades shall be water repellent.

Cracks in finished plaster wider than 0,2 mm shall be deemed as defects.

When selecting the plaster careful consideration of the nature of the underground shall be taken.

Rust free tools shall be used for spreading the plaster.

### **proportioning**

Unless specified otherwise, materials are specified on a volume basis and shall be measured in approved containers, to ensure that the specified proportions will be controlled and accurately maintained during the progress of the work.

### **gypsum-cardboard walls**

Gypsum-cardboard walls must consist of boards of 12.5 mm thickness, attached to metal sub-construction, containing thermal insulation. Building works on gypsum-cardboard walls should include bandaging all joints and skimming. Waterproof boards must be used for the lavatory walls.

### **joints**

Bed joints and vertical joints shall be of uniform width. Lay bricks on a full bed of mortar and fill vertical joints solidly with mortar. Point up joints around flashing as necessary. Leave the joints un-struck in brickwork where finish is cement render / solid plaster. Upon completion of masonry work and before cleaning, cut out defective mortar joints and tuck point joints and all holes solidly with prehydrated mortar.

### **pointing works**

Pointing works should be included in price calculation for all stone paving works. Cut out and patch loose, cracked, damaged, or defective plaster. Patch shall match existing work in texture, colour and finish flush with previously applied plaster surfaces. Point work abutting or adjoining finish work in a neat manner. Remove droppings or splattering from surfaces. Leave clean and in a condition to receive paint or other finish.

#### **1.4.8. Carpentry works**

##### **GENERAL REMARKS**

This section of *Technical specifications for architectural and civil engineering works* sets out the requirements in regard to the quality of materials and standards of workmanship to be employed in carpentry works.

All carpentry works must be performed strictly according to the design and the relevant standards and regulations. The prices should include all work operations, auxiliary materials and scaffolding.

Quality of materials must comply with relevant standards and regulations.

Cross-cutting, binding and assembling is to be done on site, so that wooden elements of appropriate length for all necessary bonds and overlapping must be supplied. In case wooden elements are not to be built-in immediately, they should be properly marked, classified and stored until their installment.

##### **SCOPE OF WORKS FORESEEN IN THE DESIGN DOCUMENTATION**

The carpentry works foreseen in this design involve:

The carpentry works foreseen in this design involve:

- manufacturing of wooden roof construction, (Stone building, Towers 5 и 6)
- placing the new ceiling construction of wooden beams, dimensions 8x18 cm, axial distance 65.00 cm; (Stone building)
- supply of material, transport and lathing the roof with battens of 24/48 mm parallel to the rafters, for creation of air space under the roofing. The battens are to be placed at 40 cm distance; (Stone building)
- boarding of the roof with boards of 24 mm; (Stone building)
- application of the special impregnating protective agents to the wooden elements of roof and ceiling construction, for the protection against fire and insects; (Stone building)
- supply of material, transport and lathing the roof surfaces with battens 3/5 cm (that bear the wood shingle) at axial distance of 15 cm, for triple wood shingle roofing, parallel to the eaves; (Towers 5 and 6)
- placing the wooden ceiling beams made of white wood, dimensions 18x20 cm, axial distance 80.00 cm;
- building and placing the wooden beams for batch boxes (wooden 'grill' inside the wall), dimensions 14x14 cm, made of white wood; (Towers 5 and 6, Bastion 6)
- construction and placing the white wood door lintels, dimensions 14/14 cm;
- construction and placing the single-flight staircase made of oak wood; (Towers 5 and 6)

- construction and placing the "šašovci" ceiling (small boards made of splitted wood) in the ceiling beam grooves; (Towers 5 and 6)
- placing the sub-floor over the ceiling beams; (Towers 5 and 6)
- building and placing the impregnated wooden planks d=50 mm, over wooden sub-construction, dimensions 10x10 cm; (Bastion 6)
- preparation the wooden sheathing for the ceilings in the ground floor and first floor and their attachment to the floor and ceiling beams;
- supply and installment of wooden roof construction;
- supply and installment of wooden roof sheathing;
- preparation of wooden sheathing for roofing works in copper metal sheets, including installment of sheathing paper;
- preparation of wooden sheathing for the dome for roofing works in copper metal sheets, including installment of sheathing paper;
- supply and installment of floor construction between ground floor and first floor;
- supply and installment of ceiling construction at the first floor, except in the decorated hall;
- replacement of wooden door and window lintels;
- supply and installment of wooden sub-floor.

## **SUPERVISION AND APPROVAL FOR WORK STAGES AND APPLICATION OF MATERIALS**

- Applicable norms and standards for Bosnia and Herzegovina:

*Norms and standards of works in building construction 1-3 – Normativi i standardi rada u građevinarstvu – Visokogradnja, knjige 1-3, Građevinska knjiga, 2008 (12<sup>th</sup> issue).*

- European norms and standards:

DIN 52130 Bitumen sheeting for water-proofing of roofs - Concepts, designation, requirements

DIN 52143 Bitumen roofing felt with glass fleece base; terms and definitions, designation, requirements

DIN 4102 Fire behaviour of building materials and elements

DIN 18336 Construction Contract procedures for building works - Part C: General technical specifications for building works; Water-proofing works

- All carpentry works are to be done in accordance with recognized good trade practices.

## **SPECIFICATIONS FOR THE BUILT-IN AND USED MATERIALS**

### **wood**

Wooden elements for carpentry works are supposed to be of fir timber of 2nd class. Fir must be hard and elastic, without cracks and dry (12-20% humidity).

Thickness of wooden sheathing must be 2.4 mm.

Dimensions of other elements must be in accordance with dimensions given in the design documentation. For the door and window lintels to be replaced, exact measures must be taken on site, and replacing elements and all details of their binding made according to the authentic ones.

### **cross-cutting, binding and assembling of wooden elements**

Cross-cutting, binding and assembling is to be done on site, using appropriate and sharp tools and necessary additions, nails, anchors, screws, bonds etc, all according to rules of carpentry craft.

### **sheathing paper**

Bitumenized roof cardboard with sand rubbing.

Nailing shall be made at joints of roof sheeting at least 10cm from the edge of the sheet. At least 3 Nails per m<sup>2</sup> shall be provided for buildings up to 20m with a minimum of 6 nails per m at edges and 9 nails per metre at corners.

### **"šašovci" ceiling**

"Šašovci" are made of beech or oak, medium dry. Timber must be felled in the early spring, before the appearance of natural juices. Wood must be manually fragmented. Between two beams, in average in the grooves on the sides, string "šašovci" sheets at right angle to the cap and horns. For making shingles used to be the usual carpenter and wood turner tool, ax, adze, lathe and "prosjek".

### **storing the material on site**

Store and handle materials in a manner to protect from damage, exposure to open flame or other ignition sources, and from wetting, condensation or moisture absorption. Store in an enclosed building or trailer that provides a dry, adequately ventilated environment.

Materials packed in rolls must be stored vertically.

## **1.4.9. Roofing works**

### **GENERAL REMARKS**

This section of *Technical specifications for architectural and civil engineering works* sets out the requirements in regard to the quality of materials and standards of workmanship to be employed in roofing works.

Pricing must include all necessary work operations, auxiliary material and tools. Restore work and materials that become damaged during construction to original condition or replace with new materials.

### **SCOPE OF WORKS FORESEEN IN THE DESIGN DOCUMENTATION**

The foreseen works involve:

- Supply of material, splitting, finishing, transport and placing the oak wood shingle in three layers (Towers 5 and 6)
- installation flat crown tile (Stone building)

### **SUPERVISION AND APPROVAL FOR WORK STAGES AND APPLICATION OF MATERIALS**

Engineer will inspect and approve the surfaces immediately before starting installation.

### **STANDARDS APPLIED TO WORK PERFORMANCE AND MATERIALS USED**

- Applicable norms and standards for Bosnia and Herzegovina:  
*Norms and standards of works in building construction 1-3 – Normativi i standardi rada u građevinarstvu – Visokogradnja, knjige 1-3*, Građevinska knjiga, 2008 (12<sup>th</sup> issue).  
 Roofing Manufacturer's instructions.
- European norms and standards:

DIN EN 1253 Gullies for buildings

DIN 4102 Fire behaviour of building materials and elements

DIN 18339 Construction contract procedures VOB - Part C: General technical specifications in construction contracts (ATV); Sheet metal roofing and wall covering work

## **SPECIFICATIONS FOR THE BUILT-IN AND USED MATERIALS**

### **wood shingle**

Wood shingle is made from oak, medium dry. Wood must be felled in the early spring, before the appearance of natural juices. Wood shingle must be manually splitted in a shape of a small board of wedge-like transversal section, with a groove along the middle of thicker longitudinal side. The thinner longitudinal side ('knife') is about 1 cm thick, while the thicker side has cca. 3-4 cm thickness. The thinner longitudinal side is to be symmetrically thinned, or shaped so that its bottom surface has a shallow stepped groove. The thicker longitudinal side is to have a groove in the middle made using turning lathe. At the bottom end of the thicker longitudinal side, an angular cut is to be made, which is known as 'kalem'. When placing on the roof the boards are to be angled to the left, in a way that the 'knife' (the right side of the board) is inserted into the groove ('šipilo') which is in the left side of the neighbouring board. The rows overlap for 5-10 cm. Within the width of the overlap, each wooden board is to be slightly trimmed at both ends.

### **crown tile**

Crown tile must be in accordance to the standards DIN / EN 1304, manufactured from clay, waterproof, resistant to frost and to actively breathe. Ceramic quality needs to ensure low water absorption and to below 3% as well as extreme resistance to freezing.

Tile is plane with two holes for the nails, dark red color.

### **precautions and protection**

Surfaces shall be clean, smooth, and dry. Check roof deck surfaces, including surfaces sloped to roof drains and outlets, for defects before starting work. Do not permit phased construction.

Protect open ends of each day's work with temporary water cutoffs and covers, and remove when work is resumed. Do not permit storing, walking, wheeling, or trucking directly on insulation or on roofed surfaces. The storage of pressure gas cylinders in basements, stairwells, corridors and escape routes is forbidden. During hot working with inflammable gases hand held fire extinguishers according to DIN EN 3 must be readily available immediately adjacent to the area of working.

### **delivery, storage and handling the material**

Deliver materials to site in manufacturer's unopened and undamaged standard commercial containers bearing the following legible information:

- a. Name of manufacturer;
- b. Brand designation;

c. Specification number, type, and class, as applicable, where materials are covered by a referenced specification.

Deliver materials in sufficient quantity to allow continuity of the work.

#### **clean-up**

Upon completion of the works all debris shall be removed from site as well as any material which has fallen to ground level.

### **1.4.10. Insulation works**

#### **GENERAL REMARKS**

This section of *Technical specifications for architectural and civil engineering works* sets out the requirements in regard to the quality of materials and standards of workmanship to be employed in horizontal waterproofing and thermal insulation works.

Provide only thermal insulating materials recommended by manufacturer for type of application indicated. Installation procedures must follow relevant norms and standards and manufacturer's instructions.

All necessary overlaps must be taken into account and included in pricing.

#### **SCOPE OF WORKS FORESEEN IN THE DESIGN DOCUMENTATION**

The works foreseen in the design documentation involve:

- placing the vapour barrier for the flat roof; (Stone building, Towers 5 и 6, Bastion 6, Underground Arsenal)
- placing the waterproofing of the sanitary rooms and elevator shaft; (Stone building)
- placing the waterproof paper over the boarding base below the beaver tile roofing; (Stone building)
- placing a single layer of aluminium foil; (Stone building)
- placing a single layer of PVC foil; (Stone building)
- placing the thermal insulation of the ceiling - infilling, mixture of sawdust and lime; (Towers 5 и 6)
- placing of waterproofing protection for the roof of existing underground building (Green roof); (Landscaping)
- placing the horizontal waterproofing; (Stone building, Towers 5 и 6, Bastion 6)
- installation of horizontal waterproofing in the ground floor;
- lacing the horizontal waterproofing over the slab on ground and at the flat roof;
- thermal insulation of floor construction and attic (fill);
- thermal insulation in the ground floor.

#### **SUPERVISION AND APPROVAL FOR WORK STAGES AND APPLICATION OF MATERIALS**

All materials to be used and manufacturers' instructions shall be approved by the Supervising engineer.

Before installing insulation, ensure that all areas that will be in contact with the insulation are dry and free of projections which could cause voids, compressed insulation, or punctured vapour retarders. If moisture or other conditions are found that do not allow the

proper installation of the insulation, do not proceed but notify the Engineer of such conditions.

Supervising engineer will inspect and approve the surfaces immediately before starting installation.

## **STANDARDS APPLIED TO WORK PERFORMANCE AND MATERIALS USED**

- Applicable norms and standards for Bosnia and Herzegovina:

*Norms and standards of works in building construction 1-3 – Normativi i standardi rada u građevinarstvu – Visokogradnja, knjige 1-3, Građevinska knjiga, 2008 (12<sup>th</sup> issue).*

Waterproofing and Insulation Manufacturer's instructions.

- European norms and standards:

DIN 4102 Fire behaviour of building materials and elements

DIN 18336 Construction contract procedures (VOB) - Part C: General technical specifications in construction contracts (ATV); Waterproofing

DIN 18195 – 1 Water-proofing of buildings - Part 1: Principles, definitions, attribution of waterproofing types.

DIN 18195 – 2 Water-proofing of buildings - Part 2: Materials.

DIN 18195 – 3 Water-proofing of buildings - Part 3: Requirements to the ground and working properties of materials.

DIN 18195 – 4 Water-proofing of buildings - Part 4: Water-proofing against ground moisture (capillary water, retained water) and non-accumulating seepage water under floor slabs and on walls, design and execution.

DIN 18195 – 5 Water-proofing of buildings - Part 5: Water-proofing against nonpressing water on floors and in wet areas; design and execution.

DIN 18195 – 6 Waterproofing of buildings and structures; waterproofing sheeting subjected to hydrostatic pressure from the inside; design and workmanship

DIN EN 13163 Thermal insulation products for buildings - Factory made products of expanded polystyrene (EPS) – Specification

DIN EN 826 Thermal insulating products for building applications - Determination of compression behaviour

## **SPECIFICATIONS FOR THE BUILT-IN AND USED MATERIALS**

### **waterproofing**

Horizontal waterproofing must be done over clean and dry concrete surface. The waterproofing consists of two layers of B3 insulation and three bitumen coats. Manufacturer's instructions are to be followed during installation. Waterproofing must be kept safe from mechanical or other damage. Overlapping must be at least 8-10 cm for rows of material in each layer and well laminated by bitumen, as well as the following layers, which must be set perpendicular to previous layer.

The material shall be certified as compatible with the insulation material.

Ensure that the following conditions exist prior to application of the membrane materials:

- a. Drains, curbs, cants, and equipment supports are in place.
- b. Surfaces are rigid, dry, smooth, and free from cracks, holes, and sharp changes in elevation.
- c. Substrate is sloped as indicate to provide positive drainage.
- d. Cast-in-place substrates have been allowed to cure and the surface dryness specified requirements have been met. Substrate curing shall be compatible with membrane system.

e. All corners are rounded using wedges of insulation material or mortar to prevent creasing of the membrane.

#### **transitions from horizontal to vertical position of waterproofing**

Transitions must be filleted, without sharp edges, with mortar slope of 1:2, which must be smoothed.

#### **waterproofing detail in stone façade walls**

As façade walls lined in stone blocks are not foreseen for plastering, the water-proofing must be set back 5 cm from the façade level, through the plinth joint. The joint is to be filled with pointing mortar.

#### **thermal insulation – fill**

Thermal insulation fill is to be made of lime and sawdust mixture and used for insulation in the floor construction and attic. Mixture is to be laid over PVC foil.

#### **thermal insulation – ground floor**

5 cm layer of hard elastified non-inflammable polystyrol including PVC foil, of 25 kP/m<sup>2</sup> bearing capacity, as defined in the design.

The material shall be at least 6 weeks old so that initial shrinkage has occurred. Installation must be done according to manufacturer's instructions. The insulation shall be cut where necessary to ensure an adequate fit. All joints between the insulation shall be tightly butted together.

#### **PVC foil overlaps**

PVC foil sheets must have at least 10-15 cm overlaps.

#### **precautions and preparation**

Surfaces shall be clean, smooth, and dry. Do not install thermal insulation fill during inclement weather or when air temperature is below 5 degrees C or when there is ice, frost, or moisture visible on the roof deck or in high winds.

Do not permit phased construction.

Protect open ends of each day's work with temporary water cutoffs and covers, and remove when work is resumed. At the end of the day's work and when precipitation is imminent protect applied modified bitumen membrane system. Applied membrane shall also be shaded from strong direct sunlight.

Do not permit storing, walking, wheeling, or trucking directly on insulation or waterproofing.

During hot working with inflammable gases hand held fire extinguishers according to DIN EN 3 must be readily available immediately adjacent to the area of working.

Select and operate material handling equipment so as not to damage applied membrane.

Prevent damage to edges and ends of roll materials when opening.

#### **storing the material**

Deliver materials to site in manufacturer's unopened and undamaged standard commercial containers bearing the following legible information:

- a. Name of manufacturer;
- b. Brand designation;
- c. Specification number, type, and class, as applicable, where materials are covered by a referenced specification.

Deliver materials in sufficient quantity to allow continuity of the work. Store and handle materials in a manner to protect from damage, exposure to open flame or other ignition sources, and from wetting, condensation or moisture absorption. Store in an enclosed building or trailer that provides a dry, adequately ventilated environment. Replace damaged material with new material. Rolls of material shall be stored vertically. Do not store roll materials in buildings under construction until concrete, mortar, and plaster work is finished and dry. Maintain roll materials at temperatures above 10 degrees C for 24 hours immediately before application.

Do not store materials outdoors unless approved by the Engineer.

#### **clean up**

Remove debris, scraps, containers and other rubbish and trash resulting from installation of waterproofing and insulation from job site each day.

### **1.4.11. Joinery works**

#### **GENERAL REMARKS**

This section of Technical specifications for architectural and civil engineering works sets out the requirements in regard to the quality of materials and standards of workmanship to be employed in joinery works.

All joinery works must be performed strictly according to the design (joinery schemes) and the relevant standards and regulations. The prices should include all work operations, auxilliary materials, tools and scaffolding, according to Norms and standards of building construction works – Building construction GN 550.

Quality of materials must comply with relevant standards and regulations.

All building-in and matching are to be done according to joinery regulations and norms, using sharp and straight tools.

#### **SCOPE OF WORKS FORESEEN IN THE DESIGN DOCUMENTATION**

The joinery works foreseen in this design involve:

- construction and placing the staircase fence and fences on the gallery (Towers 5 and 6)
- supply and installment of doors;
- supply and installment of windows;
- protective coating of wooden elements;
- supply and installment of hydrant locker mask.

#### **SUPERVISION AND APPROVAL FOR WORK STAGES AND APPLICATION OF MATERIALS**

All measures of original doors and windows are to be checked on site during dismantling. One exemplar of each is to be delivered to the joinery workshop to record the details and make new doors and windows precisely according to the existing ones.

All leveling and dimensions must also be controlled on site before supply and installment by Supervising engineer.

## STANDARDS APPLIED TO WORK PERFORMANCE AND MATERIALS USED

- Applicable norms and standards for Bosnia and Herzegovina:

*Norms and standards of works in building construction 1-3 – Normativi i standardi rada u građevinarstvu – Visokogradnja, knjige 1-3, Građevinska knjiga, 2008 (12<sup>th</sup> issue).*

- European norms and standards:

DIN 18355 Construction contract procedures (VOB) - Part C: General technical specifications in construction contracts (ATV); Joinery

DIN 18357 Construction contract procedures (VOB) - Part C: General technical specifications in construction contracts (ATV); Mounting of door and window hardware

DIN 68121-1/2 Timber profiles for windows and window doors; dimensions, quality requirements

DIN 18203-3 Tolerances for building; building components of timber and wood based panel products

- All joinery works are to be done in accordance with recognized good trade practices.

## SPECIFICATIONS FOR THE BUILT-IN AND USED MATERIALS AND PARTICULAR REQUESTS

### **wood**

Provide wood doors and windows of the types, sizes, and designs indicated in the drawings. Doors and windows must be made of massive oak, repeating authentic dimensions, binding details and colour. Width of the door frames is to be determined by wall opening width taking into account the dimensions of battens.

### **hardware and accessories**

Provide windows complete with necessary hardware, fastenings, clips, fins, anchors, glazing beads, and other appurtenances necessary for complete installation and proper operation.

All door and window hardware is to be made according to originals, following authentic material, binding details and colour.

Provide, as far as feasible, locks, hinges, pivots, and closers of one lock, hinge, pivot, or closer manufacturer's make. Modify hardware as necessary to provide features indicated or specified.

Hardware shall be designed to support a dead load to 1-1/2 times the door and attached hardware without deformation which would interfere with the operation of the door.

### **workmanship**

Finished doors and frames shall be strong and rigid, neat in appearance, and free from defects, waves, scratches, cuts, dents, ridges, holes, warp, and buckle. Moulded members shall be clean cut, straight, and true, with joints coped or mitred, well formed, and in true alignment. Dress exposed welded and soldered joints smooth. Corner joints shall be well formed and in true alignment.

### **cleaning**

Upon completion, clean exposed surfaces of doors and frames thoroughly remove mastic smears and other unsightly marks.

Clean interior and exterior surfaces of window units of mortar, plaster, paint spattering spots, and other foreign matter to present a neat appearance, to prevent fouling of weathering surfaces and weather-stripping, and to prevent interference with the operation of hardware. Replace all stained, discoloured, or abraded windows that cannot be restored to their original condition with new windows.

#### **delivery, storage, and handling**

Deliver doors to the site in an undamaged condition and protect against damage and dampness. Stack doors flat under cover. Support on blocking, a minimum of 100 mm thick, located at each end and at the midpoint of the door. Store doors in a well-ventilated building so that they will not be exposed to excessive moisture, heat, dryness, direct sunlight, or extreme changes of temperature and humidity. Do not store in a building under construction until concrete, masonry work, and plaster are dry. Replace defective or damaged doors with new ones.

Use care in handling and hoisting windows during transportation and at the site. Store windows and components out of contact with the ground, under a weathertight covering, so as to prevent bending,

warping, or otherwise damaging the windows. Damaged windows shall be repaired to an "as new" condition as approved. If windows can not be repaired, provide a new unit.

#### **1.4.12. Ceramic tiling works**

##### **GENERAL REMARKS**

This section of *Technical specifications for architectural and civil engineering works* sets out the requirements in regard to the quality of materials and standards of workmanship to be employed in ceramic tiling works.

Generally products from different manufacturers shall not be used in the same room.

Supply an extra two percent of each type tile used in clean and marked cartons.

Do not start tile work until roughing in for plumbing, heating, ventilating, air conditioning, and electrical work has been installed and tested; and built-in bathtubs, shower stalls, and membrane water-proofing have been installed and tested.

##### **SCOPE OF WORKS FORESEEN IN THE DESIGN DOCUMENTATION**

The ceramic tiling works foreseen in this design involve:

- supply of material and floor tiling works; (Stone building, Tower 6)
- supply of material and wall tiling works. (Stone building, Tower 6)

##### **SUPERVISION AND APPROVAL FOR WORK STAGES AND APPLICATION OF MATERIALS**

The following samples must be submitted for approval:

- ceramic floor tile sample showing colours, finish, pattern, and form of each type, with joints between the tiles grouted;
- ceramic wall tile sample showing size, form, finish, and range and shades in each colour, with joints between the tiles grouted;

- ceramic tile accessories - pieces of each type, showing colour, finish, type, and style.

## **STANDARDS APPLIED TO WORK PERFORMANCE AND MATERIALS USED**

- Applicable norms and standards for Bosnia and Herzegovina:

*Norms and standards of works in building construction 1-3 – Normativi i standardi rada u građevinarstvu – Visokogradnja, knjige 1-3, Građevinska knjiga, 2008 (12<sup>th</sup> issue).*

- European norms and standards:

DIN 18352 Construction contract procedures (VOB) - Part C: General technical specifications in construction contracts (ATV); Wall and floor tiling

DIN 18195 Waterproofing of buildings and structures; waterproofing sheeting subjected to hydrostatic pressure from the inside; design and workmanship

DIN EN 87 Ceramic floor and wall tiles - Definitions, classification, characteristics and marking

DIN EN 186-1 Ceramic tiles - Extruded ceramic tiles with water absorption of E between 3% und 6% (Group A IIa)

DIN EN 176 Dust-pressed ceramic tiles with a low water absorption (E up to 3 %) - Group BI

DIN EN 177 Dust-pressed ceramic tiles with a water absorption of E between 3% and 6 % (Group B IIa)

DIN EN 1347 Adhesives for tiles - Determination of wetting capability

DIN EN 12808 Adhesives and grouts for tiles - Part 1: Determination of chemical (1 to 5) resistance of reaction resin mortars; Adhesives and grouts for tiles - Part 2: Determination of resistance to

abrasion; Adhesives and grouts for tiles - Part 3: Determination of flexural and compressive strength; Adhesives and grouts for tiles - Part 4: Determination of shrinkage; Adhesives and grouts for tiles - Part 5: Determination of water absorption

DIN EN 13888 Grouts for tiles - Definitions and specifications

## **SPECIFICATIONS FOR THE BUILT-IN AND USED MATERIALS**

### **ceramic tiles**

All ceramic tiles must be 1. class tiles according to local standard. Dimensions and other properties of floor ceramic tiles are to be approved by the Designer. Wall ceramic tiles must be set by gluing. Dimensions must be 20 by 25 cm, and other properties are to be approved by the Designer.

Ground floor walls to be tiled up to 2.05 cm high, and in the first floor up to 2.37 cm high.

Tile colours and patterns shall be as selected from the manufacturer's standard colour samples. Colours and patterns indicated by reference to manufacturer's name and designations are for colour and pattern

identification only and are not intended to limit selection of other manufacturer's products with similar colours and patterns.

All tiles used shall be strictly those approved during the sampling. Mixing of wall or floor tiles from different manufacturers within a single room is not permitted. All floor tiles shall be anti-slip. Tiles shall be lead free.

### **sand for grout**

Sand for grout shall pass a number 16 sieve.

**water**

Clean, potable.

**metal dividing strips**

Heavy-top terrazzo type, brass or zinc alloy, approximately 2 mm thick with 6 mm thick top, and depth equal to thickness of tile plus setting bed.

**mortars and grouts**

Mortar Tile Setting - portland cement mortar or dry-set portland cement mortar, factory sanded. The use of organic adhesives is limited to wall applications.

Grout must be of commercial portland cement, tile-setting and grouting epoxy, to be non staining and environmentally neutral.

**surface preparation**

Do not begin floor tile installation in areas receiving wall tile until wall tile installation has been completed. The bedding shall be chosen to suit the underground.

Bedding on concrete floor: Prepare with mortar setting bed before applying tile with dry set mortar. Fill areas where the floor does not meet the required tolerances and level. Provide expansion joints where indicated.

Preparation of Mortar Mixes: Measure mortar materials in approved containers to ensure that proportions of materials will be controlled and accurately maintained. Measuring materials with shovels is not permitted. Unless specified otherwise, mix mortar in proportions by volume in approved mixing machines or mortar boxes. Control the quantity of water accurately and uniformly.

Salt deposits on Walls: Salt deposits on underground shall be removed using a stiff brush (not metal !) after the wall has been permitted to dry.

**joints**

Joints must be parallel, plumb, level, and in alignment. Make end joints in broken-joint work on centre lines of adjoining tiles, as far as practicable. Set square tiles with straight joints, and set oblong tiles with broken joints. Jointing shall only be made following the setting of

the bedding mortar. Make joints uniform in width and space to accommodate tile with a minimum of cutting, but maintain standard mounting widths between units abutting sheets of mounted ceramic mosaic tile. Generally joint widths in wall tiling shall not exceed 3mm. Provide expansion and control joints in tile. Install dividing strips in mortar setting bed while bed is in a plastic state. Set dividing strips where indicated in straight, unbroken lines, flush with unfinished

floor surface. Provide dividing strips at joints where floor tile abuts and is flush with other types of floor finishes, except at doors where thresholds are provided. The joint between wall or floor tiles and fixtures (e.g. bathroom fitting) shall be made water tight and elastic where not otherwise specified. Floor gullies shall be fitted with sealing rims and tiles around the gullies shall be laid to a slight fall. Elastic joints shall be installed at all points where tiling crosses underground

of different materials: Elastic joint are also required at returns in the tiling. Edges of joints shall be primed and surfaces covered using adhesive tape. Joints shall be free from grout deposits. Elastic fillers shall be compatible with both the tiles and underground. In staircases, elastic joints shall be provided between stair tiles and skirting tiles. Sealing shall be provided under baths and shower bases.

Expansion joints shall be provided at least every 4 m.

### **pattern geometry**

Generally tiles shall be laid parallel to walls unless otherwise stipulated. Where possible joints of floor tiles shall be continuous with wall tile joints. The Contractor shall confirm his intentions to the Engineer prior to commencing tiling works. If tiles are grooved on the underside then all tiles shall be laid with the grooves orientated in the same direction.

### **cut tiles**

Only tiles larger than half the size of the main tile may be used. The use of small fill pieces of cut tile shall be avoided.

### **precautions, conditions and protection**

Do not start tile work unless the ambient temperature in work area is at least 10 degrees C and rising. Maintain the ambient temperature above 10 degrees Centigrade while work is in progress and for at least 3 days after its completion. Do not use adhesives in unventilated areas. Recess, or depress setting bed where indicated. Tiles shall not be laid on cement screed with a moisture greater than 2%.

Wall surfaces to receive ceramic tile shall have square corners, be plumb and true, with variations not exceeding 2,5 mm per meter from the required plane.

During tiling works all floor gullies etc are protected from ingress of grout, deposits etc. Cover finished tile floors with clean, 1.45 kilogram per sq m natural kraft paper before permitting foot traffic. Place board walkways on floors that are to be continuously used as passageways by workers. Protect tiled corners, external angles, with board corner strips in areas used as passageways by workers.

### **cleaning**

Upon completion of tiling works in any one room the room shall be brushed clean, waste material and excess mortar removed.

Acid cleaning of unglazed tile when necessary, shall be done no sooner than 14 days after setting tile.

When grinding tools are used for dry cutting then vacuum dust removal shall be adopted.

### **1.4.13. Floor installation works**

#### **GENERAL REMARKS**

This section of *Technical specifications for architectural and civil engineering works* sets out the requirements in regard to the quality of materials and standards of workmanship to be employed in all works on wooden floor installation

All works must be performed strictly according to the design and the relevant standards and regulations. The prices should include all work operations, auxilliary materials and tools.

Quality of materials must comply with relevant standards and regulations.

Sharp and straight tools must be used for all work operations.

#### **SCOPE OF WORKS FORESEEN IN THE DESIGN DOCUMENTATION**

The floor installation works foreseen in this design involve:

- supply and installation oak strip flooring (Stone building)
- supply and installation of oak matched floor over the wooden sub-floor, including all necessary operations and protective coating. (Towers 5 and 6)

## **SUPERVISION AND APPROVAL FOR WORK STAGES AND APPLICATION OF MATERIALS**

Quality of materials, all leveling and dimensions must be controlled on site before installment by Supervising engineer.

### **STANDARDS APPLIED TO WORK PERFORMANCE AND MATERIALS USED**

- Applicable norms and standards for Bosnia and Herzegovina:

*Norms and standards of works in building construction 1-3 – Normativi i standardi rada u građevinarstvu – Visokogradnja, knjige 1-3, Građevinska knjiga, 2008 (12<sup>th</sup> issue).*

- European norms and standards:

DIN 18203-3 Tolerances for building; building components of timber and wood based panel products

DIN 4102 Fire behaviour of building materials and elements

- All works are to be done in accordance with recognized good trade practices.

### **SPECIFICATIONS FOR THE BUILT-IN AND USED MATERIALS**

#### **wood**

Wooden elements for sub-floor works are supposed to be of fir timber of 2<sup>nd</sup> class.

Oak wood matched floor must be of 1<sup>st</sup> class boards 12 to 16 cm wide and of 2.4 mm thickness.

Matching angle battens must also be supplied and included in price.

All wooden elements must be hard and elastic, without cracks and dry (12-20% humidity).

#### **storing the material on site**

Store and handle materials in a manner to protect from damage, exposure to open flame or other ignition sources, and from wetting, condensation or moisture absorption. Store in an enclosed building or trailer that provides a dry, adequately ventilated environment.

#### **1.4.14. Sheet metal works**

### **GENERAL REMARKS**

This section of *Technical specifications for architectural and civil engineering works* sets out the requirements in regard to the quality of materials and standards of workmanship to be employed in sheet metal works.

Pricing must include all necessary work operations, auxiliary material and tools, as well as the necessary scaffolding. Restore work and materials that become damaged during construction to original condition or replace with new materials.

All works must be done according to the design details and relevant rules and regulations.

### **SCOPE OF WORKS FORESEEN IN THE DESIGN DOCUMENTATION**

The foreseen works involve:

- construction and placing the hanging gutters, semi-circular, made of copper metal sheets (Stone building)
- placing the gutter downpipe of copper metal sheet (Stone building)

- construction and placing the ending copper metal sheet above the hanging gutter, (Stone building)
- construction and sheathing the elevator walls with copper metal sheets (Stone building)
- building and placing the marginal copper metal sheet towards the façade (Stone building)
- Building and placing the water collector made of copper metal sheet (Stone building)
- placing and mounting the drain flume lining made of copper metal sheet (Bastion 6)
- supply and installation of copper metal sheathing of the chimneys
- supply and installation of copper gutters and down spouts together with holders
- supply and installation of copper metal sheathing at the joint of the attic wall and the roof
- supply and installation of attic wall sheathing made of copper metal sheets

## **SUPERVISION AND APPROVAL FOR WORK STAGES AND APPLICATION OF MATERIALS**

Engineer will inspect and approve the surfaces immediately before starting installation. The cut out decorative metal elements for the dome must also be approved before installation.

## **STANDARDS APPLIED TO WORK PERFORMANCE AND MATERIALS USED**

- Applicable norms and standards for Bosnia and Herzegovina:

*Norms and standards of works in building construction 1-3 – Normativi i standardi rada u građevinarstvu – Visokogradnja, knjige 1-3, Građevinska knjiga, 2008 (12<sup>th</sup> issue).*

- European norms and standards:

DIN 18451 Construction Contract procedure for building works – Part C: General technical specifications for building works; Scaffolding works

DIN EN 1253 Gullies for buildings

DIN 4102 Fire behaviour of building materials and elements

DIN 18339 Construction contract procedures VOB - Part C: General technical specifications in construction contracts (ATV); Sheet metal roofing and wall covering work

DIN EN 612 Eaves gutters and rainwater down-pipes of metal sheet - Definitions, classification and requirements

DIN EN 1462 Brackets for eaves gutters - Requirements and testing

## **SPECIFICATIONS FOR THE BUILT-IN AND USED MATERIALS**

### **sheet metal**

Copper sheet metal is to be used for all the numbered sheet metal works. Thickness is to be 0.55 mm for all sheets. Chimney sheathing must be done with double joints.

Widths of copper metal sheets when unfolded:

Copper sheets for cutting out decorative dome elements must be of 0.55 mm thickness.

Sharp edges of metal sheeting shall be ground down. For sheets up to 1 mm thick a protection bead shall be utilised. Fixings for metal works (screws, rawl plugs, anchors etc) shall be suitable for the materials in which they are installed.

### **joints**

Down pipes shall be in copper. Joints shall be visible and spigots shall extend at least 5 cm into sockets. If the joint is held by a rim then soldering is not necessary.

Over laps shall be at least 10 mm. For horizontal and lightly sloped items 10 mm wide welds are required. For vertical or steeply sloped items 5 mm welds are sufficient. The weld gap shall not be greater than 0,5 mm to ensure adequate capillary action.

### **precautions and protection**

Surfaces shall be clean, smooth, and dry. Gutters shall be laid with a gradient of at least 3 mm per m unless otherwise indicated. The storage of pressure gas cylinders in basements, stairwells, corridors and escape routes is forbidden. During hot working with inflammable gases hand held fire extinguishers according to DIN EN 3 must be readily available immediately adjacent to the area of working.

### **delivery, storage and handling the material**

Deliver materials to site in manufacturer's unopened and undamaged standard commercial containers bearing the following legible information:

- a. Name of manufacturer;
- b. Brand designation;
- c. Specification number, type, and class, as applicable, where materials are covered by a referenced specification.

Deliver materials in sufficient quantity to allow continuity of the work.

### **clean-up**

Metal cuttings and borings as well as metal dust produced during grinding activities shall be cleaned from the permanent works immediately upon completion of the cutting works. Upon completion of the works all debris shall be removed from site as well as any material which has fallen to ground level.

## **1.4.15. Locksmith's works**

### **GENERAL REMARKS**

This section of *Technical specifications for architectural and civil engineering works* sets out the requirements in regard to the quality of materials and standards of workmanship to be employed in locksmith's works foreseen.

Pricing must include all necessary work operations, auxilliary material and tools. All works must be done according to the design details and relevant rules and regulations.

### **SCOPE OF WORKS FORESEEN IN THE DESIGN DOCUMENTATION**

- supply of material, transport and placing the steel "I" profiles at a part of the ceiling (Stone building)
- supply of material, construction and placing the staircase fence (Stone building, Bastion 6)
- supply, transport and placing the sheet metal, thickness=8 mm, to be attached to the INP beams by welding (Stone building)

- cleaning of the steel from corrosion by sanding or by other means until metal shine is obtained, and protection of the beams with anti-corrosive coatings (Stone building)
- supply, transport and placing the conjunction elements for connection of steel beam and reinforcement concrete slab (Stone building)
- supply of material, construction and placing the exterior staircase - wrought iron fence (Tower 5)
- building and mounting the northern gate according to the design details, installation of wrought iron hinges. Handle for opening and closing the door with the inscription for the blind on the board of wrought iron (Landscaping)
- building and mounting the heat pump mask (Landscaping)
- construction and placing of the fence on the roof (Bastion 6)
- construction and placing the single-winged smoke and fire protective door, certified to have 90 minutes fire resistance (Bastion 6)

The foreseen works involve all necessary remedial measures for the interior cast iron fence with wooden handrail.

## **SUPERVISION AND APPROVAL FOR WORK STAGES AND APPLICATION OF MATERIALS**

The Designer will verify the colour to be used for the fence.

The Client reserves the right to take 0.5 litre samples of paints at random from the products delivered to the site and test them to verify that the products either conform to the referenced specifications or the approved substitution. Products which do not conform shall be removed from site and replaced with new products that conform to the referenced specification or the approved substitution. The Engineer may request that multiple coatings of corrosion protection coatings are applied in different tones to enable the verification of the number of coats.

## **STANDARDS APPLIED TO WORK PERFORMANCE AND MATERIALS USED**

- Applicable norms and standards for Bosnia and Herzegovina  
*Norms and standards of works in building construction 1-3 – Normativi i standardi rada u građevinarstvu – Visokogradnja, knjige 1-3, Građevinska knjiga, 2008 (12<sup>th</sup> issue).*
- European norms and standards

DIN 18363 Construction contract procedures (VOB) - Part C: General technical specifications in construction contracts (ATV); Painting and varnishing

DIN 4102 Fire behaviour of building materials and elements - Classification of building materials - Requirements and testing

DIN 6173 Colour matching General Rules

DIN 971-1 Paints and varnishes - Terms and definitions for coating materials - Part 1: General terms

## **SPECIFICATIONS FOR THE BUILT-IN AND USED MATERIALS AND PARTICULAR REQUESTS**

## **Steel**

The structural steel has to be chosen according to EN 10025. Galvanizing after fabrication using zinc coating by thermal spraying (metallizing).

Steel must be high quality (alloy) with a sulfur content to 0.025% phosphorus and DO, 0.025%.

Elements of the fence create and incorporate according to the details and instructions of the designer. Joints and welds should be perfect, clean and sand the surface. Before installing, fence needs to be cleaned of dust and corrosion, applied a waterproofing paint and primary colors.

The construction of the steel door is a box profile in the wall  $d = 20\text{cm}$ . The wing is a double-coated steel sheet thickness of 1.5-2 mm with a filling of mineral wool  $d = 5\text{cm}$ . Doors is to be made with peak and consmoke and rubber sealing strips around the edge of the wing.

## **wrought iron**

The fence must be made and placed in accordance with the details and the manufacturer's instructions. Joints and weldings must be made perfectly, cleaned and polished. The fence is to be cleaned of corrosion and dust, grinded and dusted off before installation.

## **aluminum**

Aluminum profiles with thermal break must be constructed to have good thermal properties. Profile must have in structure polyamide in width of 16-24 mm. Profile has a separate inner and outer chambers between which is the polyamide strips that makes thermal bridge (thermal break). Chambers should have been formed EPDM gaskets or polyamide, which ensures the coefficient  $k = 1.8$  to  $2.44 \text{ W/m}^2\text{K}$ . Sound insulation system of aluminum profiles should be 38 dB.

## **work operations**

The existing fence must be thoroughly cleaned from rust, and the existing colour coat is to be removed. The metal parts must be protected with anti-rust coating and coloured.

The wooden handrail must be coated with transparent lacquer.

Apply coatings when surfaces to be painted are dry. Touch up damaged coatings before applying subsequent coats. Paint and coating systems shall be complete so that all primers, thinners toners etc recommended by the manufacturer are included in order to ensure a complete system.

Provide finished surfaces free from runs, drops, ridges, waves, laps, brush marks, and variations in colours. Apply coatings with approved brushes, approved rollers, or approved spray equipment, unless specified otherwise. Spray areas made inaccessible to brushing by items such as ducts and other equipment. Impregnation and base coating are to be applied and installed all elements. After installation, base coating is to be fixed, putty is to be applied, then the elements must be grinded and painted in two coats. First coat of fireproof paint for metal has to be applied on fire-check doors, after putty, grinding and applying final – second coat.

## **missing fence details**

All missing details must be restored according to original ones.

## **protection**

The Contractor shall cover and mask all items in the area of the works to protect them from being soiled by paint. Any soiling shall be immediately removed. Floors shall also be

protected. The storage of flammable materials on site shall be discussed agreed with the Engineer.

#### **clean-up**

Remove waste fencing materials and other debris from the site.

#### **1.4.16. Interior painting works**

##### **GENERAL REMARKS**

This section of *Technical specifications for architectural and civil engineering works* sets out the requirements in regard to the quality of materials and standards of workmanship to be employed in interior painting works.

Pricing must include all necessary work operations, auxilliary material and tools, as well as scaffolding.

Paint and coating systems applied shall be complete, as recommended by manufacturer.

The Contractor shall submit a detailed list of all coatings and paints used following completion of the work. This list shall include use, manufacturer, product reference, supplier & charge number of the materials to enable the Client to re-order materials for maintenance purposes.

##### **SCOPE OF WORKS FORESEEN IN THE DESIGN DOCUMENTATION**

The painting works foreseen in this design involve final painting of interior walls and ceilings (two coats of semi-dispersive paint), together with the necessary preparation works. (Stone building, Towers, Bastion 6)

##### **SUPERVISION AND APPROVAL FOR WORK STAGES AND APPLICATION OF MATERIALS**

The Designer will verify the paint colours to be used.

The Client reserves the right to take 0.5 litre samples of paints at random from the products delivered to the site and test them to verify that the products either conform to the referenced specifications or the approved substitution. Products which do not conform shall be removed from site and replaced with new products that conform to the referenced specification or the approved substitution.

##### **STANDARDS APPLIED TO WORK PERFORMANCE AND MATERIALS USED**

- Applicable norms and standards for Bosnia and Herzegovina:

*Norms and standards of works in building construction 1-3 – Normativi i standardi rada u građevinarstvu – Visokogradnja, knjige 1-3, Građevinska knjiga, 2008 (12<sup>th</sup> issue).*

- European norms and standards:

DIN 18363 Construction contract procedures (VOB) - Part C: General technical specifications in construction contracts (ATV); Painting and varnishing

DIN 18451 Construction contract procedures (VOB) - Part C: General technical specifications in construction contracts (ATV); Scaffolding work

DIN 4102 Fire behaviour of building materials and elements - Classification of building materials - Requirements and testing

DIN 6173 Colour matching General Rules

DIN 971-1 Paints and varnishes - Terms and definitions for coating materials - Part 1: General terms

DIN 18350 Construction contract procedures (VOB) - Part C: General technical specifications in construction contracts (ATV); Plastering and rendering

## **SPECIFICATIONS FOR THE BUILT-IN AND USED MATERIALS AND PARTICULAR REQUESTS**

### **surface preparation**

Two-layer skimming is to be done as preparation before painting wall and ceiling. The paint must be applied in two coats.

Remove dirt, splinters, loose particles, grease, oil, and other sub-stances deleterious to coating performance. The underground shall be prepared to ensure the requests regarding final quality of the coating are met. Small defects in plaster in wet rooms shall only be filled with

non-gypsum based materials. In cases where the underground is considered unsuitable the Engineer shall be immediately notified. Remove the following deleterious substances: dirt, grease, and oil. Wash surfaces. Plastered surfaces shall be brushed using a copper brush prior to painting. Plaster imperfections shall be removed prior to painting. Plaster shall be clean and free from loose matter; gypsum board shall be dry. Remove loose dirt and dust by brushing with a soft brush or rubbing with a dry cloth prior to application of the first coat material.

### **application, conditions and protection**

The Contractor shall cover and mask all items in the area of the works to protect them from being soiled by paint. Any soiling shall be immediately removed. Floors shall also be protected.

*Apply coating materials in accordance with manufacturers instructions.* Thoroughly work coating materials into joints, crevices, and open spaces. Touch up damaged coatings before applying subsequent coats. Allow time between coats, as recommended by the coating manufacturer, to permit thorough drying, but not to present topcoat adhesion problems. Provide each coat in specified condition to receive next coat. Provide finished surfaces free from runs, drops, ridges, waves, laps, brush marks, and variations in colours. Apply coatings with approved brushes, approved rollers, or approved spray equipment, unless specified otherwise. Spray areas made inaccessible to brushing by items such as ducts and other equipment.

### **reserve of paint**

The contractor shall present the Engineer with a reserve of each coating used in original colour to permit touching up of small damages which may occur before handing over the building. These reserves are included in the Contractor's price unless the quantity required exceeds 10% of the original container or 10 kg by silo delivered paints.

### **cleaning**

Interior areas shall be broom clean and dust free before and during the application of coating material. All surplus materials shall be removed from site unless otherwise stipulated by the Client.

#### **1.4.17. Façade painting works**

##### **GENERAL REMARKS**

This section of *Technical specifications for architectural and civil engineering works* sets out the requirements in regard to the quality of materials and standards of workmanship to be employed in façade painting works.

Pricing must include all necessary work operations, auxilliary material and tools, as well as scaffolding.

Other general notes as in section 1.4.15. of these *Technical specifications*.

##### **SCOPE OF WORKS FORESEEN IN THE DESIGN DOCUMENTATION**

The façade painting works foreseen in this design involve final painting of façade surfaces, together with the necessary preparation works and including installation of façade scaffolding. (Stone building)

##### **SUPERVISION AND APPROVAL FOR WORK STAGES AND APPLICATION OF MATERIALS**

The Designer will verify the paint colours to be used.

The Client reserves the right to take 0.5 litre samples of paints at random from the products delivered to the site and test them to verify that the products either conform to the referenced specifications or the approved substitution. Products which do not conform shall be removed from site and replaced with new products that conform to the referenced specification or the approved substitution.

##### **STANDARDS APPLIED TO WORK PERFORMANCE AND MATERIALS USED**

- Applicable norms and standards for Bosnia and Herzegovina:

*Norms and standards of works in building construction 1-3 – Normativi i standardi rada u građevinarstvu – Visokogradnja, knjige 1-3, Građevinska knjiga, 2008 (12<sup>th</sup> issue).*

- European norms and standards:

DIN 18363 Construction contract procedures (VOB) - Part C: General technical specifications in construction contracts (ATV); Painting and varnishing

DIN 18451 Construction contract procedures (VOB) - Part C: General technical specifications in construction contracts (ATV); Scaffolding work

DIN 4102 Fire behaviour of building materials and elements - Classification of building materials - Requirements and testing

DIN 6173 Colour matching General Rules

DIN 971-1 Paints and varnishes - Terms and definitions for coating materials - Part 1: General terms

DIN 18350 Construction contract procedures (VOB) - Part C: General technical specifications in construction contracts (ATV); Plastering and rendering

##### **SPECIFICATIONS FOR THE BUILT-IN AND USED MATERIALS AND PARTICULAR REQUESTS**

###### **scaffolding**

As defined in section 1.4.15. of these *Technical specifications*.

### **surface preparation**

Remove dirt, splinters, loose particles, grease, oil, and other sub-stances deleterious to coating performance. The underground shall be prepared to ensure the requests regarding final quality of the coating are met. Small defects in plaster in wet rooms shall only be filled with non-gypsum based materials. In cases where the underground is considered unsuitable the Engineer shall be immediately notified. Remove the following deleterious substances: dirt, grease, and oil. Wash surfaces. Plastered surfaces shall be brushed using a copper brush prior to painting. Plaster imperfections shall be removed prior to painting. Plaster shall be clean and free from loose matter; gypsum board shall be dry. Remove loose dirt and dust by brushing with a soft brush or rubbing with a dry cloth prior to application of the first coat material.

The Contractor shall carryout a test clean for approval by the Engineer prior to commencing with the cleaning works. Permanent works shall be suitable protected during cleaning works.

### **application, conditions and protection**

Do not apply coating to surfaces during foggy, rainy weather or strong direct sunlight. The creation of shading using tarpaulins etc. shall be permitted only with the permission of the Engineer.

Apply coating materials in accordance with manufacturers instructions. Thoroughly work coating materials into joints, crevices, and open spaces. Touch up damaged coatings before applying subsequent coats. Allow time between coats, as recommended by the coating manufacturer, to permit thorough drying, but not to present topcoat adhesion problems. Provide each coat in specified condition to receive next coat. Provide finished surfaces free from runs, drops, ridges, waves, laps, brush marks, and variations in colours. Apply coatings with approved brushes, approved rollers, or approved spray equipment, unless specified otherwise. Spray areas made inaccessible to brushing by items such as ducts and other equipment.

Paints shall be in sealed containers that legibly show the contract specification number, designation name, formula or specification number, batch number, colour, quantity, date of manufacture,

manufacturer's formulation number, manufacturer's directions including any warnings and special precautions, and name and address of manufacturer. The storage of flammable materials on site shall be discussed and agreed with the Engineer.

### **reserve of paint; cleaning**

As defined in section 1.4.15. of these *Technical specifications*.

### **1.4.18. Injection works**

#### **GENERAL REMARKS**

This section of *Technical specifications for architectural and civil engineering works* sets out the requirements in regard to the quality of materials and standards of workmanship to be employed in all injection works.

All works must be performed according to drawings, details, static calculations and *Technical conditions for performance of works* (see Section 1.3. of these *Technical specifications*), with skillful and appropriate workmen and under appropriate supervision.

All necessary work operations, auxiliary materials, tool, equipment and scaffolding must be included in price.

Generally set of compatible products from same manufacturer is to be used for injection works.

## **SCOPE OF WORKS FORESEEN IN THE DESIGN DOCUMENTATION**

The foreseen works involve:

- wall injection according to the design (Fortress walls, Bastion 6, Tower 5, Main gate)
- injection of cracks and fissures in walls (Fortress walls, Bastion 6, Tower 5, Main gate)
- injection of foundations (Fortress walls, Bastion 6, Tower 5).

## **SUPERVISION AND APPROVAL FOR WORK STAGES AND APPLICATION OF MATERIALS**

Prior to injection, the Supervising engineer will check and approve all surfaces, materials and distribution of injection tubes. Continuous supervision during performance of works is to be provided.

## **STANDARDS APPLIED TO WORK PERFORMANCE AND MATERIALS USED**

- Applicable norms and standards for Bosnia and Herzegovina
- European norms and standards:

DIN 53452, ICC/ICBO, ASTM, EN 1504-4

## **SPECIFICATIONS FOR THE BUILT-IN AND USED MATERIALS AND PARTICULAR REQUESTS**

### **injection mass**

Injection mass for wall injection must be water-resistant.

### **injection process**

The wall injection is to be done up to the 1 meter high from the -20.00 level counted from terrain. The pressure is to be 2 bar. Injection tubes must be set on both sides of wall/foundation, in a zig-zag distribution. At least four tubes must be placed per 1 m<sup>2</sup> of wall. The injection is to be done from lower to upper levels.

For detailed instructions please refer to Section 1.3. of these *Technical specifications* and descriptions given for each position in the Bill of quantities.

Manufacturer's specifications must also be followed during the injection process.

### **precautions and work conditions**

Do not apply materials when the ambient temperature is below 5 degrees Centigrade. The surfaces must be clean from dirt and oil. The surfaces must also be firm. Weak parts and particles must be brushed off and/or cleaned by compressed air.

The interior areas where injection works take place must be properly ventilated. Preferred weather conditions for injection in the exteriors – no precipitation.

All tools used should be cleaned immediately after use.

Detailed health and precaution measures as defined in manufacturer's instructions are to be followed.

#### **storage and handling**

Materials must be stored in dry environment, strictly preserved from condensation, protected from fire, direct sunlight and extreme cold and heat. Manufacturer's instructions are to be followed.

#### **clean up**

Upon completion of all stages of injection works, waste material and debris is to be removed from the site.

### **1.4.19. Plasterboarding works**

#### **GENERAL REMARKS**

This section of *Technical specifications for architectural and civil engineering works* sets out the requirements in regard to the quality of materials and standards of workmanship to be employed in Plasterboarding works foreseen.

Pricing must include all necessary work operations, auxiliary material and tools. All works must be done according to the design details and relevant rules and regulations.

#### **SCOPE OF WORKS FORESEEN IN THE DESIGN DOCUMENTATION**

The foreseen works involve:

- building the partition wall on metal subconstruction (Stone building, Bastion 6)
- single wall cladding with plaster boards (Stone building, Bastion 6)

#### **SUPERVISION AND APPROVAL FOR WORK STAGES AND APPLICATION OF MATERIALS**

Quality of materials, all leveling and dimensions must be controlled on site before installment by Supervising engineer.

#### **STANDARDS APPLIED TO WORK PERFORMANCE AND MATERIALS USED**

- Applicable norms and standards for Bosnia and Herzegovina
- Manufacture instructions

#### **SPECIFICATIONS FOR THE BUILT-IN AND USED MATERIALS AND PARTICULAR REQUESTS**

##### **plasterboards**

The core of the board is gypsum, exterior part is made of cardboard.

##### **precautions and work conditions**

Single metal subconstruction of 50 mm, d= 0.6 mm, faced bothsidedly with double plasterboards 12.5 mm, 'Knauf' system or similar. Mineral wool is to be placed in a 40 mm layer. Air space between the stone walls and gypsum cardboard panels is 7 cm. Joints must be finished with skimming mass and bandaging tapes. Mineral wool is to be placed 80 mm thick. Scaffolding is also included in the price.

**storage and handling**

Materials must be stored in dry environment, strictly preserved from condensation, protected from fire, direct sunlight and extreme cold and heat. Manufacturer's instructions are to be followed.

**clean up**

Upon completion of all stages of plasterboarding works, waste material and debris is to be removed from the site.

## **2. TECHNICAL SPECIFICATIONS FOR WATER SUPPLY AND SEWAGE WORKS**

### **2.1 INTRODUCTORY NOTES**

#### **2.1. General notes**

The spatial unit 9 is located inside the fortress in its northeastern part, includes the area of the eastern yard, with its bastions and the building of the Museum.

Hydro-technical installations are designed in accordance with the architectural and construction projects, UT conditions, conditions of "VODOVOD" ad Banja Luka, the norms and regulations for this type of installation.

### **2.2 SCOPE OF THE FORESEEN WORKS**

#### **2.2.1 Water supply installation**

Installation of the Unit 9 are connected to the city water supply pipe F 150 mm in the fortress Kastel, the subsequent installation of the appropriate fittings and the terms "VODOVOD" Banja Luka.

#### **Water supply - MUSEUM**

The building is connected to city water supply pipe F 150 mm in the fortress Kastel, the subsequent installation of the appropriate fittings and the terms "WATER" in Banja Luka. Water measuring manhole is located in a building plot and it is envisaged setting up two water meters:

- Water meter for hot water F20 mm
- For fire flow meter F50 mm

Distribution of water supply plumbing are guided through the installation duct between the plasterboard walls. At the bottom of the water supply vertical pass valves are placed. At the beginning of bathroom branches are designed the flat-pass valve wheel (for easier handling), and in front of sanitary facilities are placed the pass valves with a cap.

Water supply network is designed from steel galvanized pipes and fittings, dimensions obtained by hydraulic calculation. If the investor decides on the production of plumbing from akvaterm or PE pipes, take into account the pipe diameter. In front of each tap place put the appropriate pass valve. Pipes must be attached to hooks or stirrups for the walls and ceiling. Tube through the construction must be well protected. All pipes, both for cold and hot water, which is built into the walls under the plaster or tile must be wrapped over the entire length with suitable insulation. Inside the building pipes are thermally insulated with plamaflex or similar thermal insulation materials, cold water pipes in the walls are insulated against condensation decorodal tape, and the pipes for hot water with felt. Overall installation must be tested to the pressure before closing and plastering. Pipes in the ground are placed on a layer of sand, thickness = 10 cm and isolated with based coatings bitulit. Hot water is resolved boiler capacity of 10l located in the toilet lobby. At the intersection point of water supply and sewage are required water supply above the sewage. Overall supply network must be disinfected and chlorinated with chlorine solvent in order to be correct for drinking and human consumption, as described in the design text. It is necessary

to examine a sample of water after disinfection and chlorination in the Public Health Institute.

### **2.2.2 Sewage installations - MUSEUM**

Below the ground floor level of +0.00 is provided collecting fecal horizontal, which exits to the revision shaft, and then through the current shaft 164.61 / 162.63, installations sewage are connected to the city network in the fortress Kastel to the existing collector F300. Rainwater are collected in the collection horizontal and then through the shaft to the external network. The connection of the building to the public network is done with pipes F200 falling 2%. The sewage vertical provides a revision to clean and maintain of sewage. Profiles of pipes and pipe bottom elevations are given in the design and the hydraulic calculation. Make horizontal and vertical sewage network from PVC sewer pipe and fittings in all the dimensions from the design and supervisory instructions. All types of pipe are defined in the bill of quantities, and location of manholes with elevations is given in the site plan. The network is measured by the axis of pipe. For all works comply with current regulations and standards. Overall the installation prior to closing must be washed and tested to the pressure, which is necessary to make a record.

### **2.2.3 Hydrant network**

#### **Hydrant network - MUSEUM**

Fire protection is designed with the hydrant system. Two wall fire hydrant are planned on each floor, ground floor and attic. Hydrant network is connected to a separate hydrant distribution. One wall hydrant is designed for each floor. Wall hydrants have hydrant valve, nozzle and hose impregnated of 15 m up on the spool and set the console that can be tilted in a box for easy unwinding hoses. Hydrant network is made of galvanized steel pipe.

#### **Hydrant network - EASTERN YARD**

The design of remodeling and revitalization of the fortress "Kastel" unit 9, includes landscaping of the eastern yard. The landscaping of the eastern yard includes outdoor fire hydrant network.

The projected pipeline has profile Ø90 and will supply with the water from the existing water supply Ø150 in the fortress Kastel. The pipeline is equipped with a on ground hydrants, according to the site plan. The pipeline is connected to the existing network through existing manhole, and according to terms and connector design "VODOVOD" Banja Luka.

Other facilities connected to the pipeline are:

- Water measuring manhole with a set of measuring the amount of water at chainage 6.80 m
- Above-ground hydrants for fire fighting at 59.20 m distance between.
- Final Š1 manhole where the connection is left for the internal hydrant of bastion 6.

The total pipeline length is 100.40m. The basic parameters in the conducting of pipeline are the position of the external hydrants in accordance with the applicable Rules on technical norms for the hydrant system (Sl. List SFRJ br. 30/91) and the existing level marks of landscaping. Vertically there are no fractures, and horizontally to fracture must be secured.

Pipes are designed from high strength polyethylene, and connection are made by welding. Pipes are designed as polyethylene PE-100 with high resistance to external influences,

shock, pressure, corrosion. Width of the trench for laying pipe is 60 cm. The pipes are laid in a bed of sand 10 cm below the tube and 10 cm above the tube, and the rest is dumped material from the excavation without major additions. The final layer is a buffer as a base pavement stalls. All nodes are in reinforced concrete manholes. Above-ground hydrants are installed without a manhole according the detail in the appendix. All fittings must be corrosion protected with bitumen. Covers for manholes are cast iron for heavy traffic. Flushing the pipeline is performed through above-ground hydrants. Before backfilling should perform hydraulic testing by following the instructions. If the pipeline is correct and does not emit compounds can be proceed with backfilling of the pipeline. Before putting the pipeline into operation it is necessary to disinfect and cadastral survey. Pursuant to the Regulations for the hydrant network, hydrant network with all devices must be controlled at least once a year. During control water pressure is measured by while working all hydrants that provide water flow for fire fighting in the building. For external hydrants shall be placed with a narrow nozzle diameter 16 mm, a pressure is measured at the hydrant, which is farthest from the connector. Pressure is measured with emphasis on water in the full stream of all the hydrants after the expiration of two minutes. Records of testing must be made with accurately set the date and time of testing.

#### **2.2.4 Manholes**

Manholes (sewage and water supply) are made of concrete MB 25. Base slab and the shaft walls are reinforced with a net, and upper slab and the AB crown are reinforced with conventional iron. Manholes must be made of waterproof concrete. Location of manholes are listed on the site plan in the design, as well as the bottom elevation and elevation covers. The dimensions of all manholes are given in graphic attachments. Cast iron covers, dim. 60x60cm, are made in the same level as the street.

#### **2.2.5 Sanitary fixtures, fittings and accessories**

In the buildings of the unit 9 is predicted the installation of high-class, quality and color of choice of interior designer:

- toilet with cistern and low-installing water cauldron with an angle valve. Inner cover of the toilet make with a frame made of high quality plastic.
- sanitary porcelain sinks from the first class, the color of designer choice, complete with trap and trap mask. On the sink install one handed freestanding battery for hot and cold water.
- mirror, holders for napkins, soup carrier.
- floor drains
- electric heater with thermostat, volume 10 liters.

**Note: Calculations for the water supply system and sewage are given to the design.**

#### **2.2.6. Supervision and authorization for each phase of works and installing material**

Regarding the Law on construction Investor shall promptly appoint a supervisor who has a license to work on installing water supply and sewage - Art. 104th. Technical supervision during construction of the building or construction work, supervisor of construction, which is determined by the act of writing the investor. Professional supervision includes adequate

control of technical documentation, quality control and verification of performance of all types of works and application of regulations, standards, technical norms and standards of work quality, quality control of materials, equipment and installations to be installed, giving instructions to the contractor and, if necessary, providing details of performance of works. The supervisor can be a person who, in accordance with the provisions of this Act, shall have the authority to create the appropriate technical documentation and authorization for constructing such buildings. Regarding the Law on construction investor is obliged to entrust the works to company which has the license for the works, plumbing and sewage system (Article 123, paragraph 4). After completion of installation examine the installation and provide adequate protokole. Handover of the installation perform with the actually built design of water supply and sewage installations according to the laws, regulations and professional standards of the day technical acceptance

## **2.3 TECHNICAL CONDITIONS FOR EXECUTION OF WORKS**

### **2.3.1 Preliminary measures**

Prior to beginning of works the contractor must perform the recording and marking routes and facilities, and during construction should be made permanent control of elevation, falls and directions. The works must be carried out in all the conditions of authorized KRO and sanitary inspection, and applicable regulations and standards for this type of work. If during the performance of some of these regulations suffer the changes, amendments or adopt a new, contractor is required to act upon them without charge. The material for the works must comply with standards and regulations for this type of material. With each delivery of materials shall be submitted to attest that the material tested and the corresponding regulations. Contractor is responsible for all the installed material and quality of work until the final handover, or getting use permits and taking over the complete installation. The works must be carried out according the design, contract and these conditions. If there is any inconsistency, the Contractor shall seek the solution of the supervisory authority in the right timeline. For each possible modification must be a written consent of the designer and supervisor. Trench excavation, backfill, compaction of fill shall be carried out fully in accordance with the description.

### **2.3.2 Laying down pipelines**

The contractor shall check all elevation levels in the design and collate them with real elevations at site. All horizontal lines shall be laid down with a drain gradient towards the lowest outfall spot. Bending of galvanized pipes must be done in neither hot nor cold state. Pipes must not run at a rakish angle through the walls, but perpendicularly to the wall surface.

### **2.3.3 Pipes in the ground**

The pipes can be laid only at the base-planned and after the control of elevation marks. Laying of pipeline allows the supervisory authority (to write in a diary). Pipe must be designed so that they are tight. Material and method of connection is determined by the project. Beside and below the pipes must be manually recharge the sand, so the pipeline before backfilling is fixed in direction and altitude. One should not start before filling the pipeline to examine vododrživost. The supervisory authority is obliged to inspect the

pipeline laid, safety joints, alignment and allows filling (recorded in the log). Tamping of trenches shall be done in layers of 30 cm, a compaction test every 60 cm in height and 20 m along the length of the trench. Formwork must be drawn so as to prevent sloughing of sides of trench. If it happens that a trench dug to a depth greater than necessary, the material must be added in layers with compaction by mechanical means to a certain density. Compaction of the trench in the embankment roads (access to the city sewer system) must match the compactness of the road. The degree of compaction and examination eay determines the supervisory authority.

Installation works include supply of pipes, fittings and valves. Installation of pipes perform according to the manufacturer. Bracket of pipes shall be performed to avoid uneven settlement. All concrete work must be performed solidly and professionally, with appropriate qualifications, labor force, according to current regulations for concrete. To the transport of concrete should be given special attention. Transportation time should be as little as a transport in accordance with the regulations carry mixers. Before concreting , formwork should be inspected and wetted. Installation of concrete perform with vibrators. Upon completion of the concreting should be applied curing period of seven days. Fittings must be properly installed and cleaned. It is essential to perform proper control of built in concrete. The cube are getting out and the contractor must obtain the appropriate quality certificate.

#### **2.3.4 Pipes in structures**

Solid building-in of pipes in the walls and the other constructions are not permitted. Openings for the pipes passing through the constructions shall be big enough and the gap between pipes and constructions filled with plastic material in order to prevent damaging of pipes. Water supply pipes which pass through the construction walls shall be protected with a sleeve piece whose diameter is 40 mm larger than the external water pipe diameter, and a gap shall be filled up with hem in bitumen or permanently elastic putty. Sewage pipes - when passing through the walls, must not be built-in fastly and the gap shall be filled with wet clay, and/or with hem and asphalt or another permanently elastic putty if there is a danger of water running into the building.

Possible unforeseen chase cutting in the walls and the other constructions can be done only after having been approved by hte supervising authority.

#### **2.3.5 Pipes protection**

Water pipes shall not run through the chimney walls and the ventilation ducts, through ducts shafts, under the floor in WC bowl and nowhere where they can be exposed to contaminating, freezing, heating and corroding.

On the pipe crossing spot, pipes often must be protected. When crossing sewage drain, the water pipe must be on a higher level and the space between them should be compacted with clay of thickness at least 20 cm. If a distance is smaller, water pipe shall be pulled through a sleeve piece when passing through a wall.

At places where pipes are exposed to freezing, they have to be thermaly insulated. Insulation is to be done carefully and the mains must not be closed prior to being checked by the supervizing authority. The same goes for the sound insulation.

During the work, damaged insulation has to be carefully mended. If work is suspended, pipes should be plugged in a suitable way in order to prevent contaminating, filling with material and damaging.

### **2.3.6 Joints**

Pipe joints amongst themselves, and/or pipe fittings, shall be done carefully. During jointing, the pipe bore must be neither tapered with remnants, pipe fittings parts, hem, tin or any other way, nor deformed by bending of pipe.

Galvanized pipes joints are to be sealed with hem and putty which shall not contain minium or the other poisonous ingrediants.

Plastic pipes are to be jointed with rubber sealing rings.

Pipe joints in the walls, ceilings and the other constructions are to be avoided.

### **2.3.7 Pipes fastening**

Pipelines are to be fastened on the walls and ceiling by holdfast and pipe hangers, at distance depending on a diameter and kind of pipe. Plastic pipes in warm premises are to be on a solid bedding along its entire length.

### **2.3.8 Pipe fittings**

Water pipe fittings have to be previously examined in a workshop and then fitted in. Their fitting-in have to be done accurately, having in mind good and easy handling and aesthetic looks.

### **2.3.9 Sanitary fixtures and accessories**

Sanitary fixtures and accessories fitting-in has to be done neatly, dirt-free and precisely, having in mind good utilization and aesthetic looks as a whole. Sanitary fixtures are to be fastened on the walls by plastic or metal screw anchors. Mounting of sanitary fixtures by wall brackets is to stand downward acting forces of 100 kp at the most adverse spot.

### **2.3.10 Installation testing**

#### **Testing and disinfection of water supply**

The test pressure to be tested on installation in the buildings should be 5 bar bigger from operating pressure, i.e. the one obtained by hydraulic calculation. The procedure for testing is as follows: All open ends of the piping network should be closed with caps, then the network is filled with water. Prior to that manometer is set in suitable place. Then the water is compressed with pump druk until it shows the test pressure. If the hour hand on the manometer drops, observe the network seeking place that leaks. Often this is not apparent at first glance and every part must be felt by hand and see if it is wet. Failure is sometimes only in the form of dew and sweat pipes. Invalid place should be immediately put in order and than repeat the test. When the whole installation is complete, test of the whole network is performed again in the same way. For this purpose, the best place is the main drain valve

of water meter. Before using the main installation should be rinsed with water under pressure. Rinsing is done until you get very pure water.

### **Disinfection**

Contractor will select disinfectant in accordance with the city sanitary inspection, and control of flushing and disinfection. The dose of chlorine for disinfection should be in range of 10 to 20 mg / l. In this case the dose prescribed by an authorized representative of the Sanitary Service, which is entirely responsible for the disinfection and possible consequences. A lower concentration (10 mg / l) is recommended when chlorine is in contact 12-24 hours. Normal operation period of chlorine is 3 to 12 hours. Higher doses of chlorine are used when the pipe is known to contain organic matter, which is impossible to remove the test or when it is necessary to shorten the time of disinfection. Minimum duration of disinfection should be 30 to 60 minutes. Parts of the network that are not disinfected must be excluded from certain parts network that is disinfected. Responsible leader of the Sanitary Service to provide protection to people working in disinfection, as chlorine is a health hazard if not handled carefully with him. The responsible manager should also provide (through public notice etc..) to avoid the fact that someone uses water used for disinfection. When the time for disinfection is run out, piping should be rinsed with clean water until it gets clean drinking water with tolerable concentration of chlorine. About chlorination must keep a log that verifies the person under whose control is carried out disinfection of the pipeline.

### **Testing of sewage**

Testing of sewage networks in buildings is done in three stages:

- The first stage involves the examination of the lower drainage network before burying the trenches. Then the slope of the canal is controlled by the plan and composition of the sealing tube. The slope is testing with leveling screed or spirit level. To check the validity of joints it is necessary to fill system with water, as previously clogged chanal at the lowest end. If any joint leaks, it must be done again and then repeat the sealing test. Only after this can start filling the trench.
- The second stage is performed after the completion of entire network of vertical branches. Testing is performed by using water or air. Water testing is done in partially for certain verticals, as previously well-being clogged all the ends of the branches except the highest part through which the network is charging. Testing is done by pressing the water column height of at least 3 m above the highest outlet. If within 15 minutes all compositions survive, it means that all connections are correct.
- Air testing is applied to vertical networks, using a compressor with pressure manometer. The compressor is connected to one of the openings, and all the other are clogged well. Test pressure is 0.35 atm for 15 minutes. A minimum pressure drop means some connection leaks and that it must be brought in a valid state.
- The third phase of testing is done after fixing all sanitary facilities. Test pressure of 2.5 cm of water column. If there is no change to the entire network and all the traps hold water, than the installation is correct. Until the test is not performed chutes must not be closed or pipes must not be laid under the surface.

### 2.3.11 Obligations of contractor

The duty of the contractor to secure the installation and building of mechanical damage , clogging, illegal use until the final handover is done. Testing of the pipeline must be in full compliance with the relevant conditions KRO, and testing costs bears contractor. Testing and discharge networks must be performed only at the direction of the supervisory authority. It is prohibited to discharge of network to the excavated trench or to the sewage derived stocks. All costs for the processing of compounds or repair work performed bears contractor.

The Contractor shall do all work not covered by the design, if it is necessary for normal functioning of the installations and compliance with existing propisima. The Contractor is required to submit the correct installation, capable of functioning properly. At the intersection with other installations must carry out the provision of settlement or later damaging during operation. If installations of water and sewage are crossed, watersupply pipe must goabove the sewage.

Contractor shall install the cadastral record before backfilling. All costs of recording bears contractor.

### 2.3.12 Overview of regulations and standards applied

The Law on Physical planning of RS (The Official Gazette of RS 19/96,25/96,10/98,53/02)

The Law on Fire protection (The Official Gazette of RS no. 16/95)

Water law (The Official Gazette of RS no.10/98)

Standardization law ( The Officiao Gazette of SFRJ br.80/91)

The Law on protection at work (The Official Gazette of RS no.26/94)

Book of rules on technical norms for external and internal fire hydrant network for fire protection (The official Gazette of SFRJ, no. 30/91)

Book of rules on drainage and treatment of sewage waters for the city areas and settlements where there is no public sewerage (The Official Gazette of RS no. 68/2001)

JUS standards:

C:B5.124 (68) Steel pipes C 1402, seamless

C.B5.225 (68) Steel threaded pipes

G.C6.511-506 (74) Pipe fittings made of hard PVC for drainage

G.C6.600-685 (74) Pipes and fittings made of polyethylene

G.C1.701 (84) Pipes made of polypropylene. Measures and permitted deviations

G.C1.702 (84) Pipes and jointing elements made of polypropylene. Quality and test conditions.

General regulations

M.B6.500-595 (66) Fittings made of tempered cast iron with cylindric thread

M.B6.651 -688 Pipe couplings for fire fighting

Z.C6.010-017 (70) Fire fighting woven hoses

M.C5.011 (67) Water and sanitary fittings, operating pressure up to 10 kp/cm<sup>2</sup>

M.C5.013 (88) Pipe valves. Delivery technical conditions. Types, inspection and tests.

M.C5.021 (71) Valves for general purposes

M.C5.250 (66) Water pipes fittings. Discgarhe valve for connection . Main external

- measures, connection measures.
- M.C5.251 (66) Water fittings. Discharge valve for connection. Main external measures, connection measures
- M.C5.280 (66) Water fittings. Depletion valve. Main external measures, connection measures
- 290 (66) Sanitary fittings. Standing drain cock. Main external measures, Connection measures
- M.C5.300 (66) Sanitary fittings. Flat discharge valve with movable discharge. Main measures, connection measures
- M.C5.301 (66) Sanitary fittings. Angle discharge valve with movable discharge. Main measures, connection measures
- M.C5.310 (67) Safety valve  $\frac{1}{2}$  " i  $\frac{3}{4}$ " NP 9kp/cm<sup>2</sup>, for electric water heaters. Main measures, connection measures
- M.C5.803 (66) Sanitary fittings. Standing H&C water faucets with movable outlet. Main external measures, connection measures.
- M.C5.804 (67) Sanitary fittings. Standing H&C water faucets with movable outlet. Main external measures, connection measures.
- M.C5.805 (67) Sanitary fittings. Standing H&C water faucets with movable outlet. Main external measures, connection measures.
- M.C5.810 (67) Sanitary fittings. Trap for a washbasin. Main external measures, connection measures.
- U.N5.100 (88) Sanitary vitreous china. Definition, quality and testing methods
- U.N.5.110 (88) Sanitary ceramics, definition, quality
- U.N.5.110 (88) Washbasins, shape and measures
- U.N.5.111 (89) Washbasins
- U.N.5.120 (82) WC bowl, shallow, shape and measures
- U.N.5.121 (82) WC bowl, deep, shape and measures
- U.N.5.170 (82) WC flush tank, technical conditions
- M.J6.210-235 (70) Covers for manholes
- M.J6.285 (71) Step irons
- N.M1.100 (71) Electric water heaters
- U.J1.030-220 (72) Fire protection. Fire load

The other standards:

DVGW W-542

ÖVGW/MP 52 PP-R 80 in composite with aluminium

DIN 1988 T2

EN 1401 Sewage PVC pipes

DIN 19560 Drainage PP pipes

## **2.4 GENERAL TECHNICAL SPECIFICATIONS FOR THE WORKS ON THE WATER SUPPLY AND SEWAGE**

### **2.4.1 Cement**

Domestic production cement shall be used for workmanship of concrete. Chosen type and kind of cement shall not be changed without supervisor's approval in writing. Two different kinds of cement must not be used for concrete elements casting.

### **2.4.2 Stone aggregate**

Stone aggregate must be solid and resistant with mud sediment up to 2% of weight. Washing of aggregate is obligatory and aggregate of proper granulometric composition is to be used.

### **2.4.3 Water**

Water must be clean, without any organic constituent. Used water quantity shall be checked during the work having in mind the prescribed water-cement ratio.

### **2.4.4 Concrete cast in site**

All cast construction parts have to be done precisely by the prescribed dimensions. After concrete casting is over, concrete protection from the sun is to be done by prescribed concrete wetting during the period of at least three days. Protection from extremely high or low temperature, as well as damage caused by rain is to be provided. All concrete surfaces must have uniform structure and colour, cracks free, without air penetration and bubbling, and the other deformations. MB must be in accordance with design defined.

### **2.4.5 Armature**

During concrete casting, armature have to be clean and rust-free.

### **2.4.6 Formwork**

Made formwork must be stable, resistant, stiffened, supported enough in order not to get curved up and slacken in any direction. Inner surfaces must be flat.

### **2.4.7 Sand**

Sand in layers of appropriate thickness, minimum 5 cm is used for pipe bedding and protection after testing. Clean sand without any harmful admixture, waste, stone chips and the like should be used. Poured sand is to be rammed with light rammer to the required compress.

All the works and expenses which are related to supply and spreading of sand, and which are not stated in the work cost estimate, are included by a unit price.

### **2.4.8 Step irons**

Cast iron steps are to be placed at distance of 30 cm.

Corrugated metal sheet cover, dim. 60x80 cm with a locking mechanism

Cover made of corrugated metal sheet, thickness 5 mm, with an angle iron frame. Cover is to be equipped with a locking mechanism, cleaned, red lead coated and painted with paint for protection of metal surfaces.

Cast iron manhole cover □625, bearing capacity 150 KN

Covers for sewage manholes have to correspond to loads they will be exposed to. Covers are made of grey casting according to JUS.

#### **2.4.9 Water supply installation**

Galvanized seamless pipes are to be used. They are - by galvanization, coated with a thin coat of zinc, inside and outside for protection from rust. They are not to be bent even in a cold condition because their zinc coat falls off and a pipe is then exposed to corrosion. On their ends, pipes have conic thread, and if cut, a thread has to be done subsequently. Temper cast iron fitting which has got cylindrical thread is used for pipe jointing. A wisp of hem that is spread with flax oil or special putty for sealing is to be spooled up onto external thread and a part which is to be jointed is screwed over it.

#### **2.4.10 Polyethylene pipes**

Laying down of buried polyethylene pipelines can be done manually or mechanically. Pipes which are spooled on a reel are to be carefully unreeled in order not to get damaged. On temperatures close to 0°C, pipes are to be heated with hot air up to 100°C. Open flame and temperature higher than 100°C is not permitted. Before pipes laying down – it is recommended, to check them for damages, then carry out their jointing, i. e. welding by the trench and laying them down after being cooled. A trench for a pipe shall be dug in such a way that all the pipeline parts are laid down at the depth where there is no ground freezing. A trench depth is to be 0.6 m. In exceptional cases, it can be 0.4 m under condition that additional technical measures are undertaken. A trench is to be at least 30-40 cm wider than the pipe diameter.

#### **2.4.11 Polypropylene fusion welded pipes**

All the parts which are – according to the regulations, associated with drinking water are considered to be, according to DIN 1988 T2, expandable items according to the Law on groceries and expendable products. Plastic mass pipes have to meet the requirements of:

- KTV – recommendations of the Federal office for health.
- DVGW document W270, multiplication of microorganisms on materials in drinking water domain – testing and estimating.
- BS 6920 – Appropriateness of non-metallic products for drinking water pipeline installation regarding their effects on water quality.

Polypropylene fusiontherm water pipes are jointed by fusion. By using polypropylene pipes reinforced with aluminium shield, a decreased extension is achieved in length up to 75 % compared with ordinary PP pipes. Coefficient of extension and installation fitting conditions are to be taken into account by all means. Pipes and fittings manufacturer's instructions shall be used in everything.

#### **Insulation of pipes**

It is obligatory to insulate steel galvanized pipes in and outside the building. Bituminous band which is wrapped around a pipe in a hot state – by all means with overlap, shall be

used for the insulation of galvanized pipes which are to be laid down into a trench. Pipes in the walls and suspended distribution pipes are to be insulated with closed cells flexible self-extinguishing polyethylene pipe insulation, thickness 13 mm.

The insulation has to prevent deteriorating of pipes, heating loss, water freezing in pipes, as well as condensing occurrence.

#### **2.4.13 Ball built-in valves**

High quality valves with threads made of brass are to be used, and gaskets are made of rubber in accordance with regulated standards. Inner surfaces are to be smooth and clean and of such a shape to allow as lower resistance as possible during water running through them. By turning a capstan, the valve spindle on whose lower part there is a washer with a gland nut or a gasket of another shape, turns as well. This gland nut rests on its seat in the opening of the penstock and stops water flow. Closing is full due to the gasket elasticity and a good rest onto the seat and it is also gradual due to longer spindle turning. External cap should have a nice design.

#### **2.4.14 Valves with discharge**

High quality valves with threads made of brass are to be used, and gaskets are made of rubber in accordance with regulated standards. Inner surfaces are to be smooth and clean and of such a shape to allow as lower resistance as possible during water running through them. By turning a capstan, the valve spindle on whose lower part there is a washer with a gland nut or a gasket of another shape, turns as well. This gland nut rests on its seat in the opening of the penstock and stops water flow. Closing is full due to the gasket elasticity and a good rest onto the seat and it is also gradual due to longer spindle turning. Construction of these valves is such that they have a discharge though which water can be discharged even when the valve is closed.

#### **2.4.15 Valves without discharge**

High quality valves with threads made of brass are to be used, and gaskets are made of rubber in accordance with regulated standards. Inner surfaces are to be smooth and clean and of such a shape to allow as lower resistance as possible during water running through them. By turning a capstan, the valve spindle on whose lower part there is a washer with a gland nut or a gasket of another shape, turns as well. This gland nut rests on its seat in the opening of the penstock and stops water flow. Closing is full due to the gasket elasticity and a good rest onto the seat and it is also gradual due to longer spindle turning.

#### **2.4.16 Non-return valves**

Non-return valve allows water flow only in one direction. It works in such a way that a flap, valve or another body in the shape of a ball or a bullet allows water flow only in one direction, and the passage closes in the opposite direction. To use construction for horizontal or horizontal and vertical fitting. Valve body is made of brass, as it is the case with the other valves.

#### **2.4.17 Water meter**

Water meter of a type, class and reading method in accordance with requirements of the authorized public utility company is to be used.

#### **2.4.18 Interior hydrants**

Interior hydrants shall have a jack of at least 52 mm. Metal cabinets equipped with a hydrant valve on the supply line, then trevira hose in length of 15 m and a jet nozzle  $\square$ 52-12 mm, are to be used for placing hydrant equipment. Every hydrant is to be marked with letter H. Hydrant door should be easily opened or if necessary to break the door glass to reach the device.

#### **2.4.19 Manual fire extinguishers**

Two fire extinguisher for the initial fire extinguishing S9 and one CO2-5 are to be placed by each hydrant cabinet.

#### **Gate valve with built-in fittings and street cap**

Gate valve consists of a valve body in which – by capstan turning, the spindle on whose end is a ring plate of conical clearance turns as well, and by which a clearance of the pipe is closed. Sealing is metal, i.e. polished metal face of the ring plate double leans to the polished metal valve body seat rim and in that way, without any gasket, closes the pipe. When the plate is up, entire pipe clearance is free, and water flow is almost unchanged. Valve body and the headgear are made of cast iron, and the other parts are made of brass and bronze. Gate valve body has got flanges for coupling with fittings. In order to be able to handle the gate valve placed at a certain depth in the ground, the spindle is to be extended by a rod in the sleeve piece and it is ended by a cast iron street cap with a headgear. The rod is rotated by special key.

#### **Water installation pressure testing**

Before the pipe insulating and closing is done, it is necessary to carry out testing for water tightness and functioning of the installation. Testing is done by pressure pump which is to be connected to the block valve on the downstream line of the watermeter and pressure is done in the water flow direction when the network is in operation. Prior to testing, the network has to be filled with water, and the air that is in the network has to be discharged. In order not to cause a hammer, filling up is done by gradual opening of the main valve while the valves at the end of the network are open (which are to be closed only after the water flow). Pressure at testing should be higher 1,5 up to 2 times than the operating peak pressure (depending on the pipes manufacturer's instructions and valid regulations), but it cannot be lower than 10 bars. Time duration is at least 2 hours.

A minutes on the testing has to be written and signed by works contractor and the supervisor.

#### **Purging and disinfecting**

After the works completion on the water piping, it is necessary to be well purged and disinfected. Disinfetion is done by the authorized organization, within which water from the installation is sent to bacteriological and physical-chemical analyses. Only after getting valid data on drinking water correctness, according to the valid regulations, the constructed installation can be put into function.

#### **2.4.20 Sewage**

Polypropylene sewage pipes with fittings and sealing rings

PP sewage pipes are steadfast to hot water, fire retardant, lighter than water, have good hydraulic characteristics; fire retardant but with great thermal stretching. Pipes and fittings jointing is done with rubber sealing rings. Storing, transporting, installing and testing to be done according to the valid regulations and pipe manufacturer's instructions.

#### **2.4.21 Ventilation grilles on facade**

Ventilation grille at the end of the stack on the facade is to be mounted in order to prevent entering of beetles, insects and small animals into the sewerage network. The grille is to fit - with its appearance, into the required appearance of the facade.

#### **2.4.22 Polyethylene floor drains**

Floor drains are made of high quality polyethylene with a siphon and air trap which reliably blocks unpleasant smell and without water in the siphon. Siphon is to be with a frame rim Ø133 mm and with a plate made of inoxa □112 mm, hight adjustable.

#### **2.4.23 Cast iron manhole cover □625, bearing capacity 150 KN**

Covers for the drainage manholes must correspond to the load they will be exposed to. Covers are made of grey cast according to JUS.

#### **2.4.24 Washbasin**

A washbasin is made of sanitary porcelain, high class, colour and shape according to the interior designer's choice. Washbasin is fixed to the wall with screws.

#### **2.4.25 Mask for a trap and valves**

A mask for a trap on a washbasin is made of high class sanitary porcelain, colour and shape that matches washbasin.

#### **2.4.26 Washbasin trap**

A trap for a washbasin is to be made of high quality material, with nickel external finishing, high quality and nice design, according to the interior designer's choice.

#### **2.4.27 Standing H&C water faucet with two angle valves**

H&C water faucet is to correspond to the conditions set by standards and the other technical regulations. It must have high quality construction and external protection.

#### **2.4.28 Wall mounted faucet for cold water**

Wall mounted faucet for cold water is to be according to the conditions set by standards and the other technical regulations. It must have high quality construction and external protection.

#### **2.4.29 Shelf above washbasin**

A shelf is to meet the requirements regarding its function and aesthetic, as per interior designer's choice. Material for its fixing is to be delivered too.

#### **2.4.30 Paper holder by washbasin**

Paper holder is to meet the requirements regarding its function and aesthetic, as per interior designer's choice. Material for its fixing is to be delivered as well.

#### **2.4.31 Liquid soap holder**

Liquid soap holder is to meet the requirements regarding its function and aesthetic, as per interior designer's choice. Material for its fixing is also to be delivered.

#### **2.4.32 WC bowl**

WC bowl made of sanitary vitreous china, high class, colour and shape as per interior designer's choice. WC bowl is to be fixed with screws. Seat with a cover is to be made of solid high quality plastic, adequately fastened onto WC bowl.

#### **2.4.33 Flushing tank**

Flushing tank for the monoblock is made of high quality porcelain, colour the same as WC bowl.

#### **2.4.34 Angle valve and flexible connection**

Angle valve for a flushing tank connection to water supply installation is to be made of high quality material, nickel-plated. Connection to the flushing tank is high quality plastic or nickel-plated hose.

#### **2.4.35 WC bowl seat paper holder**

WC bowl seat paper holder is to meet functional and aesthetic needs, as per interior designer's choice. Material for its fixing is to be delivered as well.

#### **2.4.36 Toilet paper holder**

Toilet paper holder is to meet functional and aesthetic needs, as per interior designer's choice. Material for its fixing is to be delivered as well.

#### **2.4.37 Electric water heater, capacity 10 liters**

Electric water heater, high quality performance with thermostat, safety valve, brackets for a water heater and flexible connections, it is to be properly mounted and connected to the electrical and water installations, tested and put into operation.

### **3. TECHNICAL SPECIFICATIONS FOR ELECTRICAL INSTALLATIONS WORKS**

#### **3.1. INTRODUCTORY NOTES**

##### **3.1.1. General notes**

In performing designed installation of unit 9, it is necessary to comply with the following:

1. These technical requirements are an integral part of this project and are mandatory for contractors and investors.
2. The investor is obliged to entrust execution of the works contractor authorized for such operations.
3. Supervisor of contractor of electrical installation must meet the statutory requirements.
4. Derogations from the project shall be allowed only with prior approval Supervisor, if such it does not change the basic concept of the project. Otherwise, one must obtain the prior approval of the designer.
5. Any changes related to the project must be entered in a works record and verified by the Supervisor.
6. The contractor shall before commencing work to study the project and on-site verify whether during the execution of other works on the building have been no changes that are essential for the execution of works, if there is an essential change contractor is obliged to report the Supervisor and the works commence only after obtaining written permission.
7. Any changes made during the execution, the contractor should enter in one copy of the project, which will be base for development of built design.

##### **3.1.2. Technical regulations**

1. Contractor is obliged to install material which corresponding to regulations. Material which is going to be installed must be new. If it is determined that the material is not new, and not by the standards, the contractor shall at the request of the Supervisor make changes without the right to compensation.
2. It is the duty of contractor that before and after laying of cables check continuity of each individual wire, the insulation resistance according to earth wire of each wirre and between wires. If the insulation resistance is less than allowed, the cables must be replaced. Measurement of insulation resistance must be made using relevant instrument which is at least equal to the rated voltage of the voltage installations. Insulation resistance shall be not less than  $1000 \text{ W} / \text{V}$ .
3. When laying the cables take care about outdoor temperature which must not be less than  $5^{\circ}\text{C}$ . If the installation must be carried out at temperatures below  $5^{\circ}\text{C}$ , the cables must be pre-heated, and then unwinding from drum and stretched.
4. At all points where the cables exits from the floor, pass through walls, etc., cables must be inserted in pipe with appropriate diameter because of mechanical protection.
5. When bending the cable ensure that bending radius not less than  $15D$ , where  $D$  is the outer diameter of the cable.
6. At the beginning and end of the route set tiles with embossed markings according to the list of cables.
7. The conductors are only allowed to continue on in boxes and these connections must be properly executed.

8. Cable lengths are approximate, so that the cutting must be done only after the measurements on site, with the endings left a little bit longer (20-30cm).
9. All equipment must be tested before installation.
10. If installation of low voltage (telephone, measuring transducers) is leaded in parallel with high voltage lines it should be at a distance of 20 cm and at the intersection t a distance of 10 cm.
11. It is prohibited repairing or relocation of soluble fuse inserts.
12. Pipe for installation must be placed that water cannot stay in them.
13. Lines on the walls are placed between 30-110 cm from the floor and 2m above the floor and at ceilings.
14. The cables in the walls should not be sloped.
15. Voltage drops from the entrance to the building to the final consumer should be for lighting up to 3%, and for other electricity consumers up to 5%. Voltage drops from substation, which is supplied by high voltage to the last lighting place should not be over 5%, and for other consumers up to 8%. For cable whose length exceeds 100 m allowable voltage drop increases to 0.005% per meter above 100 m but not more than 0.5%.
16. Through the same multi core cable must not be run more electrical circuits, except conductors and auxiliary control electrical circuits.
17. Electrical installations shall be placed under the non-electrical installations where possible condensation or leakage is.
18. Cross-section of neutral conductors in single phase electrical circuit and multiphase electrical circuit in which the cross-section of conductors is smaller or equal to 16 mm<sup>2</sup> (for Cu) and 25mm<sup>2</sup> (Al) is equal to cross-section of the phase conductors. For larger sections neutral conductor can be smaller cross-section, if it allows the maximum expected electricity through it.
19. The distance between insulated conductor attached to isolated, must be at least 2 cm and 5 cm in wet rooms.
20. Live parts of control or distribution block must be on distance of 20 mm from case, and smaller
21. distance is allowed only if applied isolated compartments.

### **3.1.3. Control regulations**

1. Controlling the protection against electric shock, including distance measurement for the protection barriers or enclosures, partitions or placing out of reach.
2. Controlling the protective measures against spread of fire.
3. Controlling the settings of protective devices.
4. Controlling the accuracy of distribution devices in terms of separation distance.
5. Controlling the selection of equipment and protective measures against external influences.
6. Controlling the identification of the neutral and protective conductor.
7. Controlling the existence of schemes, tiles with inscriptions and etc.
8. Controlling the Identification of electrical circuits, fuses, switches, terminals and other equipment.
9. Controlling the connection of conductors.
10. Controlling the accessibility and availability of space for operation and maintenance.
11. Controlling the continuity of protective conductors and additional conductors for potential equalization.
12. Controlling the value of insulation resistance.

13. Controlling the electrical separation of electrical circuits.
14. Controlling the resistance of the floor and walls.
15. Controlling the functionality.

## **3.2. SCOPE OF THE FORESEEN WORKS**

### **3.2.1. General notes**

Perform electrical power installations of unit 9. The spatial unit 9 is located inside the fortress Kastel in its northeastern part, covers the area of the eastern courtyard, with its bastions, towers and facility of stone building.

Surface of respective area of unit 9 is around 13 257 m<sup>2</sup>. This unit consists of two subunits of which one is existing facility stone building with future purpose Historical Museum gross floor area 722.40 m<sup>2</sup> and the other one covers towers, bastion, arsenal with gross floor area of 1,151.03 m<sup>2</sup> and landscape part consist of backyard intended for exhibition and parts of the ramparts with bastions, with an area of 11,383.57 m<sup>2</sup>.

From the point of electrical installations unit 9 is treated as whole, with possibility to install in space of towers and bastions subsequently electric meter in MDC (main distributive cabinet) and transform that spaces into a separate entity.

### **3.2.2. Scope of the foreseen works**

The main project is developed using world electrical standards for this type of facility, taking into account the current standards and architecture of the building and use of certain premises. The project foresees the development of new wiring taking care of finding the optimal route for the cable distribution to individual consumers. Connection facility to main power network solve under the terms of the local power company.

Measurement of electric energy consumption:

Measurement of electric energy consumption perform uniquely for a facility, with meter located in the distributive-measuring cabinet.

## **ELECTRICAL INSTALLATIONS OF HIGH VOLTAGE**

Following electrical installations are foreseen:

- General lighting installation
- Anti-panic lighting installation
- Installation of sockets and terminals
- Terminals for power supply of distribution cabinets
- Installation of equipotential
- Installation of power supply for technological consumers of mechanical installations

Adjust general lighting purpose facility, taking into consideration current standards and recommendations.

Security lighting performs with fluorescent lamps of power 1x8W, with autonomous power supply 3h.

Installation of socket terminals and the power of technological consumers of mechanical installations adjust to technology and purpose of certain areas. Agree the details with the architect and other phase designers.

Pay special attention to the nature of the facility (the cultural and historical monument) and that fact have particular in mind when performing works.

## **ELECTRICAL INSTALLATIONS OF LOW VOLTAGE**

Following electrical installations are foreseen:

- Fire alarm installation
- Video surveillance installation
- Anti theft system installation
- Phone installation

For a complete facility foreseen is a quality fire alarm featuring automatic alerting police and fire services in case of fire. Video surveillance carried out so that they can monitor the entrances (exits) to the facility and showroom. With anti theft system cover the entire facility with the ability to automatically alerting the police and fire services in case of burglary.

### **NOTE:**

All equipment of low voltage as follows: fire-alarming control panel, video surveillance equipment and anti theft install in a room proposed for such use.

## **LIGHTNING ROD INSTALLATION**

Lightning rod installation performs according to applicable regulations and aligns with the actual needs of the facility.

## **RAMPARTS**

### **OUTDOOR LIGHTING OF RAMPARTS AROUND EASTERN YARD**

Following electrical installations are foreseen:

- Exterior projector lighting installation of ramparts around the eastern courtyard

### **PARTERRE DECORATION EAST YARD**

### **LIGHTING AND DISTRIBUTION OF EASTERN YARD**

Following electrical installations are foreseen:

- Installation of ramparts lighting on the side of the eastern courtyard.
- Installation of floor lighting for eastern courtyard
- Installation of projector lighting for trees and details
- Installation of facade lighting for towers and museum 6
- Installation of lighting for exhibition plateau
- Installation of lighting the stairs for exit from bastions 6
- Installation of indirect lighting for stone benches
- Installation of power supply for distribution cabinet DC-lig

## **GROUNDING INSTALLATION**

With electrical power installations lead and grounding installation for all roads and areas that are illuminated with metal poles or the lamps (projectors) are with metal casing.

### **3.2.3. Supervision and authorization for each phase of works and installing material**

Regarding the Law on Spatial Planning Investor shall promptly appoint a supervisor who has a license for electrical works - art. 104. Technical supervision during construction of the building or construction work, performs supervisor of construction, who is appointed from Investor by act of writing. Professional surveillance includes adequate implementation control of technical documentation, quality control and verification of performance of all types of works and application of regulations, standards, technical norms and standards of quality work, quality control of materials, equipment and installations to be installed, giving instructions to the contractor and, if necessary, providing details for the works. Supervisor of construction may be a person who, in accordance with the provisions of this law, shall have the authority to create the appropriate technical documentation and authorization for the construction of such facilities. Regarding the Law on Spatial Planning investor is obliged to entrust the works company that is licensed to perform electrical work (Article 123, paragraph 4). After completion of installation, test the installation and obtain the appropriate protocols. Handover of the installation to be done with built design of electrical installations under the laws, regulations and rules of the profession on the technical acceptance.

## **3.3. TECHNICAL CONDITIONS FOR EXECUTION OF WORKS**

### **3.3.1. Overview of regulations and standards applied on designing and performing works and for installed materials**

These technical conditions are integral part of project documentation, and therefore oblige investors and contractors that in performing of projected installations comply with these conditions and that contain those elements that are not listed in the data sheet and the rest of the text, and related to the works.

- Law on Spatial Planning Official Gazette RS no. 55/2010
- Law on Protection at Work Official Gazette no. 26/93, 14/94, 21/96, 25/97
- Law on Fire Protection Official Gazette no. RS 16/95, 16/2002
- Rules on technical standards for low voltage electrical installations Official Gazette SFRJ no. 53/88, 54/88 and Official Gazette SRJ no.28/95
- Rules on technical regulations on lightning rods Official Gazette SFRJ no.13/68 Official Gazette SRJ no. 11/96 and other applicable regulations.
- Rules on protective measures and safety at work, tools and devices Official Gazette SFRJ no.18/91.
- Following standards: JUS N.B2.751; JUS N.B2.743; JUS N.B2.743/1; JUS N.B2.751; JUS N.B2.752; JUS N.B2.754; JUS N.B2.754/1; JUS N. B2.004, JUS U.C9.100, JUS IEC 1024-1, JUS IEC 1024-1-1

### **3.4. GENERAL TECHNICAL SPECIFICATIONS FOR THE WORKS ON THE ELECTRICAL INSTALLATIONS – HIGH VOLTAGE**

#### **3.4.1. Specification for installed and applied materials**

##### **3.4.1.1. General notes**

In all of these items include the supply of all necessary materials and equipment with transportation to the place of installation, marking the installation, supply and installation of small materials (lamps, junction boxes, terminals, screws, clamps, gypsum, flexible pc, channels that are not particularly pronounced, hard plastic tube to protect the 2m lines, etc.). with completion of equipment installation, commissioning in operation and test operation.

More detailed specification of materials and equipment is provided in the project documentation. Investor can choose another equipment, but it should be similar in the class of equipment listed or better.

##### **3.4.1.2. Main distribution cabinet and distribution cabinets**

###### **Main distribution cabinet and distribution cabinets - MUSEUM**

According to urbanity-technical requirements and approvals of the competent electricity company, facility is supplied with electricity from existing TS "Kastel". The building is connected to the LV system through the distribution cabinet, according to the attached chart.

Power supply of facility carried out from a distribution cabinet, labeled DC-SB in attached graphic. From the aforementioned distribution cabinet are supplied distribution cabinets of towers 5 and 6, and from this distribution cabinet were supplied and distribution cabinets of outdoor lighting. In the distribution cabinet is located measurement sets for metering consumption of electricity and all necessary equipment according to single-pole scheme, and from that cabinet were supplied all consumers in the facility.

###### **Main distribution cabinet and distribution cabinets- TOWER 5**

Power supply of switchboard of tower 5(SB-T5), is provided from distribution cabinet of stone building(DC-SB), see the project mentioned facility. From the switchboard of tower 5, are supplied end users of this tower. From DC-T6 were supplied and distribution cabinets of outdoor lighting,DC-OL 2. Measurement of electric consumption of towers, is planned in distribution cabinet stone houses(DC-SB), from which are supplied these cabinets.

###### **Main distribution cabinet and distribution cabinets – SOUTHERN RAMPART**

Outdoor lighting around the ramparts of the eastern yard perform in accordance with the recommendations of the external lighting of roads, squares and monuments of culture. Outdoor lighting of ramparts supply with electricity from distribution cabinet DC--square envisaged in the project "City Square" - 5a and which should be mounted in the electrical room in the garage while the measurement of electricity consumption is performed in main distribution cabinet of garage with independent meter (Project - pf unit 5b). The number and

arrangement of luminaires will be select to satisfy photometric recommendations about lighting level on such facilities, to be filled conditions of efficiency of protection against indirect voltage and low voltage and that the selected equipment is high quality and modern technology.

### **Main distribution cabinet and distribution cabinets – LANDSCAPING**

Outdoor lighting of the eastern courtyard perform in accordance with the recommendations of the external lighting of roads, squares and monuments of culture .Outdoor lighting supply with electricity from distribution cabinet DC-lig which is mounted in the tower 6 while measurement of electricity consumption is planned in the main distribution cabinet located in the museum facility jointly for Unit 9. Power supply cable designed for power supply distribution cabinet og tower 6 (DC-T6) only extended to this cabinet. The number and arrangement of luminaires will be select to satisfy photometric recommendations about lighting level on such facilities, to be filled conditions of efficiency of protection against indirect voltage and low voltage and that the selected equipment is high quality and modern technology.

#### **3.4.1.3. Lights for general purposes**

##### **Lights for general purposes – MUSEUM**

Lighting in the present facility was designed to provide good visual conditions, on the other hand that, in the architectural complex design, harmonic and aesthetically fit iin the integral whole of room. In the exhibition hall are provided rails to which are hanging spotlights of 45W power, and in area of suspended ceiling are foreseen recessed downlight lamps. In the sanitary facilities are foreseen recessed downlight lamps and decorative wall lights according to choice of architect. In attic next to the reflector lighting,are foreseen hangers are designed as a working lighting.

##### **Lights for general purposes- TOWER 5**

Lighting in the present facility was designed to provide good visual conditions, on the other hand that, in the architectural complex design, harmonic and aesthetically fit iin the integral whole of room. In these facilities are provided decorative wall lamps by choice of architect, which has dim mode. In front of each entry are provided decorative ceiling lamps by choice architects. Management of these lamps is by switches which are located next to the entrance doors. Lighting of ground floor (passage),Tower 5, was carried out by decorative wall and ceiling lamps, selected by the architect. The lighting is supplied from switchboards of towers 5 and it is controlled by "forel" (photo relay).

##### **Lights for general purposes- SOUTHERN RAMPART AND LANDSCAPING OF EASTERN YARD**

For lighting of ramparts and eastern yards are used projectors NEOS 2 (80 LED) that provide a warm white (3500 ° K) and mounted in the channel near the ramparts. Next to each projector is mounted distribution cabinet type T350 fa-Obo Bettermann, IP66 in which enter and exit cables wih cross-section 35mm<sup>2</sup> and DALI bus cables and in that cabinet is mounted switchboard SB, from which is supplied projector. Lighting places are foreseen at a distance which meets the required level of brightness and conditions in relation to  $E_{min}$  ,

$E_{ave}$  i  $E_{max}$  . The projectors are deployed to meet the photometric, aesthetic and other requirements in consultation with the architect. Foreseen projectors are products of fa-Minel Schreder, led, it means the most modern technology in the world of lighting and they can be performed in the DALI according to representatives Minel-Schreder. Therefore, the designer predicted Helvar control that lets you control every light fitting with a DALI ballast. Each control device 910 Digidim Router (Helvar) can be connected with two lines of 64 DALI elements (lamps, sensors, panels ...). Led by the idea that the lighting be fully controlled until the last lamp and projector and confirmation of representatives Minel-Schreder that their LED lamps as possible with DALI electronic ballast apparatus is provided for the designer to use this protocol for centralized management / control of lighting and integration. For DALI managing of projectors around the ramparts of eastern courtyard designer foreseen the installation of two new management devices Digidim 910 Router (Helvar) in the cabinet DC-square. Since there are still high prices of led lighting there is a possibility that the investor decides for the classic lamp, distribution cabinet is designed to be managed with classic lighting without a problem only to leave enough room for Helvar controllers in the cabinet and lays DALI lines and in a better time install the projected led lighting.

For floor lighting are designed LED projectors NOCTIS MAHI Noctis and NOCTIS MIDI. For lighting of stairways from the Bastions of 6 exits to the tyard are designed LED luminaire BLOCO (6 led x1, 2W) which are installed in the side wall at a height of approximately 40cm. For indirect lighting, stone benches is designed LED strip.

**In locating luminaires is taken care about the line of ramparts, in locating luminaires in landscaping of eastern yard is taken care about horticulture, and other surrounding buildings and all other relevant matters, but due to the very precise requirements it is required close cooperation of contractor, designer and supervisor in order to successfully solve all the specific problems in performance.**

Technical solution of lightening of eastern yard complex is solved according to the categorization of roads and the European recommendations. The level of illumination of the central segment of a yard comprising of ramparts is more than 100 lx with designed a warm white. Considering the purpose of the site, were selected projectors with LED's, with 3500 ° K. Lighting of yards was done with lamps (projectors) with LEDs that give cold white and normal white color, with 4000 ° K-6000 ° K. In all of these lamps is the reproduction of color over 82%, while for example for high pressure sodium 25%. On the other hand the ratio W / lm is very favorable for these lamps. The designer is looking for quality and cost-effective solution, which will be from the point of exploitation to be flexible with the possibility of different enlargement in the future. The general approach was to discretely illuminate yard with color white and cold white, and to illuminate the ramparts with warm white color and very strongly, so that lighting of yard is just an introduction to lighting of ramparts and in no way detracts from the ramparts.

Most of the network is performed in a three-phase, but the lamps are sorted by the system of L1-L2-L3 interchangeably.

#### **3.4.1.4. Lights – panic lights**

Safety and evacuation lighting is designed with fluorescent tubes 1x8W and local NiCd batteries for three hours work, with the corresponding pictograms of direction and exit sign.

The brightness in all areas of the facility is calculated to meet all regulations and in accordance with the recommendations of the Yugoslav Committee for lighting.

### **3.4.1.5. Conductors**

#### **Conductors – MUSEUM and TOWER 5**

Installation of lighting and sockets, performs in the floor distribution (through the glaze) or in suspended ceiling in the self-extinguishing PVC ribbed pipes. The doors and casing of all cabinets are grounded to a common ground strip Fe / Zn 25x4 mm<sup>2</sup> or P / F wire with the appropriate cross section. Electrical equipment that is installed in the cabinets should correspond to the highest European standards and single-pole schemes, and all circuits must be properly labeled. In the present facility is foreseen TN - C - S system protection (grounded with 4 or 5 conductor), which means that the part of the network closer to the transformer system applied TN - C (grounded with 4 wires), and in part of the network (the building) TN - S system (grounded with 5 conductors). This ensures that any fault power does not flow neutral conductor, which provides reliable protection against too high touch voltages. Protection of live parts from direct contact is ensured with the isolation of casing. Protection against indirect contact is provided with an automatic power switches. All metal masses that do not belong to the electrical installation, and could come under voltages (metal hardware, electrical machines, taps, cisterns, baths, etc.). must be grounded.

#### **Conductors – SOUTHERN RAMPART AND LANDSCAPING OF EASTERN YARD**

Installation of ramparts lighting perform with cables PP00-YA, 4x35mm<sup>2</sup> and in a way that projectors from B51 to B113 supplies with cable which is designed in Unit 5a design where that cable supplied the projectors from A1 to B50 and only extends to the B113, while for projectors from B114 to B198 laying a new cable from DC-square. Besides cables for supply lays the cables for Management (DALI bus) type PP00, 2x2.5mm<sup>2</sup> (DALI bus for the B51-B113), type PP00, 2x4mm<sup>2</sup> (DALI bus for B114-B176) and type PP00, 2x4mm<sup>2</sup> (DALI bus for B177-B198 ). The designer foreseen cross-sections greater than 1.5 mm<sup>2</sup> because of the fact that 1.5 mm<sup>2</sup> cross-section allows a maximum length of 375m (for safety is taken 300m) which guarantees that the voltage drop on the DALI bus would be smaller than allowed (2V). Cross-sections of 2.5 mm<sup>2</sup> and 4 mm<sup>2</sup> allow length of laying cables that are larger than ours. The designer is aware that these cross-sections could not be directly pull to the control equipment and projectors, and it is foreseen in Dc-square and in the junction box next to the projector transition to the foreseen cross-section. Cable routes of lighting ramparts are integrated with other distribution so that it uses a single channel whose width at the bottom should be 40 cm for laying all necessary cables (see details of channel), thereby reducing costs for earthworks around the excavation and backfilling the trench, filling of river sand and protective gear (guard and warning tape). Here are also foreseen cable trenches of 80 cm deep, but the cables under roads lays much deeper from 1 to 1.5 m, depending on the category of road. For cables of ramparts lighting provide two PVC pipes F 70 mm. Above cables in the cable channel must be laid and grounding tape, placed about 30 cm over the cable in the same cable trench. The tape should be minimum 25x4 mm (30 x 4 mm). With tape to connect all metal parts, which should never be under voltage (poles, steel pipes, distribution cabinets, etc.). On this tape to connect all metal parts that are encountered along the route (water pipes, cast - iron heating pipe-heating system and other ground, etc.). Above it laying the warning tape.

Lighting of the eastern courtyard is supplied with an distribution cabinet DC-lig, which is located in the tower 6, next to the cabinet DC-T6 foreseen for supply of tower 6. Power supply cable for this two cabinet is type PP00, 4x25mm<sup>2</sup> + PP00- Y, 1x16mm<sup>2</sup> laying from distribution cabinet of museum in which is performed measurement for the whole location of eastern yard. Installation of internal lighting of eastern yard ramparts perform with a cable PP00-Y-A,4x35mm<sup>2</sup> + PP00, 2x1.5mm<sup>2</sup> (DALI bus) in a way that pull special cables for the left and right side of ramparts.

Cable routes of lighting ramparts -landscaping are integrated with other distribution so that it uses a single channel whose width at the bottom should be 60 cm or 40 cm for laying all necessary cables (see details of channel), ththereby reducing costs for earthworks around the excavation and backfilling the trench, filling of river sand and protective gear (guard and warning tape). Here are also foreseen cable trenches of 80 cm deep, but the cables under roads lays much deeper from 1 to 1.5 m, depending on the category of road. For cables of ramparts lighting provide PVC pipe F 70 mm. For projector lighting of trees and details use cables PP00-Y, 3x1.5mm<sup>2</sup> + PP00, 2x1.5mm<sup>2</sup> (DALI bus) and LED projectors ROCCA MIDI. For the floor lighting of eastern yard are used cables PP00-Y, 5x6mm<sup>2</sup> + PPOO, 2x1.5mm<sup>2</sup> (DALI bus), provided that this power supply cable leads to the most advantageous point in the line of floor projectors where in a box with the IP67 is switching to cable PP00-Y, 3x1.5mm<sup>2</sup> which is inserted into the projector. The designer did not foresee the installation of a separate fuse in box because in the beginning of lines is chosen 6A fuse which protects and cable of cross-section 6mm<sup>2</sup> and cable of cross-section 1.5mm<sup>2</sup>, and this choice of cables is foreseen that meet the requirements of the allowable voltage drop and efficiency of care. For the lighting of museum facade are used cables PP00-Y, 5x6mm<sup>2</sup> PP00, 2x1.5mm<sup>2</sup> (DALI bus), provided that this power cable leads to the best end point of the museum where in the box of IP67 is done switching to a cable PP00-Y, 3x1.5mm<sup>2</sup> which is inserted into the projector. For the lighting of tower 6 facade are used cables PP00-Y, 3x1,5mm<sup>2</sup> PP00, 2x1.5mm<sup>2</sup> (DALI bus).Lighting of facades for museum and tower 6 is performed with LED projectors ROCCA MAHI.For the lighting of exhibition plateau is foreseen cable PP00-Y, 5x6mm<sup>2</sup>,PP00, 2x1.5mm<sup>2</sup> (DALI bus) and projectors NEOS 2 (80 LEDs) mounted on the piles 0.5m heights . Due to the reasons mentioned above (the voltage drop and efficiency of care) was chosen AL cable 35mm<sup>2</sup> cross-section for ramparts lighting provided that the designer calculated with a subsequent extension of the line. Above cables in the cable channel must be laid and grounding tape, placed about 30 cm over the cable in the same cable trench. The tape should be minimum 25x4 mm (30 x 4 mm).With tape to connect all metal parts, which should never be under voltage (poles, steel pipes, distribution cabinets, etc.). On this tape to connect all metal parts that are encountered along the route (water pipes, cast - iron heating pipe-heating system and other ground, etc..). Above it laying the warning tape.

Pillars (0.5 m) around exhibitions plateau are mounted on the previously concreted foundation according to detail. In foundation must be left input-output pipes for entrance and exit of cables. Grounding tape over the crossing joints separate of the fundamental plates of pillars, on which it shall be installed under the screw or welded thereto. In foundation should be concreted necessary anchor bolts. Foundation to work from concrete, with concrete type MB 100-150.

#### **3.4.1.6. Jacks (outlets) and switches**

Lighting Control of exhibition area is made from a single location-info desk, according to the attached graphic and on upper floor is also foreseen central management from single location-switching panel. Turning on and off lights of ancillary facilities, shall be done with

appropriate switches. All switches should be modular and uniform, according to limits, in principle, horizontally, at a height 1.2 m (frames for a switch, for double switch, for two or three switches, etc.). If are on the same wall-mounted thermostats, regulators or other commands and they should be preferably in the same module (70x70) and according to vertical and possibly horizontal. If it is not possible, than find common solution with supervisor and leading architect. All sockets have grounding contact, the so-called Schuko sockets and can be mounted at 0.3 m from the finished floor.

#### **3.4.1.7. Conductors for heating and ventilation**

In the design are foreseen cables for power supply cabinet of electro-mechanical equipment : air handling cabinets, cabinet of heating substations, power supply cable for the chiller and the power supply cable for fan-coil and air curtains. The cables lays partly in floor distribution, and partly in suspended ceiling in the self-extinguishing PVC pipes. Power supply cable for the chiller lays partly through facility in SAPA tubes, and the outside of facility in excavated trench depth of about 80cm

#### **3.4.1.8. Lightning rod installation**

##### **Lightning rod installation - MUSEUM**

Grounding is carried out in a ring-shaped with tape Fe / Zn 25x4mm, on distance of about 1m from the building at a depth of 0.8 m. From grounding is foreseen a certain number of terminals for grounding distribution cabinets, grounding cabinets and elevator shafts, and certain number of terminals for connection with lightning rod installation. In addition to the grounding electrode should be connected all other metal objects that may come under voltage in the case of fault (gutters, metal fences, etc.). As the receiving system of lightning rod installation, on the roof of the building to the corresponding support is placed round copper conductor 50mm<sup>2</sup>. Down to building facades is designed a certain number of sweeping lines, also a round copper conductor 50mm<sup>2</sup>, according to graphical appendix.

##### **Lightning rod installation- TOWER 5**

Grounding is carried out in a ring-shaped with tape Fe / Zn 25x4mm, on distance of about 1m from the building at a depth of 0.8 m. From grounding is foreseen a certain number of terminals for grounding distribution cabinets and certain number of terminals for connection with lightning rod installation. In addition to the grounding electrode should be connected all other metal objects that may come under voltage in the case of fault (gutters, metal fences, etc.). As the receiving system of lightning rod installation, on the roof of the building to the corresponding support is placed round copper conductor 50mm<sup>2</sup>. Down to building facades is designed a certain number of sweeping lines, also a round copper conductor 50mm<sup>2</sup>, according to graphical appendix. As the receiving system of lightning rod installation of tower 5 is foreseen one descent with round copper conductor 50 mm<sup>2</sup>, which will be connected with tape Fe / Zn 25x4mm to grounding of stone building, the mentioned tape is laid in a trench along the power supply cable for tower 5.

### **3.5. GENERAL TECHNICAL SPECIFICATIONS FOR THE WORKS ON THE ELECTRICAL INSTALLATIONS – LOW VOLTAGE**

#### **3.5.1. Technical conditions**

- The safety distance while crossing power lines (supply voltage of 1 kV to 400 kV) via antenna television and radio receivers must be at least 5m and insulation shall be mechanically and electrically amplified.
- Crossing of power lines (supply voltage of 1 kV to 400 kV) over the antenna transmitting and receiving radio station is not allowed.
- At the point of crossing overhead electric power lines (supply voltage of 1 kV to 400 kV) with telecommunications lines safety height between the lowest conductor of the electric power lines and highest conductor of telecommunications lines is:
  - 1.for lines of supply voltage 400 KV.....5.5m
  - 2.for lines of supply voltage 220 KV.....4.0m
  - 3.for lines of supply voltage from 35 KV to 110 KV.....3.0m
  - 4.for lines of supply voltage from 1 KV to 35 KV.....2.5m
- At the point of crossing overhead electric power lines (supply voltage of 1 kV to 400 kV) with telecommunications lines is not allowed to set safety net over the telecommunications line.
- In range of crossing overhead electric power lines (supply voltage of 1 kV to 400 kV) with telecommunications lines is not allowed to set conductors, or safety rope.
- The angle of crossing overhead electric power lines (supply voltage of 1 kV to 400 kV), by rule, shall not be less than 450, but can be extremely reduced to 300
- Telecommunication cables which lays in the earth must be kept away from the pillars of electric power lines at least 10m for rated voltages up to 110kV, 15m, or rated voltage of 220 kV, 25 m for a or rated voltage of 400kV. If these conditions can not be fulfilled , it is permissible to pass a telecommunications cables at least 1m of the pillars of power lines with nominal voltages up to 35kV.
- Installation of telecommunication lines on pillars of overhead electric power lines is not permitted unless the telecommunications line is used for signaling and telecommunications in electric power networks.
- Above or below antennas for television receivers,radio receivers or radio transceiver, cables (rated voltage up to 1kV) with rope are not built.
- Above antennas for television receivers,radio receivers or radio transceiver, safety height for the lines with the SKS is 1 meter,and safety distance of 1 m for rope lines.

#### **3.5.2. Technical conditions – fire alarm system installation**

- Installation of fire alarm systems must be designed to ensure proper selection, number and arrangement of detectors providing signalization of fire at the earliest possible stage, with enough security to prevent false alarms.
- It is forbidden to turn off the signal light of interferences , because it turns off itself when interference is removed .
- The sensitivity of the installation for fire alarm systems can be changed only by authorized and trained persons.
- The fire alert(alarm) should be signalized with light and audible on fire alarm control board, all parallel tableaux and the local fire control center.

- Fire alert must be such that it allows quickly find the place of fire.
- It is strictly prohibited turn off fire alarm devices to unauthorized persons.
- Light signaling of alerts or malfunction shall be performed so that remains active during the occurrence of fire or malfunction, regardless of the turning off of sound installations.
- All fuses of signal zone - indicators and devices for handling - must be clearly and permanently marked.
- Casing for placing signal central must be mechanically resistant, provide visibility of all indicators and prevent unauthorized use.
- Fire alarm panel shall be placed in a room where someone must be constantly on duty or to a place with a continuous duty service must be provided parallel signaling or automatic remote transmission of fire alerts and interferences.
- Nearby to signal central must be set alert plan, control book, manual handling and maintenance of fire alarm central.
- To the fire control panel must be installed Legend plate with data about manufacturer, label about control panel type, year of production, the factory number and number of certificates of quality.
- Elements of the alert and alarm systems must be in good condition and protected from damage and blocking.
- Signal areas should be spread out over one floor only (excluding stairs and elevators), and must not be greater than fire sector, nor more than 1600m<sup>2</sup>.
- In one notifying zone should be more rooms if they are adjacent and no more than five, with a total area not exceeding 400m<sup>2</sup>, or if they are adjacent, and approaches can be easily monitored and the total area not exceeding 1000m<sup>2</sup>.
- Smoke detectors and fire detectors can be placed in locations where temperatures does not exceed +50° C.
- Temperature of response thermal detectors must be between 10 and 350C above the highest temperature that can occur naturally or operating activities in the vicinity of detectors

### **3.5.2.1. Fire alarm system installation**

#### **Fire alarm system installation - MUSEUM**

In the facility of stone building-historic museum, is designed the installation of fire alarm system independently of other objects. In facility were also deployed optical smoke detectors and manual call point. Mentioned optical - thermo fire detectors, mounted on the ceiling, as shown in the graphic attachment. Alarming of security should be done with common sirens, internal and external. Complete installation perform with fire resistant cables JBY 2x2x0, 8, cables lays in a suspended ceiling in the self-extinguishing PVC pipes. Accros the object is deployed a certain number of infrared motion detectors, as shown in the graphic attachment. Complete installation perform according to current regulations and instructions of the supervisor and designer.

### **3.5.3. Technical conditions – telephone installation**

- Telephone installation begins from bunch of installation lines in the building and ends up on telephone jacks.

- To create a phone installation and telephone entrances must be used the installation materials that meet the technical regulations ZJPTT and JUS standards.
- Telephone installations and telephone entrances must be installed in the manner due to moisture, mechanical, chemical, thermal and electrical influences without endangering human safety and security of objects and buildings.
- Telephone installations and telephone entrances in areas with high voltage electrical installations in the emission of radio stations must be carried out according to specific technical regulations.
- Telephone installations and telephone entrances must be installed to suit the technical regulations regarding the protection of telephone lines from the influence of electrical installations.
- To create a phone installation and telephone entrances can only be used installation materials foreseen for in this instructions and technical regulations ZJPTT for installation materials. The installation of all materials must conform to regulations.
- For telephone cables and wires, telephone cabinets and boxes, accessories for completion, continuation and bifurcation cabling, telephone wiring material for the installation channels, fuses and protective devices required certificate (attest) of the authorized organization that the materials may be used for construction.
- For telephone installations and telephone entrances shall be used cables with copper conductors of the wire with cross-section of 0.6mm.
- Installation cables are installed in the installation pipes and ducts. Only when the installation cables are used to for entrances and when in the building cannot be made the installation of pipes set into the wall, and installation cables are not exposed to mechanical damage, installation cables can be mounted on the wall.
- Installation cables are intended for installation lines in the building must be drawn into the installation pipes or ducts. Directly placement on wall or into a wall of installation of conductors is not allowed.
- All types of pipe installation must comply with JUS N.E1.010 and other associated standards.
- Installation pipes made of combustible materials (polyethylene and the like.) are not allowed on the wall. When installing in wall, the pipe must be covered with a layer of non-combustible materials a minimum thickness of 2cm.
- Cabinet for internal cable terminal must comply with technical regulations ZJPTT.
- Telephone jacks must meet JUS N.E1.101.
- Installation pipes in the floors of the building should be placed in a straight line to the horizontal and vertical. For horizontal installation, pipes in wall, pipes for telephone installation shall be placed 10 cm below the ceiling and with small decline to junction box that in pipe would not be retained condensed vapor.
- When is used mounting method of construction it is allowed to horizontally placed pipes lays in the ceiling.
- At each building technology, it is necessary to foresee all the holes, passing, etc.. on structural elements of the building to be used for laying the pipes and for them to obtain approval of structural engineers.
- When laying the installation pipes in wall ducts pipes are attached on 2-3m distance, gypsum or plaster.
- On the wall can be laid only installation pipes that are designed for installation on wall (with increased resistance to pressure) and in dry areas where there is no risk of mechanical damage.

- Outlet cabinets and cabinets on the direction of riser pipes in which the cable is the continuation and the transition from cables to conductors, are placed at a height of about 1.6 m above the floor.
- Cabinets and boxes used as a passing usually should be placed on 10 cm below the ceiling.
- Telephone jacks and other sockets, are placed at 30cm from the floor. Setting the socket below this distance is not allowed.
- When performing telephone installation with installation ducts must be taken care about following conditions: 1) in installation ducts that are laid telephone installation cables intended for connection to the telephone network, can be laid and other telecommunications lines if you excluded possibility the electric influences of this lines to telephone wiring 2) telephone lines and the electric power lines must be placed in special ducts, or in a separate field of a multiple channel, so there is no electrical impact on telephone wiring installation.
- Telephone Installation lines regardless of the place and manner of laying must be in terms of electricity safely separated from electric power lines and other telecommunications installations.
- Minimum distance between the telephone connection points and connection points for other electrical and telecommunication devices must be at least 20 and 10cm, respectively.
- For telephone installations the insulation resistance between conductors of the same line or different lines is not less than 20MΩ and the insulation resistance between any conductors and grounding is not less than 10MΩ.
- In addition to these tests order to check the quality of work of telephone installations and entrances must be tested and method of production, and quality of the used type of installation materials. The manner of making and quality of used installation materials must comply with these instructions and relevant regulations for installation materials.

### **3.5.3.1. Telephone installation**

#### **Telephone installation - MUSEUM**

The installation of phones, according to the terms of reference, was treated on the level of computer networks.

### **3.5.4 Video surveillance installation**

For video surveillance is mounted certain number of IP color camera and one of them is external camera and monitors entrances in facility, and other cameras monitors diferent areas within the building space for the museum.

There are foreseen high-resolution cameras with casing for outdoor installation, and cameras for indoor use. All cameras connect directly to digital video recorder DVR with cable RG 59 B / U. Cables lay partly in PNK, and partly in PVC pipes 16mm diameter,surface mounting.

### **3.5.5. Intrusion and fire detection installation**

#### **Intrusion and fire detection installation - MUSEUM**

In the present facility of stone building-historic museum, is designed installation of fire alarm system independently of other facilities. In facility are also deployed optical smoke detectors and manual fire alarms. Mentioned optical-thermal fire detectors, mounted on the ceiling, as shown in the graphic attachment. Alarming of security should be done with common sirens, internal and external. Complete installation perform with fire resistant cables JBY 2x2x0, 8, cables lays in a suspended ceiling in the self-extinguishing PVC pipes. Accros the object is deployed a certain number of infrared motion detectors, as shown in the graphic attachment. Complete installation perform according to current regulations and instructions of the supervisor and designer.

## **4. TECHNICAL SPECIFICATIONS FOR HVAC INSTALLATION WORKS**

### **4.1. INTRODUCTORY NOTES**

The spatial unit 9 is located inside the fortress in its northeastern part, covers the area of the eastern yard, with its bastions, towers and facility of the museum. HVAC installations are designed in accordance with the architectural and construction design, urban and technical requirements, "GRADSKE TOPLANE" - Banja Luka, the norms and regulations for this type of installation.

1. Installation must be performed according to design and may be transferred only to contractor who is able to commit and prove that it is able to deliver a complete installation, install, examine and put into operation.
2. Prior the commencement of works contractor is obliged to review the design and compare it with facility and to inform investors about the possible shortcomings of the design or substantial changes necessary and ask for his further instructions.
3. The investor is obliged to provide contractor an enclosed space on the site for storage and preparation of materials.
4. Contractor of installation may be the company, who has the knowledge and abilities required for the performing of these types of installations, i.e.:
5. that can purchase, deliver and install all installation elements foreseen in design, and that is capable to obtain for this equipment complete technical documentation;
6. that has the knowledge and capabilities to solve all the details necessary for the installation of central heating installations, the technically and aesthetically appropriate manner;
7. that has appropriate control, measurement and regulating equipment to perform good regulation of all installed equipment elements.
8. Installation elements that are not standard product, but are made specifically need to be made of materials of good quality and the best way provided for this type of works. Surface protection must be performed exactly as indicated in the design, and in places where it is indicated, in the manner usual for such works in accordance with the regulations on quality.
9. Architect and contractor have to be in consultation with the designer and contractor of installation and in walls provide large enough openings and penetrations for installation of vertical and horizontal distribution.
10. Contractor of central heating installation must coordinate the performing of his installations with contractors of other installations that avoid misunderstandings and damage of installations.
11. The coefficients of heat transfer harmonize with the applicable regulations of the thermal protection of buildings.
12. Foresees source of thermal energy with connection of facility to the heating system of the city of Banja Luka or electric boiler depending on the facility which should be processed in a given unit.
13. For off season period of the year / when is not in use heating system of the city of Banja Luka, anticipate source of heat energy with using the heat of condensation from cooling heat pump version.

### **4.2. SCOPE OF THE FORESEEN WORKS**

For facilities, which are one of the units within the project of remodeling and revitalization fortress Kastel is necessary to design the installation of central heating, ventilation, cooling

and heating substation. All installations design fully in accordance with applicable standards, regulations and technical requirements for the specified type of installation, and technical solutions to the contemporary. Special attention is given to energy efficiency of the facility in terms of energy consumption for heating and cooling, and for that purpose provide for adequate systems for heat recovery from ventilation systems. In selecting technical solutions and installation of equipment give special attention to harmonization and installation of equipment in the ambient.

#### **4.2.1. Heating and cooling installation**

##### **Heating and cooling installation – MUSEUM**

single installation of heating and cooling is predicted as a fan-coil devices predict fan convectors - fan coil devices parapet and ceiling /depending on installation location/, for two-pipe system of heating and cooling temperature regime 60/55 - 7/12°C. System cooling / and heating /, solved through fan-coil apparatus for two-pipe system work. FC has been previously described. The system cooling / heating is "associated" with the ventilation system:

In the ground-plan of ground floor you can see two linear diffusers with lengths of 26 m in a continuous construction; the diffuser section are 1m lengths and are alternately connected to the air handling unit, insertion of prepared air in space, and to FC - heating / or cooling. Blowing air from the linear diffusers is performed at an angle. Exhaust air is through exhaust grids in the central part of spaces, and through the duct system in suspended ceiling, to air handling unit and FC who are in technical room. In the attic fan coils are parapet - they heated / cooled space-by circulated air, "fresh" air from the air handling unit(AHU) leads to them(part of the anticipated amount of air that circulates through the FC - and the air from AHU has been prepared, in all units, to projected temperature space, and over FC is inserted into the space. (details provided in the drawings). Exhaust of air in attic is made through the circular exhaust ducts which are conducted in a visible ridge structure, to air handling unit KK2-1500 and KK4-1500. Fan Coils were selected for two-pipe system running in temperature regime 7/12°C , in the cooling mode ,or heating mode via heat exchangers of city heating system 60/55°C and for mode of heating, via cooling machine when the machine is running as a heat pump 45/40°C. Pipe network of FC system is dimensioned for the cooling mode. The whole network is isolated with Armaflex insulation thickness of 13 mm, with a vapor barrier, as part of the network in the TS, in front of the valve for transition from the heating system to cooling system. Part of pipelines from facility to the refrigerating machine conduct through pre-insulated steel pipes placed in the ground. Condenser networks performed with polypropylene plastic tubes-PPR, with relevant dimensions, which are connected via a siphon to drainage network of facility. It is selected cooling machines, heating pump, which will heat in off season period, while city heating still do not work, type CARIERR AquaSnap 30RH 080 B, nominal cooling capacity 71 kW, a nominal heating capacity of 80 kW, electric power absorbed  $P = 40$  kW, the coolant freon R407 C, complete with hydro circulating pumps in duplex design flow rate  $V = 12.2$  m<sup>3</sup> / h, and pressure drop  $h = 150$  kPa, and an electric heater to protect the evaporator from freezing.

Refrigerating machine is equipped with "Pro-dialog" system for control of operation and links for connection to a central monitoring system. Machine is placed on a concrete foundation near the facility in case of demand of landscape and environment integration in the fortress can be visually protected with appropriate decorative fence. Heating pump is equipped for winter conditions with electrical heater to protect the evaporator, and if

necessary, Pro-dialog includes a circulating pump of machines, at low external temperatures: By opening the valve in by-pass (NO40) on pipeline (DN80) machine, which is in TS - with separation of heating pump through a valve, is also provided circulation through the pipeline (DN80), which connects heating pump with the rest of installation.

Overhead part of heating pump is isolated from black pipe with insulation Armafleks thickness 19 mm and 60 mm mineral wool, covered with Aluminium sheet; With preinsulated pipes beneath the Museum facility-stone building, from the indicated position of the heat pump (in the graphics section) comes to the position of heat substation, pipes are conducted under the floor boards, it is a route of pipes from the machines and hot water networks - up to TS (the heat exchanger for hot water network in the TS).

Hence cooling / heating system of Museum - Stone Building is designed that in cooling mode from heating pump cold water goes into the network of fan coil and cooler of air handling unit.

Control-command equipment was selected for the ability to connect to central monitoring system, Building Management System, although no precise request from the Investor.

#### **4.2.2. Ventilation installation**

##### **Ventilation installation - MUSEUM**

It is designed mechanical inlet-exhaust ventilation, direct injection of fresh and exhaust of waste air for rooms on the ground and attic. Due to the purpose of space - the museum, provide control of humidity in the space. A special exhaust ventilation system ventilate toilets and waste air carry out above the roof of building. The amount of air is adopted by the applicable EN standards depending on the purpose ventilated space. Air handling unit placed in a loft in the technical areas. Mechanical ventilation systems, air preparation, are provided for rooms on the ground and top floor. The amount of air has been adopted in accordance with DIN 1496 and it is 40m<sup>3</sup> / h per person: For ground floor 150 people \* 40 m<sup>3</sup> / h = 6000 m<sup>3</sup> / h; There are selected two handling units of 3000 m<sup>3</sup> / h labeled in the design AHU 1-3000 and AHU 2-3000, details in the bill of quantities.

For attic 75 people \* 40 m<sup>3</sup> / h = 3000 m<sup>3</sup> / h, were selected the two AHU each with 1500 m<sup>3</sup> / h labeled in the design AHU 3-1500 and AHU-1500. The facility is multidimensional and it is envisaged that works as a museum. Therefore, the appeared request to control moisture. All four AHU are equipped with electric steam humidifier (dimensioned that in winter in the air after the heater of AHU, relative humidity increases from 3.5% to 50%) the details of the humidifier in the bill of quantities. Operation of electric steam humidifiers regulates with system of automatic regulation of AHU. The needed water for the humidifier is supplied with plastic pipes from the heating room-water from the city water system.

(Technical space for placing of AHU in the attic is limited, so when assembling is going to be done first will have to place AHU and ventilation equipment, and after that perform the roof structure). It determined the type of AHU, fitting, and selection recuperator of air heat -laminated recuperator is selected, the details in the Bill of Quantity. It is necessary to provide a "serving" of AHU, for maintenance and repairs, and access "through" the wall that separates the technical area of the office in the attic, almost throughout its length, access to air handling units AHU1-3000 , AHU2-1500, AHU3-3000 and AHU4-1500 . Intake air and exhaust of waste air for AHU is through the roof, there are given positions and dimensions in graphic section. These "details" are part of the bill of quantities.

Exhaust ventilation is provided from the technical rooms of heat substation, above the electrical cabinets and UPS, 800 m<sup>3</sup> / h. This air is discharged outside the building, via

ducts, through the waste air vents on the roof. Compensation of air in the TS over relief gratings in the doors TS.

Ventilation ducts are derived from galvanized sheet metal thickness corresponding to the regulations from the technical requirements, and partly from the interlocking spiral tubes. Connecting sections of air ducts performs with custom-fit fittings and flanges. The layout of the ducts network is shown in the graphical section of the project. Because of the partial cooling of air through ventilation system /to temperature around 26°C, which is well above the dew point / isolation is not provided for ventilation network. As a distribution line elements are designed aluminum bars, linear diffuser. The combination of distribution elements and air ducts performs with flexible hoses. In rooms that have only exhaust ventilation for bypass of air on the front door are mounted relief gratings / or in the lower part of the door leaves the corresponding gap /. On the part of the ducts network behind the fan for air intakes and in front of fan for exhaust noise suppressors are installed (or are integrated into the ventilation chamber). After completing installation, the installation of equipment in trial operation shall be regulation of certain systems with adjustable of designed parameters.

Within system of ventilation is foreseen ventilation of sanitary facilities in the amount of 75 m<sup>3</sup> / h per unit, with custom-fit fans for toilets CBF 100. Turn on of this fans performs by lighting switch.

#### **4.2.3. Heating substations**

##### **Heating substations - MUSEUM**

For supplying of facility with heat energy is foreseen their own substation, which is placed in a room on the ground floor under the stairs.

Heat capacity of exchange cells was determined on the basis of the calculated transmission losses of facility, losses through ventilation system, the condition of city heating system and the reserve capacity of 10%. Based on all this plate heat exchanger with capacity  $Q = 220\text{kW}$  was selected, the temperature regime - primary 130/73 ° C, and secondary 90/70oC, the product "Danfoss" or the like. In substation are located distributor and collector of hot water with four individual branches by type of consumer heat pipelines Each branch is equipped with a circulating pump and shut-off valve and the control elements of automatic control for sliding or running water at the starting temperature at a constant value.

For a transitional period when the city heating system is not in a function, facility was supplied with heating energy through the refrigerating machine which operates in heat pump mode. Changing modes of refrigerating machine performs with appropriate software package PRO-DIALOG and the corresponding reversing valves whose labels given in the application schema - table of working mode of reversible valves.

The manner of functioning of the system, is visible from the the substation application schema or schemas of connecting equipment in thermal cooling station that is provided in the graphics section of the design.

The expansion of water in the system is solved via closed expansion vessels, with total volume  $V_u = 250$  litres complete with a safety valve No32, opening pressure 2.5 bar.

Measuring the consumption of thermal energy is conducted through an ultrasonic calorimeter as Siemens Sonoheat 2WR546 nominal sizes DN25 nominal flow  $V_n = 3.5$  m<sup>3</sup> / h.

Pipe network of substation is performed with black steel pipes after cleaning, the corrosion protected double coat of paint of different shades. The pipeline of the primary network is

isolated with mineral wool in the mantle of aluminum sheet 0.7 mm, 60 mm insulation thickness.

Pipe connections should not be performed in the walls but in easily accessible places. When pipe installation take care of possibility of thermal elongation.

The substation equipped with fire extinguisher with dry powder S-6 2 pcs.

#### **4.2.4. Supervision and authorization for each phase of works and installing material**

Regarding the Law on Spatial Planning Investor shall promptly appoint a supervisor who is licensed for HVAC installations - article 104.

Technical supervision during construction of the building or construction work, perform the supervisor of construction, who is appointed by Investor. Technical supervision includes adequate control implementation of technical documentation, quality control of performance of all types of works and application of regulations, standards, technical norms and standards of quality work, quality control of materials, equipment and installations to be installed, giving instructions to the contractor and, if necessary, providing details for the works. Supervisor of construction can be a person who, in accordance with the provisions of this Law, shall have the authority to create the appropriate technical documentation and authorization for constructing of such facilities. Regarding the Law on Spatial Planning investor is obliged to entrust the works company that is licensed to perform HVAC work (Article 123, paragraph 4). After completion of installation test it and provide adequate protocols. Handover of the installation to be done with built design of HVAC installations under the laws, regulations and rules of the profession on the technical acceptance.

### **4.3. TECHNICAL CONDITIONS FOR EXECUTION OF WORKS**

#### **4.3.1. Overview of regulations and standards applied**

Installed equipment, material and works are in accordance with bellow mentioned standards and norms. They define individual phases of work:

EN 442, ISO 9001:2000, EN 10204, EN 12288, RAL-RG 641/2, DIN EN 1044, BS EN 12735-1, BS EN 12735-2, JUS C.B5.221, DIN 2440, DIN 2448.

#### **4.3.2. General technical conditions for air conditioning and ventilation installations**

1. The installation must be fully in accordance with the design. It can be leased to performer, which is capable to take over the obligation and to prove the ability for delivering the entire installation, to mount, adjust and commission in operations according to project.
2. All elements of installation must be in accordance with all their details with designed, specified characteristics and, must have such dimensions so they can fit in overall sizes defined by design.
3. Elements of installation that are not a serial product, then are made according to special order must be made of good quality materials on the best way foreseen for such kind of work, as it is marked in the design, and on places where it is not marked, on a way usual for such kind of work and in accordance with provision of quality.

4. Contractor of installations declares he has adequate knowledge and ability requested for the work out of these particular installations, apropos:

a) ability to purchase, deliver, mount and connect elements with other elements of installation, to regulate it and to let run all elements of installation facility, foreseen by design for domestic or imported equipment, and to provide appropriate documents, manuals, instructions which would be necessary for that purpose (of the installation regulation) ;

b) having at disposal necessary knowledge and ability for solving of all details in the scope of installation set up, on appropriate technical and esthetical manner, for which detailed drawings are not provided as for: hanging of pipes and air ducts, manufacturing of solid and sliding supporters, installing of air-discharge vessels, installing of heating bodies, installing of the equipment on floating, elastic or solid foundations, fitting in of the equipment in architectural - constructing unit, etc.

c) having at disposal necessary knowledge and ability for regulation of working parameters of installation: velocity and flow rates, temperatures of water and air and humidity of air, by using of all regulating elements foreseen by the design.

5. Equipment, material and armature, which will be used for performing of the installation have to be of the most recent production, all in accordance with valid regulations. Armature and measuring instruments have to be of good quality, entirely fulfilling its purpose.

6. Contractor of the installation is obliged to install all the equipment foreseen by the design on a manner supposed by drawings, technical description, and this technical specifications. Contractor is obliged to provide his skilled and working support, tools, machinery, instruments, and all the rest support necessary for assembling.

7. Works on performing of foundations, basis, for the equipment requesting foundation, are a part of delivery equipment works, and performer is obliged to conduct them. Also, all masonry works necessary for fixing of the holders, supporters, clips etc., for carrying of installation elements, is obligation of the contractor.

8. Regulating circles, as well as all other elements which make automatic regulation, to install according to enclosed documentations. During installation contractor is obliged to obey manual instructions of the equipment producer for measuring and regulation; those are: detailed schemes of connecting, instructions for installation, for regulation and for handling.

9 After installation assembling is finished, performer is obliged to execute control and regulation of the measuring and automatic equipment, according to designed parameters.

10. El. installation is subject of the electrical installation project design, but connecting of all el. devices, assembled into designed mechanical equipment, contractor of mechanical installations is obliged to perform, with his workers, material and tools.

11. All electrical equipment foreseen for assembling into designed installation, have to be adjusted for connecting power supply network 3x380x V, 50Hz, or 220 V and 50Hz, for monophase connecting places.

12. El. engines should be delivered together with fusers and devices for admission.

13. El. commands of distributing board should have all elements necessary for managing, control securing of devices (fusers, devices for admission, control lamps, etc.). On electric distributing board, all necessary relays and the rest of electrical instruments which fall in

the scope of automatics or they are a part of the equipment making connection between automatics and electric engine.

14. Performer of installation is obliged to provide all necessary material needed for connecting of all electrical engines and remained electrical devices which go into composition of installation inter-related, as well as with el. commanding distributing board.

15. After successfully performed assembling and waterproof inspection of installation, one starts with insulation and painting. Before insulating and painting, all metal parts of the installation, without manufacturers surface protection, are to be cleaned properly with steel brush and to be painted, two times, with foundation-protective paint. Insulation to be performed properly, all in accordance with the design. Paint of the installation facility will be determined by the Investor. Paint should have good covering characteristics and to be resistant, stable, on maximal foreseen temperature.

16. After assembling of the installation is finished, one should start with testing operation and regulation of the installation. During performing of the test all preliminary operations, e.g. air-discharge of the pipeline, preliminary regulation, set up of dampers in working position etc., and than let installation run. After removing of possible defects, which can occur during the installation running, than précised regulation of the installation is to be done, by using measuring devices and equipment, foreseen by the design and installed. Regulation of the velocity, flow and temperature to be done correctly and well, obeying all conditions defined by the design.

#### **4.3.3. Special technical conditions for air conditioning and ventilation installations**

1. Pipeline should be set up so, that pipes can elongate freely, without stress. Pipe movement due to its extension must not bring to braking or damage of elements caring pipeline, nor to damage constructive part of the building. All fixed parts (fixed points) have to be conducted properly so pipeline can not move on that places. Pipe bushings are to be installed in the pipe penetration places, trough walls and inter-floor constructions. Before welding, it necessary to prepare connecting pipe parts, and after welding to treat the weld by taking care not to change diameter of clear opening. There have to be an access to all separable connections ( connection-union-flat joints) of the pipeline.

2. Pipeline distribution to be conducted so, that pipes are set up with necessary slope and are to be fixed with hangers, clips and brackets. Distance between brackets, hangers, if it is not specified differently in documentation, to be adopted according to following table:

Mark of the pipe	Distance between supporters (m)
DN 10	1.5
DN 15 – DN 20	2.0
DN 25 – DN 32	2.5
DN 40 – 50	3.0
DN 65 – 80	3.0
DN 100	4.5
DN 125 and bigger	5.0

3. For manufacturing of duct sections, elbows and branches – profiled sections, galvanized metal sheet have to be used, thickness as follows :

Width or height of air duct  
(bigger dimension) mm

Thickness of the metal sheet mm

Up to 250	0.5
251 – 499	0.75
500 – 999	1.0
Over 1000	1.25

For determination of sheet thickness of reductions and other duct parts, dimension of bigger edge is relevant at the end of smaller cross-section.

4. Rolled profiled steel is used for manufacturing of flanges, according to following:

a) for parts made of metal sheet 0.5 to 0.75 mm, L 25x25x4 mm

b) for parts made of metal sheet 1.0 to 1.25 mm, L 30x30x4 mm

5. Connecting of the a/m flat and profiled sections of air metal sheet ducts, should be conducted with double seam. At the ends of flat and profiled sections one should set up flanges made of angled iron. Ends of some sections should be bent over flanges. Tape for sealing of air ducts is to be set up between flanges. For connecting of flanges screws  $\square \frac{1}{4}$ " with hexagonal head are to be used.

6. Hangers and brackets for air ducts have to be made of rolled steel  $\square 10$  mm and "L" profile having dimensions from 25x25x3 mm to 35x35x3 mm, with a use of nut M10 and washer.

7. Air ducts should be conducted with as less as possible of sharp turnings. Depending on its radius, elbow should be conducted with incorporated vanes for directing of air-stream.

Air duct sections with length which exceeds 500 mm should be pre stressed (to be stiffened), in order to avoid noise.

8. Dampers for air flow regulation have to be of solid construction with the props, stiff, on bottom and top edge, in order to avoid their vibrating in any direction. Damper axles are placed out of duct, or of air handling unit, and can have manual or engine drive.

9. All fans of ventilating installation have to provide capacity of static pressure and number of rotations, as it s marked in the specification; their case-sizes have to be suitable, so fans can be installed in places foreseen by the design. Fans fall in class of "buzz-less", it means they have the least possible buzz, sound, on defined number of rotations. Fans should be connected with el. engines via wedged belts and via clutches. Wedged belts and pulleys have to be equipped with shields.

10. El. engines for fan drive have to be adjusted for three-phase system, of AC 380V, 50Hz. Construction of electrical engine has to be totally closed, with sliding discs supplied with appropriate rotary admission-devices. Electrical engines are being set up on sliding rails made of cast iron or pressed steel.

11. Capacity and characteristic of refrigerating plants should be in accordance with designed values. The plants have to be equipped with all necessary devices for running, for regulation and maintaining of working parameter values and with safety-protecting elements. Refrigerating plant to be installed fully in accordance with conditions and request of their manufacturer.

12. The equipment requesting foundation to be set up on appropriate foundations – with final measures determined according to dimensions of delivered equipment.

13. The equipment in machine halls to be installed fully in accordance with the design taking care of the possible access to some elements and devices, because of their

maintenance and de-installation. Special attention should be given to installation of security-technical and protecting equipment, as it is connecting of expansion vessels, safety-valves, setting up of fireproof dampers as well as of the rest of fire-prevention devices, silencers etc., obeying project the design documentation and listed regulations, which have been used during performing of the project design.

14. Waterproof inspection is performed on water part of the installation as well as on its air part. Water part of the installation is checked by cold water on supposed check up pressure, which is determined as sum of hydrostatic pressure and head of pump, increased for 2 bar. Installation is being held on this pressure for two hours. During that period leaking and perviousness must not occur, apropos decreasing of pressure at control places.

15. Airproof test of air part of the installation facility, working on high pressures, is inspected by measuring of flow rate at exhaust connection of air handling unit and at streaming elements. During that inspection balance of air quantities must not differ more than 10%. On the low pressure installations only air-proof inspection is to be preformed - on air part of installation.

16. During technical inspection on installation, it is being checked, if equipment, devices and automatics which have been installed are in accordance with the design. Also quality of assembling works is being inspected and designed parameters of the installation and of air-conditioning plants are being checked.

17. Temperature of rooms is being checked: during winter regime of work, when external temperature is  $-5^{\circ}\text{C}$  or lower, and during summer regime of work when external temperature is  $29^{\circ}\text{C}$  or higher – and weather is sunny. Three hours after continues working of the installation, if rooms were normally air-conditioned a day before, temperatures in all rooms, foreseen by the design, have to be achieved. Measuring of temperature is to be performed at the middle of the room, on height of 1.2 m measured from the floor level. During this measuring, it is necessary to perform and measuring of remained parameters of the installation, needed for their recalculating on conditions of external designed temperatures.

#### **4.4. GENERAL TECHNICAL SPECIFICATIONS FOR THE WORKS ON THE HVAC INSTALLATIONS**

##### **4.4.1. General**

Prior to commencement of works the contractor must perform the recording and marking routes and facilities, and during construction should be made permanent kntrolupeak elevation, declines and directions. The works must be carried out in accordance to terms of relevant institutions as well as applicable regulations and standards for this type of work. If during the performance some of these regulations undergo changes, amendments or adopt a new, contractor is required to act upon them without charge. The material for the works must comply with recognized standards and regulations for this type of material. With each delivery of materials shall be submitted attest that the material tested and the correspond to regulations. Contractor is responsible for all the installed material and quality of work until the final commision, or to obtain permits for use and takeover of complete installation by Investor. The works must be carried out under the project agreement and these terms. If there is any discrepancy, the Contractor is obliged to timely manner contact supervisor for

clarification. For each possible modification must be a written approval of the designer and supervisor.

Design documentation for installation of central heating, ventilation and air conditioning is done on the basis of: construction design, UT conditions, terms of reference and the applicable regulations in this field for the design of mechanical installations JUS C.B5.221 , DIN 2440, DIN 2448, EN 442, ISO 9001 : 2000, EN 10204, etc.

## **General – MUSEUM**

Facility Museum -Stone Building consists of two floors:groundfloor and attic. Technical rooms are at groundfloor- under the stairs where are the heat substations, and in the attic where are placed air handling unit and fan coil. -Stone House Museum is a facility for multi-functional purpose: a museum, a space for organizing the celebrations and so on.

### **4.4.2. Heating devices**

1. As heating bodies the radiators, convectors, calorifers, pipe registers of smooth pipes, as well as remaining heating and bodies of modern construction can be applied. If during the construction other types of bodies are replacing some heating bodies, the Investor must issue the approval.
2. For all heating bodies which are being installed the certificate on quality and working characteristics, attest, issued by the authorized institution is absolutely necessary
3. Heating body by the rule should be placed freely on the brackets in the parapet wall window; exceptionally they will be placed differently in case when it is necessary due to construction or heating body itself. If mask is being put in front of heating body, it will have to provide streaming of the air, as good as possible, and to be easy removable.
4. Sanitary-hygienic demands when installing heating bodies are the visibility and accessibility to all surfaces and elements of heating bodies due to maintenance and cleaning.
5. Mounting-construction demands are following:
  - the size of heating bodies must not exceed the overall dimensions of windows and window hole;
  - heating body connectors to acclivity pipelines should be done without necessary bending;
  - heating bodies to be installed in horizontal position;
6. If radiators are used as heating bodies, during their installation following conditions must be fulfilled:
  - Distance of the radiator backside from the wall should amount 20-70 mm, depending of the radiator type
  - Distance, between bottom radiator surface and the floor, should be 100-150 mm, depending of the parapet height
  - If radiator is covered with radiator shield, or if a sill is placed above radiator, than minimal distance between top radiator surface and shield ceiling, or up to the bottom edge of the sill, should be at least 70-120 mm.
7. During mounting of radiator on brackets, they have to be set up so radiator is being supported and not to hang on them. Basically number of brackets should be determined on a way that radiator up to ten sections (ribs) has two of them, and on each next ten

sections – joined together, one bracket more. Number of holders should be one less comparing to the bracket number.

8. One should try to install in one-object radiators made only by one manufacturer, whereas the radiators should be identical in depth and in height.
9. After radiator batteries are formed, consisted of necessary number of sections, inside of the battery must be washed due to dirtiness, by jet of water.
10. After installing has been finished, and after successfully pressure probe has been done, radiators should be de-installed, properly cleaned of rust and dirtiness and protected with funding, protecting, paint. Lacquering of radiators is performed after their reinstallation, on radiator temperature at least 50°C. Special paints and lacquers, resistant on high temperatures, should be used for radiator painting. Applying of different metal (bronze) paints is not recommended due to a decreasing of surface coefficient of radiation, what brings to decreasing of heat release.
11. Calolifers as heating bodies are mainly intended for heating up of the workshop plants; especially in the case ventilation is needed besides heating. Connections for calolifer for fresh air should be as short as possible, cross sections equal or bigger than connections on calolifer. Noise produced by calolifer during working operation must be in limits foreseen by regulations of ventilating devices.
12. Convector use is allowed besides use of other heating bodies. It is not recommended to install in the same object convector and radiator bodies.
13. Convectors are installed in special convector boxes, or in the wall wholes with the installment of front mask (shield). Between convector and the mask, as well as on the backside, no free space should be left. When installing the convector one should stick fully to the manufacture's recommendations. During delivery to the object, wave card-paper or similar package should protect the convectors. This protection will be removed only after installing convectors and after finishing all construction work.

## **Heating devices - MUSEUM**

By technical solution of the mechanical installations of heating and cooling are designed systems of underfloor heating and a unique fan coil installation of heating and cooling - two-pipe system. Installation of underfloor heating is designed as a secondary system / comfort requirements / for areas in ground floor. There are foreseen fan coils as heating the cooling bodies- FC for suspended ceiling installation and parapet - without a mask. Parapet fan coils are designed in the attic. The mask is the subject of architectural bill of quantities to meet the requirements of the HVAC, connected to the insertion hole and the exhaust hole of FC air, and in respect of daily access to the temperature controller FC; Regulation of ventilation convector is achieved through the controller that is mounted inside the masks, on top under the mask. The controller provides temperature control of exhaust air, in space, on air and water-side over the three stage fan speed controller, and change the flow of fluid through the FC by three-level valve with thermostatic head. The regulator has a choice of modes / auto-manual /, on-off switch, the choice of system summer-winter, adjust the room temperature, a temperature sensor measuring the ambient air temperature at the inlet air in the FC. In addition, the regulator has the ability to connect to a central control system of the facility. More detailed description of the types and functions of work is provided in bill of quantities, for appropriate type of regulator. Also for maintenance must be provided access to the hydraulic and electrical components, the mask must be removable. Fan coil for

suspended ceiling installation are designed in technically space in attic and are suitable for heating and cooling of the ground floor, working with the FC-circulated air - the air intake is on inlet grid in the suspended ceiling of ground-floor and ducts, at FC is heated / or cooled and injected into ground through the linear diffuser.

#### **4.4.3. Pipe network**

##### **A. Black steel pipes**

1. All pipes of horizontal and vertical pipeline must have certificate and must be in accordance to the standards JUS C.B5.221, DIN 2440, DIN 2441, and DIN 2448.
2. The route of placing pipelines and distribution of supporters can not be altered without designer's approval
3. Horizontal pipe net in the objects having a cellar should be hung on the ceiling or leaned on the walls of the cellar (as on bracket). In the object without cellar, placing pipe net in the floor canal is allowed, especially for those which on the distance from 8 to 10 m have light control covers. Before closing the canal one should clean it and isolate the pipe net on the appropriate way.
4. Pipes passing through the construction ought not to be tight installed (immured), and then they should have enough space for dilatation due to temperature change.
5. Vertical pipelines and connectors to the heating bodies should be guided freely along the wall. On vertical lines, right behind the connector to the horizontal pipe net one should install gate or permeable valves and above them draining taps.
6. On the spot on which the connectors to heating bodies are crossing the vertical line, the connector must have adequate roundabout arc that ought to be done on the horizontal flat.
7. Connectors for heating bodies can not be shorter than 30 cm.
8. Acclivity supplying line is always placed on the left side and it ought to be fixed with corresponding number of pipe clips.
9. For making pipe net that is assembled in the concrete layer of the floor one will use plastic-plated copper pipe JUS C.D5.502. While bending pipes, the clear opening must not be reduced and for all connection fittings made especially for copper pipes will be used.
10. Air-discharging of the installations will be solved centrally, with aired net over airing or expansion vessels.
11. On the spots where the acclivity pipeline is passing through mezzanine construction, pipes should be covered by corrugated paper, except in wet –sanitary facilities where on the passages metal bushings of larger diameter, enabling free movement of pipes with isolation, are being placed. The space between pipes and bushing will be filled in with sealing mass, stable on working temperature. In the floor passages, these bushings should be uplifted for 5 cm above the floor.
12. For straight pipelines which length exceeds 30m, by rule, compensating lyres have to be foreseen.
13. Parts of the pipeline which are not supposed to release a heat, and passing trough non heated rooms, must be insulated with good thermal insulation. The isolation

should be set up so that when the pipes are extending due to heating no damage occurs.

14. Horizontal net in all parts should be guided with the slope of 0.5 to 1% in the direction toward airing utensils, apropos valves and draining taps.
15. Connecting of pipes is being performed by welding or, if it necessary to perform separable connection, with flanges. Welded places must be well treated, with sufficient thickness of weld, but performed on a way that pipe cross section is not decreased. The quality of weld must be of the first class.
16. During every connecting by welding, following steps have to be taken:
  - Edges on joining pipe parts are to be chamfered by file. Pipes with walls thickness less than 3 mm, are to be welded without chamfering of the edges. Pipes with its wall thickness bigger than 3 mm, angle of edge chamfering have to be 60-70°;
  - cleaning of the seams from rust and dirtiness
  - Removing of slag from performed welds, and their protection against rust with basic paint
17. Pipes are fixed with mobile or immobile supporters, singe-part and two-part pipe clips and consoles. Maximal allowed distance between supporters is allocated in the Table:

Dimension of pipe (mm)	Maximal distance (m)
Ø 17.2 x 1.8	2.0
Ø 21.3 x 2.0	2.0
Ø 26.9 x 2.3	2.0
Ø 33.7 x 2.6	2.0
Ø 42.4 x 2.6	2.5
Ø 48.3 x 2.6	2.5
Ø 57.0 x 2.9	2.5
Ø 60.3 x 2.9	2.5
Ø 70.0 x 2.9	3.0
Ø 76.1 x 2.9	3.0
Ø 88.9 x 3.2	3.0
Ø 108.0 x 3.6	3.5

18. During assembling of flanged joints, standard flanges are to be used, with standard and proper dimensions and selected for proper working pressure. During joining of pipeline with armature, by flanges, use of gasket seals made of cork, minimal thickness 3 mm is necessary, or use of graphite- asbestoses cord with rectangular cross section. Cords must be cut under angle of 45°, and never vertically

19. Consoles and hungers the pipeline is leaned on must enable its free movement due to thermal dilatations, without possibility for creating deflection. Supporters and consoles must be installed in the walls by cement mortar not by plaster.

20. Performing of curves and profiled parts on pipelines can be executed by bending of the pipe (for diameter up to 26.9 mm), or by use of appropriate elbows made of the same

material. Armature and profiled parts, e.g. T-connections, must not be placed inside of the constructing elements. At places of penetration of pipe line trough walls and inter-floor construction in rooms intended for staying of people, rosettes are to be set up on both sides.

21. After finished installing and legally requested test operation , all pipes, armature and other metal parts, must be properly cleaned up of the rust and protected with suitable foundation paint. After that, pipeline in the wall can be covered with corrugated paper, and insulated or painted with oil lacquer-paint, resistant (stable) on high temperatures.

22. Installment of gate valves, taps and valves should be done so that the spindle with wheel is placed vertically on horizontal pipelines. Access for the armature must be ensured due to possible interventions. All radiator valves must be adjusted according to data from the project design.

23. On installed armature the arrow visibly marked and pointing the movement direction toward heating fluid must be placed.

24. On proper spots, one should ensure area for installment of a case in which connecting armature and meters for heating energy usage for each apartment or one will be placed for entire object.

25. Cases for setting up of connecting armature must be standard, with unified lock for all settlement. Also their size, dimensions, must be sufficient, to provide installing and de-installing of elements, without problem. Height between the spot collector and distributor are placed in the case, and floor level must be 1.5 m.

26. Construction detail of the case, the place and room-space necessary for its installing must be in accordance with architecting-civil project design, and certificate on this accordance, stamped and signed by designers should be enclosed to the investing-technical documentation.

## **B. Cooper pipes**

1. Pipe network for single-pipe heating perform with copper pipes and do it as shown in the technical description and the accompanying plans.

2. To create a pipe network for single-pipe heating use copper pipes made of high quality copper and protected with PVC insulation material thickness 2 mm.

3. Installation of horizontal pipes made without welding. For this purpose, use plastic pipes Cu with dimensions  $\phi 12h1$ ,  $\phi 15h1$  ili  $\phi 18h1$

4. Pipes delivering in coils of 1 m diameter, with lengths 25 m or 50 m.

5. The required length of pipe to unwind from coils, cut it with hacksaw or by special tool for cutting pipes. Cutted part mandatory protect with caps from dirt.

6. Bend pipe with hand tools. For a given diameter of tube bending radius is 105 mm.

7. Marking of pipes perform along the pipes by entering the following data: the external diameter of pipes, pipe wall thickness, standards, codes and trademark of manufacturer (eg 15x1 JUS C.D5.501) Marking of pipes in this manner is necessary in the technical documentation and orders for delivery tubes

8. For the connection of valves, the length of straight part of pipe to their knee of must be at least 40 mm.

9. From the end of the tube remove plastic, put a nut and sealing ring and connect it to valve. Blend seal up with tightening nuts with wrench.
10. In pipe, on blend place, put the brass cartridge to eliminate any irregularities occurred when cutting.
11. The maximum heat energy to which is tube dimensioned for one heating circuit is:
 

$\phi$ 12 h 1	5.800 W
$\phi$ 15 h 1	10.000 W
$\phi$ 18 h 1	15.000 W
12. Checking of pressure made before the final setting of cement floor base. Pressure test determines the supervisor, if it is not not defined with project documentation. About test performed shall be made appropriate protocol signed by the Supervisor on behalf of investors and the responsible manager of the site on behalf of contractors. Upon completion of installation of the system to drop the air and make sure the radiator valves were set to corresponding flow.

### **Pipe network – MUSEUM**

Pipe network of primary horizontal distribution is performed in black steel pipes and the leads beneath the ground floor ceiling and in suspended ceiling.

From primary horizontal distribution are separated branches of pipeline for supply of heating-cooling systems / fan coil appliances / hot or cold water with temperature regime 60/55oC or 7/12oC; main pipe network for FC parapet in is placed in ceiling of attic - pipe connections are through the ceiling panel of ground-floor lead to the FC.

For the purpose of being able to perform qualitative control and fixing the flow of all branches is planned to incorporate on return pipe valves. These valves are internal thread with screw spindle which is not lifted until the preset flow is restricted walk spindle. At some terminals of fan coils beside three-way control valves are mounted ball valves on the initial line and chokes on the return line. On each vertical line - branch are implanted and discharge valves (valves within the branches), which allow discharge of certain verticals or branches for possible intervention on them without the distractions of the rest of the installation.

#### **4.4.4. Automatics**

1. Automatics are to be placed fully toward attached scheme, and some elements of automatics will be placed on spots predicted by the design.
2. The contractor is obliged to obtain detail scheme for connecting form the supplier, as well as instructions for assembling, regulation and handling. It is desirable to have included into the price of delivering automatics the cost for one skilled person, who would control assembling, and regulating of automatics.
3. After finished adjustment of all elements of automatics, it is necessary to perform test operation under all working regimes and to make a record and Minutes together with the supervisor.
4. Place and room for installing of the of measuring device, calorimeter, is to be foreseen on return pipeline, obeying all requests and recommendations, issued by manufacturer, for its proper installation. In front of the, calorimeter reliable collector (of dirtiness) has to be foreseen.

5. The separated electrical cable, must be provided for all calorimeters, from the electrical case of the circulating pumps electrical distribution in heating sub station; each case has to have the connection for computing units supply by electrical current of proper voltage.

#### **4.4.5. Electrical installations**

1. Electric installations must be done with usage of water resistant elements and armature, and based on special design that is made according to the data on designing installation.
2. Centrifugal circulation pumps must work with minimal noise and vibration and on spots where it is impossible, one must install silencers of noise and vibration. Pumps are delivered assembled with electric motor of closed construction and with a connection to the voltage of 220/380 V and frequency of 50 Hz.
3. Electric motors should be delivered assembled with adequate admission ports and fuses. Nevertheless, the electric commands of distribution table should contain all necessary silencers and fuses.
4. On the table, the devices for measuring ampere and voltage should also be installed, as well as signals for operating and malfunction. Moreover, on the table, all necessary relays and other elements belonging to the frame of automatic and control plant should be placed or they should be a part of equipment forming a relation between automatics and electric motor plant.

#### **4.4.6. Installing of installation**

1. Performer is obliged to mount the entire equipment foreseen with this design on the manner set within the graphical documentation, technical description and technical conditions.
2. Mounting embraces entire installations for heating and cooling, linking pipes with water cooling and heating sub-stations, linking to connectors of water supply system and sewerage that will be constructed to the sub-station by the performer of work related to the water supply and sewerage.
3. All masonry work necessary for fixing supporters, beams, scopes for supporting canals and other elements of installation are the obligation of the installation performer.
4. Before each drilling or any other masonry work on concrete one must ask the approval by the supervisor in charge of constructing works, apropos request to have certain construction job done and give the guidelines for construction. The contractor is obliged to cover the whole after installing elements on the way adequate and compatible with the kind of installed elements.

#### **4.4.7. Installation testing**

1. All devices, pipes, armature should be fully tested during technical acceptance by measuring pressure aiming to establishing adjustment of device construction, pipes and armature with the design's technical demands. The success of done testing is recorded in the work register.
2. Full technical testing is done: by outer observation, testing on hardness, inner inspection and testing on sealing.

3. Outer inspection, observation is done without shutting down the plant, whereas attention is paid to the entire installation as well as on some elements, especially on armature.
4. Testing on hardness is done before letting the plant in operation. Before testing on hardness the plant must be cleaned and all elements of installation placed hardly in order to prevent leaking or damage during testing. The value of testing pressure is defined based on the form:

$$P_{pr} = 2,0 + P_p + P_{st} , \text{ bar}$$

Whereas:  $P_p$ - pump head,

$P_{st}$ - static pressure of water column in the installation.

Measuring the value of pressure is done by the assistance of controlling manometer whereas all installed manometers are controlled at the same time. Test pressure is kept for 180 minutes, and then the observation of the premise for 60 minutes is conducted. It is generally considered that the devices and pipelines will pass the test if no marks of damage and no deformation of installation elements is noticed. The result of testing is considered successful if except for the above mentioned conditions the pressure of first 120 minutes after reaching the value of test pressure is not decreased for more than 2%. Testing on the request of commission for technical overview and acceptance of the object can be done during the technical observation process.

5. While conducting the inner observation of device (where it can be done) one should pay attention to the status of walls, links and connections.
6. Testing on sealing is done right after testing on hardness. The pressure during this testing is equal to the working pressure. One considers that the plant has passed the test on sealing if the pressure does not fall for then 2% during the following 24 hours.
7. After completed testing on hardness, one should test the installations in terms of achieving working parameters, apropos so-called warm test. Under this testing following will be tested:
  - whether in all parts of installation designing parameters are achieved;
  - whether the armature and devices act correctly and whether the system acts without noise and drumming;
  - whether the heating bodies heat equally the entire surface;
  - whether all elements of installation are stabile and resistant to the thermal dilatations;
  - whether the net is normally aired.

Within this testing the measurement of inner temperature in all heated premises is conducted. The measurement of inner temperature is done during outer temperature having minimal value of  $t = -5 \text{ }^{\circ}\text{C}$ . The measurement is conducted on the height  $h = 1,2 \text{ m}$  from the floor by the thermometer regularity call  $0,5 \text{ }^{\circ}\text{C}$  three hours after the installment.

8. Necessary fuel, electric energy and other costs of testing, except the labor, pays and processes the Investor.
9. After successful functional testing, the installation is turned over to the Investor. On that occasion the performer, constructors obliged to turn over two copies of written Manuel for handling the installation, out of which one copy should be framed and hung on the visible spot in the boiler room.
10. All testing must be conducted completely in accordance with relevant standards.

## **5. TECHNICAL SPECIFICATIONS FOR EXECUTION WORKS ON ELEVATOR AND LIFTING PLATFORM**

### **5.1 INTRODUCTORY NOTES**

#### **5.1.1. General notes**

The spatial unit 9 is located inside the fortress in its northeastern part, covers the area of the eastern yard, with its bastions and the building of the museum.

Elevator installation is designed in accordance with the architectural and construction projects, rules and regulations for this type of work.

### **5.2 SCOPE OF THE FORESEEN WORKS**

#### **5.2.1 Hydraulic passenger elevator**

One passenger elevator and one lifting platform for disabled persons are foreseen in the Museum. has the following characteristics:

- transmission ratio - direct system 1:1
- max load 630 kg
- speed 0,47 m/s
- number of stations 2
- number of approach 2
- lifting height 4,2 m
- base dimensions 1650x1930 mm
- hole shaft 1500 mm
- top of the shaft 3200 mm
- command – per unit, microprocessor based
- control from the cabin and outside using the buttons
- shaft door -automatic , telescopic, double pan , left 1 piece i right 1 piece
- dimension 900/2000
- materialisation brushed inox
- generator on the ground floor
- cabin dimensions 1100x1400x2200
- walls and ceiling materialisation cabin is brushed inox
- floor materialisation - stone
- supporting signalization

#### **5.2.2 Lifting platform for disabled persons with the following characteristics**

- max load 300 kg- one person in the wheelchair
- speed 0,06 m/s
- number of stations 2/-1/
- number of approach 2
- lifting height 1,65 m
- base shaft dimensions 1460 x 1460 mm
- shaft depth 650 mm
- control from the cabin and outside using the buttons

- base platform dimensions 1300 x 1300 mm

### **5.2.3. Supervision and authorization for each phase of works and installing material**

Regarding the Law on Spatial planning Investor shall promptly appoint a supervisor who has a license to work for installation elevators - art. 104th. Technical supervision during construction of the building or construction work, performs the supervisor, which is determined by the investor's act of writing. The supervision includes application of technical documentation control, quality control and verification of execution of all types of works and application of regulations, standards, technical norms and standards of work quality, materials quality control, equipment and materials to be installed, giving instructions to the contractor and, if necessary, providing details for the works. The supervisor of construction may be a person who, in accordance with the provisions of this Act, shall have the authority to create the appropriate technical documentation and authorization for constructing such facilities. Regarding the Law on Spatial planning investor is obliged to entrust the works to company that has a license for the works on the installation of elevators (Article 123, paragraph 4). After completion of elevator works it is obligatory to examine the installation, and to obtain appropriate protocols. Handover of the elevator performed by the project really executed according to the state laws, regulations and rules of the profession on the technical acceptance.

## **5.3 TECHNICAL CONDITIONS FOR EXECUTION OF WORKS**

### **5.3.1 Overview of regulations and standards applied**

The main design of hydraulic passenger elevator, max load  $Q = 630$  kg, is made according to European regulations for lifts EN 81/2 approved the decision SZ to standardization number 2/2-03-002/1 of 20.10.1995 and according to the EN directive 96/15/EC and the regulations JUS M.D1.500, JUS M.D1.510, JUS M.D1.511, JUS M.D1.512, JUS M.D1.550 i JUS M.D1.556

## **5.4 GENERAL TECHNICAL SPECIFICATIONS FOR THE WORKS ON THE ELEVATOR AND LIFTING PLATFORM**

### **5.4.1 Preliminary measures**

Prior to commencement of works the contractor shall perform recording and locating of the installation elevator and platform place, and during installation should be made permanent control of level marks. The works must be executed fully in accordance with applicable regulations and standards for this type of work. If during the performance some of these regulations undergo changes, amendments or a new one is adopted contractor is required to act upon them without charge. The material for the works must comply with valid standards and regulations for this type of material. With each delivery of materials shall be submitted an attest that the material is tested and is in accordance with regulations. Contractor is responsible for all the installed material and quality of work until the final handover, or getting the use permits and complete works for this position. The works must be executed in accordance to the design, contract and these terms. If there is any discrepancy, the contractor shall seek the solution of the supervisor in the right time period. For each possible modification must be a written consent of the designer and supervisor. Trench

excavation, backfill, compaction of fill shall be carried out fully in accordance with the description.

#### **5.4.2 Elevator installation and lifting platform**

Elevator is a permanent built-powered electric power facility, intended for the carriage of persons or load, which are served by certain stations using a cabin which measures and construction allow safe access to people or load, which is moving in the shaft between at least two firmly embedded rails. Elevator is designed for vertical transport of passengers.

#### **5.4.3 Driving shaft**

Elevator driving shaft is made of reinforced concrete, dimensions: 1650 x1930 mm. Before elevator installation check all shaft dimensions. Shaft walls should not have dents or bulges bigger than 5 mm. Protrusions and recesses bigger than 2 mm must be beveled by the angle of 75 ° to horizontal. Shaft walls must be made of a material that is resistant to mechanical stress and fire, and that does not create dust, but prevents it clogging. Shaft walls must be made solid, straight and smooth. The wall is considered solid, if under the influence of perpendicular force of 300 N, at the site of action of these forces do not sag more than 10 mm. The wall is considered to be flat if there are no bumps or dips bigger than 5 mm. The wall is considered smooth if it is well cleaned and painted in a bright color.

On the shaft there are the following openings:

- Door shaft,
- The ventilation shaft and
- the passage of hydraulic and electrical installations.

All access openings in the shaft of the elevator are closed with metal doors. Between shaft and generator room set up two 100 mm diameter pipe through the floor glaze, for the passage of oily water and elevator electricity installations (the obligation of the Investor). Shaft must support the loads that occur when working with hydraulic cylinder and fitting cabins bumpers. The forces acting on the shaft are determined according to the Rules of the Yugoslav standards for elevators. In the shaft there must be an opening for ventilation with a total cross-sectional area at least 1% of the surface of the horizontal cross shaft, and which takes air from the shaft into the atmosphere directly. Shaft bottom (shaft hole) is 1500 mm. The bottom of the shaft must be permanently protected from water ingress. In the shaft is metal climbing frames set with handrail. Shaft top is 3200 mm. The vertical distance between the console is max. 1500 mm and the distance from the console to the top or bottom of the shaft, max. 500 mm. Part of the drive road left to move the cabin up, free height above the roof of the cabin, when the piston is in the most upper position and the free distance between the lowest parts of the shaft ceiling and roof top elements of the cabins are within permitted limits under Article 21 and Article 23 Official Gazette of the SFRY 16/86:

- when the elevator cabin is at rest in a fully compressed buffers in the shaft there is a space that allows the accommodation of the cuboid size 0.5 x 0.6 x 0.8 m, so that it rests on one of its surfaces and
- the free distance between the bottom of the shaft and the lowest point of the cabin is at least 0.5 m, and the free distance between the bottom of the shaft and the lowest point of the device for driving the cabin, parts of collection devices, protective cabin metal door at least 0.1 m.

In the shaft must be mounted switch with inscription "STOP", with clearly marked "ON" and "OFF" positions and which is driven off elevator, two-pole outlet with earthing contact and intermittent light switch shaft, properly marked, which is connected to the switch in the generator room.

The hydraulic platform for the disabled person means a permanently installed facility intended for transportation of persons with reduced mobility. Movement of the platform is allowed by hydraulic cylinder. The drive of hydraulic cylinder is enabled by drive generator which is located in the shaft hole of platform, and is connected to cylinder with a flexible hose of high pressure. Cylinder management is achieved with hydraulic distribution block in which the valves are located.

Hydraulic platform for disabled persons consists of basic elements:

- Constructive cabin
- Hydraulic cylinder
- Hydraulic generator
- Cabin floor
- Safety fence
- Cabin control panel
- Control panel in the stations

#### **5.4.4 Generator room**

Elevator has no separate generator room, but generator and the control group placed in a metal cabinet (generator space) dimensions 950x500x2100 mm at a ground level, the level of "0" 1570 mm away from the driving shaft. Between generator room and shaft set up two 100 mm diameter pipes through the glaze of the floor, for the passage of oil line and elevator electrical installations (the obligation of the Investor). Walls and ceiling of the generator room are fire resistant, space is dry, thermally insulated and free of dust ( $t = +5^{\circ} \text{C}$  to  $40^{\circ} \text{C}$ ). The generator room must not have built in any installation other than those belonging to elevator. Generator space is illuminated so that brightness is at least 200 lx measured at the floor and have "SUKO" jack powered from the building system. Generator room doors is a metal dimensions 900x2000 mm with ventilation holes at the top and bottom and are lockable. Access area is easily accessible, safe and permanent illuminated. Outpouring of flammable liquids from the generator room is prevented by setting the threshold height of 70 mm at the entrance to the generator space. Power cable for elevator electricity supply is derived from the main switchboard in the building to the generator room or to place of the main switches (switchboards) elevators, (obligations of the Investor). Power supply line should be dimensioned according to initial electric (not the subject of this project). For equalizing the electric potential of hydraulic elevators, to the generator room leads building grounding connector. Supplies (cleaning cloth, lubrication, etc.) are kept in the metal cans or boxes with non-flammable tops.

#### **5.4.5 Lighting, el.installation and main switch**

Illumination shaft is provided with lamps protected from dust with a bulb of 60 W. Light bulbs are arranged vertically at a maximum range of 7 m, except that the first and last a maximum of 0.5 m away from the bottom of the shaft or from the top. The lighting is investors obligation.

Electrical installations in the shaft is made of plastic channels that are used for the main vertical line of the shaft, attached to the wall or on a metal bracket mounted on the elevator

guide rails. The distance between the two attaching shall not be greater than 2 m. The output wires from the plastic channels is performed by using plastic tubes. To connect the elevator wiring to the rest of the wiring, distribution cabinet with terminals (terminals), built in the middle of the shaft, which is placed between the flexible multi-strand cable. All attachments are marked according to the technical documentation. Length of flexible cable is measured, so that when the elevator in the end, there are free and do not touch the bow lift, or parts of the shaft. The connection between the conductors is performed only in the prescribed regulations and permitted kutijama. Prilazi the shaft of the elevator is at least as well-lighted staircase lighting.

The main switch is set to the switchboard in the engine room. Marked with the main switch" and" positions" ON" and" OFF".

Fire extinguisher is mounted in a prominent and accessible place near the engine room and is secured against theft, a rubber mat elektroizolovana command is placed in front of the switchboard during the execution of maintenance operations.

#### **5.4.6 Driving shaft door, cabin and platform cabin**

Doors of the shaft

On the approaches to the levels 0 and 1 is placed a door: automatic, telescoping, double panel, dimensions 900x2000 mm, left 1 piece and right 1 piece. Automatic access door allows fast and automatic opening and closing the door of the elevator. The door with horizontal movement. Quickly, evenly and recoilless door motion is achieved by an electric motor. Opening the door may be adjusted. Opening and closing is done quietly and without noise. Starting of the door is done using a special mechanism that is mounted on the cabin. Door is supplied with the device that will in the event that the door encounters an obstacle stop the closure and include opening doors. Cabin doors may not have handels on the inside, and their surfaces must be carried out smoothly. The same applies to the outer surface of the front door of access. The distance between the threshold of the door to the shaft and the cabin door threshold is a maximum of 30 mm. All doors must be equipped with safety electric locks constructed by the regulations for elevators. Locks must ensure that the door can not open if the cabin is not located in the station, and that the elevator can not be put into motion if the door is not well closed. All doors of shaft may open, if necessary by force unlock from the outside using a special key, which is entrusted to the person in charge of maintenance. Effect of this key is to disconnect electrical managing circuit, and also elevator working. Natural or artificial lighting, as measured on the floor in front of the door shaft must be at least 50 lx.

The cabin is passing under 180°, made of metal, standard equipment, dimensions 1100 x 1400 x 2150 mm. Cabins side are coated with brushed inox. Cabin fulfills the requirement that a useful floor area of the cabin does not exceed the value corresponding to the nominal load. In the cabin is register-box control corresponding to the adopted comand. Cabin is highlighted during operation so that the minimum illumination intensity of the cabin floor was at least 50 Lx. Ventilation cabin: natural.

At the threshold of the cabin there is a protective sheet width at least equal width as the door light shaft. The vertical part of the protective sheet threshold is at the lower end of the skew angled at 60 ° to the horizontal, a miter is 50 mm measured horizontally. The total height of the protective sheet threshold is 0.75 m. At the entrance to the elevator cab is the threshold which supports all loads during loading and unloading. Middle part of the cab roof is translucent, made of tempered laminated glass. Cabin roof, in addition to requirements for mechanical strength of the walls of the cabin, meets the following criteria:

- serving a minimum of 2 persons or a load of 2 kN without permanent deformation and
- there is a free flat surface of at least 0.12 m<sup>2</sup>, long or width of at least 0.25 m.

Cabin frame is connected with carrying ropes and inflection the cob, indirect system cylinder. On the frame cabin is located safety gear wheels with the current action, which is activated in case of loosening the supporting ropes. At the cabin are placed two magnetic switches that stop the elevator at a time when both are activated by means of set up and running magnets in the shaft. In case of running of cabin for some reason out of the level of cell propulsion device returns the elevator station and leveling is done.

Platform cabin is passing cabin under 90°, dimensions: 1300 x 1300 mm. The floor of the cabin consists of a carrier part, which is made from sheet steel 3 mm thick, corrosion protected, covered with rubber profiled mats. The minimum load of 3.5 kN/m<sup>2</sup> I calculated. Cabin doors are supplied with safety lock.

#### **5.4.7 Drive**

The system of direct " Backpack" 1:1 features as the cylinder and guide rails mounted on the side compared to the cabin. The cylinder at its lower end rests on driving record, tied at the top of the clamps to the side wall, while the top of the piston directly connected to the top of the cabin frame.

By raising the piston lifts the frame cabins in a 1:1 ratio. Elevator cabin is installed in a special carrying frame made of steel profiles that are over four slider / wheel / can move vertically by a stable integrated rail guides along the shaft. Press the dial button, and through the elements on the dashboard, put the drive motor and oil pump in the engine. Oil pump generates the required pressure for starting piston. By means of electro-valves, which are an integral part of aggregates, is the regulation of oil flow in the cylinder, and speed the cabin. When you come to call the station, it automatically switches off the engine. When the command for launching the cab, does not include the engine, but the command of electro-valve regulates oil back into the tank or lowering speed cabin. In the case of power failure in the network security device is activated, via a separate power supply can cause the elevator to the first lower station.

#### **5.4.8 Electro-hydraulic generator hydraulic installations and pressure relief valve**

Electro-hydraulic power unit consists of reservoirs, pumps and electric motors. The tank is made of steel profiles and sheet protected against corrosion with a built-in oil level indicator. Screw pump is attached to a three-phase electric motor. It works sunk into the oil and the has elastic connection at the tank. At the top of the reservoir is built block electrohydraulic valve and pressure gauge to control oil pressure. The tank is fitted with oil heater thermostat to control the oil, which in no case shall exceed 70 ° C. On the block valve is a safety valve and the valve for manually lowering the cab to a lower station, and hand pump for raising the cab to a higher station, if the pump does not work.

Hydraulic installation is performed between the aggregates and the working cylinder. It consists of a rubber hose for high pressure. Special mechanical protection is required. These elements are placed according to the project and joined together by means of extensions (connectors). On the walls are strengthened with the installation of metal holder at a distance not exceeding 1500 mm.

To ensure the uncontrolled pressure in the installation, the valve block is installed safety valve, which opens automatically and prevents the increase in pressure over the planned lifting elevator with a full load or overload lifts.

Hydraulic generator for lifting the platform should have the following characteristics:

- Simple and compact design
- Reliable function
- Easy maintenance

Reduced noise thanks to a new solution to the motor and the pump submerged in oil, with built-in shock absorbers under the tank of oil. It can be installed in a small space, facilitated by the removal of heat from the oil and the high degree of utilization of oil content in the circulation.

Nominal power: 1.1 kW

Engine speed: 2750 r / min

Motor protection: thermal probe

Valve voltage: 48 V

Voltage safety valves: 12 V

Functioning of the control valve is almost independent of the load in the cabin and the viscosity of oil in both directions of walking. Decrease or reduction of the pressure load or empty the elevator and the temperature change in the area of its oil viscosity of 20 do 500 cSt, does not produce an effect that affects the drive comfort.

Hydraulic cylinder is made in accordance with the provisions of EN 81-2.

#### **5.4.9. Control panel**

The control panel consists of a supporting frame with a supporting plate, which has fixed elements of the command (contactors, relays, transformers, etc.) which are connected by electrical conductors. Command and signaling circuit conductors are derived P-section 1 mm. Conductors are colored in according to regulations. Connection between the dashboard with the other parts of the elevator is achieved via appropriate terminals that are labeled according to the following technical documents. The steel frame of the board is set collecting plate for grounding of all control elements. Electrical management scheme was deferred to a special holder next to the dashboard.

#### **5.4.10 . Thermal protection of electric motors**

The windings of electric motors have built in sensors that turn of elevator command when the motor windings heat up over the allowed temperature regulation.

#### **5.4.11. Alarm device**

Pressing "ALARM" in the register box elevator, is activate the audio signal that is embedded into the driving shaft near the main station and the elevator cab. The sound signal is activated from a separate power source (battery) that must visit each elevator control.

#### **5.4.12. Service control elevator device**

Placed on the roof of the cabin and is used to drive the cabin when reviewing and maintaining the device. The device comprises:

- switch for turning off all commands,
- switch " STOP" and the

- two keys to drive up and down, just until the button is held down.

#### **5.4.13. Necessary light**

In the cabin there is an electrical device with a constant charge of electricity from which is powered necessary light. Disappearance constant voltage in the network, the necessary illumination lamp turns on automatically. Light bulbs must have the necessary strength of at least 1 W, and at least 1 h light illuminates the box management.

#### **5.4.14. The equalization of electric potential on the metal masses**

Aggregate and guide rail are connected by galvanized steel strip Fe / Zn 20 x 3 mm. The same tape connects control panel or cabinet. All other metal components in the machine room and the shaft are connected to respective cabins conductor. Guide rails connect the lightning protection installation on the roof across the cathode and the surge arrester to the top of the shaft, and a basic grounding in the bottom of the shaft (the obligation of the Investor). This installation is not subject to the project.

#### **5.4.15. Protection against electric shock, electrical faults and overloading**

Protection against electric shock is performed according to JUS N.B2.741, Article 5 The building in which is mounted elevator installation is connected to the network TN-C, and the installation of the device is performed in TN-C\_s system- neutral and protective conductor are kept separately. Protection against indirect contact was made with soluble implants fuse.

Before putting elevator device in operation, it is necessary to measure the fault loop impedance and determine whether they are within permitted limits.

Guides in the lower and upper parts connect, and all the metal mass in the machine room and connect to the system of equalization electric potential.

Severe operating conditions may not perform due to the appearance of one of the following errors:

- power failure,
- Illicit voltage drop,
- loss of electrical conductivity of line,
- circuit to ground or earth,
- replacement phase,
- non closing of a contact part,
- Short circuit or interruption of electrical parts such as resistors, capacitors, semiconductors, light bulbs,
- non-return to the starting position of the anchors of contactors or relays,
- not opening a contact part and
- non attracting or incomplete attraction anchors contactors or relays.

To ensure against overloading (EN 81.2.) of cabin, the block valve was installed electric excessive pressure switch that turns off the elevator command if the rated load is exceeded for more than 10%. As a final measure in case of overload, which is recognized over a possible further increase in pressure in a hydraulic installation, built-in block valve is a safety overflow valve. It opens automatically and prevents the pressure rise more than 1.4 times more than anticipated pressure to lift the cabin with a full load.

#### 5.4.16. Maintenance, signs, notices and labels

The investor or the user is required simultaneously with the release of the elevator in use to provide maintenance to lift regulations on technical standards EN 81/2, Appendix D, which includes:

- daily servicing through a responsible person,
- regular maintenance by professional organizations for the maintenance of elevators and
- regular inspection by authorized institutions.

Deadline warranty is 2 years from the date when the lift is put into the correct drive. Any defect that occurs at the cable, caused by poor quality materials, poor preparation or poor installation, the Contractor shall call on investors to remove the plant and put in the correct pagon. Every elevator must have a maintenance book.

All signs, notices and markings are visible, legible and understandable from durable material and permanently attached. In the elevator cabin and the door shaft is placed a label on which the rated capacity in kg and the maximum number of persons. In the elevator cabin is also sets the mark of the company . Part of putting into effect switches labeled "STOP", is red with a permanent inscription " STOP", height of at least 7 letters mm. Alert butten is yellow, with a permanent inscription "ALARM" in height letters at least 7 mm or symbol in the form of bell. Buttens for giving commands, in the cabin are characterized by uniform numbers, letters and symbols.

On the roof are placed folowing signs and markings:

- the switch to stop or next to it – label "STOP"
- on the service switch or next to it – label "NORMAL" and "SERVICE" and
- the elements of giving commands to a service drive or next to them mark-drive direction.

On the outside of the door to the engine room are placed signs: "DANGER TO LIFE", "ELEVATOR DRIVE", "UNAUTHORIZED ACCESS PROHIBITED".

In the generator room there instructions for manually starting the cabin, management and use of individual keys for emergency opening of doors of the shaft. On the switch to illuminate the cabin, shaft and engine room is a table with the inscription: "CABIN ILLUMINATION", "ILLUMINATION SHAFT " and "ILLUMINATION ENGINE ROOM".

On all door shaft, on the inside, there is a clear mark floors, visible from the cab when the cab door closed from the control opening a cabin located in the station. On the "STOP" switch in the shaft, or next to it are the label "ON" and "OFF".

Contactors, relays, fuses, terminals and control unit are marked by an electric device scheme. On the locking door shaft device there is a mark of the device. On the Safety gear there is the mark of the device. On the Safety gear in plain sight, there is a metal plate with the following information :

- manufacturer,
- total weight in pounds which is intended Safety gear,
- much speed elevators which can be used Safety gear,

On the power generator, placed in a prominent place a metal plate with the following information:

- manufacturer,
- technical characteristics and

- number and year of manufacture.

#### **5.4.17. Main distribution cabinet for the lifting platform**

Cross section of the main power cable from direct engine start conditions should therefore be 4mm<sup>2</sup> min, for a length of 50 m. According to nominal motor starting currents and cross-section of the main lines are needed to fuse cartridges 3x6 A sluggish and the corresponding elements of TZ, EZ or UZ. Protection of overvoltage is derived in TNC-S system protection (zero with 4 or 5 conductor) which means that the part of the network closer to the transformer applied to TN-C system (zero with 4 wires), and part of the network (the building) TN-S system (zero with 5 conductors). This ensures that possible fault does not flow neutral conductor which provides reliable protection against overvoltage touch. Protection of cables and connected equipment from excessive fault currents provided the fuse located in the main switchboard cabinet. On the cover of the main top is mounted the main switch that stops the power supply elevator on all the poles simultaneously.

#### **5.4.18. Managerial - control cabinet for the lifting platform**

Using microprocessor technology in an elevator control system ensures the establishment of information and control signals, which aims to introduce the program into the system. All this reduces the amount of applied elements and simplifies the electrical scheme, and most importantly increase the functional capabilities of the management and it becomes universal.

Operating Voltage: 3x380 V, 50 Hz

Control voltage: 230 V AC, 12 V, 24 V DC, 48V

Electromagnet voltage: 48 V DC

Main power cable: 5x4 mm<sup>2</sup>

Power supply and protection: TNC-S

All metal casings el. devices are interconnected and connected to the protective line.

Managing:

Commands to drive the cab to provide electrically, using a command button on the panel in the cab and the call box outside.

#### **5.4.19. Testing - technical control**

Upon completion of installation of elevator installation must be subjected to examination by the Regulations on Technical Standards EN 81/2, Appendix D, by authorized institution, which is required to issue a record of testing report. Elevator is subject to mandatory periodic technical inspection. Occasional technical control of the elevator must be made no later than the expiration of one year from the previous technical control of the elevator.

#### **5.4.20. Contractor's obligations**

During the warranty from the date when the device is placed in the proper operation, any damage that occurs and is caused by poor quality materials, poor preparation or poor installation, the Contractor shall call on investors to remove the device and make to the correct drive. For an incompetent or careless handling contractor is responsible. Upon completion of installation of elevator installation must be subjected to testing according to the Regulations on Technical Standards EN 81/2, Appendix D. After completing the test

investor is obliged to request permission to use from the competent authority for issuing use permits. Contractor is required to submit the following certifications to the Investor:

- cylinders and valves against rupture of the oil water
- hydraulic hoses,
- wire rope,
- devices for emergency braking,
- locking devices for the access door and
- electrical insulation mats.

The investor or the user is required to release simultaneously with the use of elevators to provide maintenance, including:

- a daily basis over a person in charge,
- regular maintenance by professional organizations to maintain and
- regular inspection by an authorized institution

## **6. TECHNICAL SPECIFICATIONS FOR THE WORKS IN THE FUNCTION OF FIRE PROTECTION**

### **6.1 INTRODUCTORY NOTES**

#### **6.1.1. General notes**

The subject of the design documentation of remodeling and revitalization of the Fortress „Kastel“ in Banjaluka – Unit 9. The spatial unit 9 is situated within the fortress walls, in its northeastern part. The Eastern yard area with pertaining bastions and the Stone building belong to the Unit 9. The total area pertaining to the Unit 9 amounts to 13 257 m<sup>2</sup>.

### **6.2 SCOPE OF THE FORESEEN WORKS**

#### **6.2.1 Fire protection**

The goal of fire protection is in a concrete way to see problems of fire protection with respect to property characteristics, installation and operation of the technological process and to provide appropriate technical solutions that will be a complete, efficient and functional system of protection and that the threat of the emergence of the outbreak fire due to these causes kept to a minimum, according to art. 21st and 22 Law on protection from fire. These specifications are in accordance with the provisions of the Regulations, technical standards and laws listed in the appendix, on the basis of technical documentation.

### **6.3 TECHNICAL CONDITIONS FOR EXECUTION OF WORKS IN THE FUNCTION OF FIRE PROTECTION**

#### **6.3.1. Overview of regulations and standards applied**

Applicable laws, regulations, technical standards have been used, as follows:

1. Law on Fire Protection (Official Gazette RS no. 6/09 – prečišćeni tekst),
2. Law on Spatial Planning and construction (Official Gazette RS no.55/10),
3. Law of traffic explosives and flammable liquids and gases (Official Gazette RS no. 16/96,110/03, 67/05 and 1/08),
4. Law on Standardization (Official Gazette SFRJ no. 80/91),
5. Regulations on construction of plants for flammable liquids and on storing and pouring of flammable liquids (Official Gazette SFRJ no. 20/71 i 23/71);
6. Regulation on technical requirements for the protection of a garage for motor cars of fire and explosion (Official Gazette RS no. 19/10),
7. Regulation on technical norms for indoor and outdoor hydrant network for fire fighting (Official Gazette SFRJ no. 30/91),
8. Regulation on technical norms for protection against static electricity (Official Gazette SFRJ no. 62/73),
9. Technical regulations on lightning rod (Official Gazette SFRJ no.13/68, 13/78),
10. Regulation on technical norms for the automatic closing of fire resistant doors and valves ("Sl. list SFRJ", br. 35/80),
11. Rules on technical standards for low voltage electrical installations (Official Gazette SFRJ no. 53/86 and 54/88),

12. Regulation on technical norms for the protection of the warehouse fire and explosion (Official Gazette SFRJ no. 4/87),
13. Rules on technical standards for systems for ventilation and air conditioning (Official Gazette SFRJ no.38/89),
14. Regulation on technical norms for the protection of low voltage networks and associated transformer stations (Official Gazette SFRJ no.13/78),

Groups of Yugoslav standards with mandatory application:

Mark	Year	Description
JUS Z.C0.001.	1984	Protection against fire and explosions. Fire protection. Terms and definitions
JUS Z.C0.003.	1979	Protection against fire and explosions. Fire classification by type of flammable materials.
JUS Z.C0.005.	1979	Protection against fire and explosions. Classification of goods and commodities to the behavior of the fire.
JUS Z.C0.007.	1978	Fire protection. Classification of flammable liquids and ignition temperature of the boiling temperature.
JUS Z.C0.010.	1979	Characteristics of hazardous combustion gases, volatile liquids and solid substances.
JUS Z.C0.012.	1979	Protection against fire and explosions. Determining the categories and the degree of hazard substances in the fire.
JUS Z.C1. X		Fire-fighting equipment
JUS Z.C2. X		Hand and transport fire extinguishers
JUS Z.C5.X		Fire extinguishers.
JUS Z.C6.X		Hoses for fire fighting
JUS Z.C8. X		Flammability testing.
JUS B.F2.100	1987	Noncombustible mineral boards. Technical conditions
JUS B.F8. X		Noncombustible mineral boards.
JUS B.H8.X		Testing of liquid fuels and other flammable liquids.
JUS G.S2.753	1972	Floor coverings. Flammability testing of flooring made of plastic and rubber.
JUS N.A5.070.	1982	Degrees of protection of electrical equipment generated by the protective casing. Classification and marking of type tests
JUS N.S6..X		Elements of automatic fire detection.
JUS N.S8.X		Protection against explosion.
JUS U.J1.010	1973	Fire protection. Testing of materials and structures. Definitions of terms.
JUS U.J1.030	1976	Fire protection. Fire load.
JUS U.J1.040	1986	Technical specifications for fire safety in construction. Combustibility of materials testing.
JUS U.J1.060	1973	Fire protection. Determination of flame spread.
JUS U.J1.070	1986	Technical specifications for fire safety in construction. Examine the development of structures in fire test furnaces.
JUS U.J1.090	1986	Technical specifications for fire safety in construction. Testing walls resistance to fire.
JUS U.J1.100	1986	Technical specifications for fire safety in construction. Testing columns resistance to fire.
JUS U.J1.110	1986	Technical specifications for fire safety in construction. Testing floor constructions resistance to fire.

JUS U.J1.114	1986	Technical specifications for fire safety in construction. Testing carriers resistance to fire.
JUS U.J1.160	1986	Technical specifications for fire safety in construction. Resistance tests for doors and other elements for closing openings in the walls of the fire.
JUS U.J1.172	1976	Technical specifications for fire safety in construction. Testing ventilation ducts resistance to fire.
JUS U.J1.190	1976	Fire protection. Protective measures in fire tests.
JUS U.J1.200	1986	Technical specifications for fire safety in construction. Measuring the temperature of the unexposed side of the structure.
JUS U.J1.220	1981	Fire protection. Symbols for the scheme.
JUS U.J1. 240	1981	Fire protection. Types of construction of buildings according to their internal resistance to fire.
JUS. UJ5.X		Fire protection. Walls

## **6.4 GENERAL TECHNICAL SPECIFICATIONS OF THE WORKS IN THE FUNCTION OF FIRE PROTECTION**

### **6.4.1. Preliminary measures**

- The Contractor shall perform work in a way that does not reduce the safety of fire at the building and a neighboring building.
- The Contractor shall determine in writing and provide for measures to prevent the outbreak and spread of fire and secure the necessary funds for the fire.
- For building materials, elements, equipment and other materials that are installed in the building, which are of particular importance for the prevention of the spread of fire or in the facility, must provide proof of their fire resistance and fire characteristics.
- The contractor of the facility shall obtain a certificate or report that the wiring and construction in accordance with the provisions of the technical measures and conditions for these installations, structures and materials incorporated.
- The user object before using the facility shall provide the required amount of funds for the initial fire extinguisher handy and resources, as well as the approval of the authorized inspection of fire protection that are performed on the building designed fire protection measures.

### **6.4.2. Sources of danger**

Variety of combustible materials that are used today in construction, building construction and equipping them is very big. Increasing the level of fire danger due to the presence of various materials to a large extent contributed to fact that in the recent past are increasingly using artificial substances and primarily those that are made on the basis of different types of plastic mase. In the technical sense, the cause of fire can be considered each heat source that operates on the burning material so that it can be heated to its ignition temperature, or that can be heated to its ignition temperature, and that could ignite in the presence of oxidizer. One of the conditions to take effective preventive measures against fire is the knowledge of all the dangers that can come into play in a certain environment, and the causes that can lead to fires in high office buildings are different. Fire analysis, it is proved that the greatest number of fires caused by human activities, because of negligence and carelessness, and also for not taking appropriate measures of protections. The most common causes of fires are carelessness and inattention (30%), electricity (12%), open fire

and flaming bodies (8%), construction defects (8 %), deliberately caused fires (5%), lightning, heat transfer, static electricity, self- inflammation, chemical reactions (5%) and unproven causes (22%). technological processes in the laboratory require working with potentially hazardous materials, easy to samples flammable liquids and gases, and reagents that fall into the above group. Despite all the attention when handling these substances may occur explosive and flammable mixture of vapors and gases with air.

### **6.4.3. Mobile fire extinguishers**

#### **Manual fire extinguishers**

Manual extinguishers are used to fight initial fire, and in that capacity are an integral part of fire prevention. Such as they are a vital part of fire protection regardless of other protection of the building. For choice of means for extinguishing fires is crucial that the matter worse, or which is the most effective means for extinguishing fires. Based on the class of fire that may occur in the facility should be set up device of dry powder extinguisher label "S" and device of carbon dioxide extinguisher labeled" CO2". As a single devices are taken Appliances S-9 (9 kg dry powder) and CO2-5 (5 kg of carbon dioxide). Devices of Class" S" can be considered as a universal devices intended for extinguishing Class B and C or fire that may occur in the house but have a defect which relates to the consequences that occur after the fire and that is that the powder difficult to remove. Devices of Class" CO2" are intended to fire class B and C as well as fire extinguisher on electrical installations and high voltage.

#### **Placing of fire extinguishers**

Devices for initial fire set in a prominent and accessible place. If the devices are manual set them on a level no greater than 1.5 m. Fire extinguishers should be regularly maintained, cleaned from dust and dirt. Control of correctness carried out every 6 months, a control specialized hire service. The tests carried out, replacement the fill or replacement of the parts make a record in the book. Regardless of manual placed on the devices, it is required to educate and conduct demonstration exercises for persons working within the facility, that at a critical time properly and effectively use the device and put out a initial fire because of the education of employees depends largely on the efficient use of appliances.

#### **Tactics of fire fighting with selected devices**

##### **A. Dry powder extinguisher label "S"**

Operation of manual fire extinguisher dry powder in the label" S" according to JUS Z.C2.035 and JUS Z.C2135 is very easy but the experience is often not achieved the desired effect due to improper handling of device. Therefore it should follow the instructions for handling manufacturers. Certain types of fire extinguisher requires also knowledge in firefighting. The flame is extinguished by a cloud, a liquid flame cutting off the flame at the bottom to the surface liquid. For a larger initial fire more effective is the simultaneous use of several hand-held fire extinguishers. After the cease fire stop highlighting powder. By suppressing the fire should remain in the vicinity and monitor the further development of the situation to avoid recurrence flame.

- Type: S9
- Weight (kg): 12.5
- Filling quantity (kg): 9

- Type of powder : ABCE
- Working pressure : 12-14
- Discharge time (sec.): 20
- The range of stream (m): 12.5
- Diameter of vessels (mm):175
- The total height (mm): 540



*Picture 1. Dry powder extinguisher label "S"*

### **B. Device of carbon dioxide extinguisher labeled "CO2"**

Handling of manual carbon dioxide fire extinguisher label "CO2" JUS Z.C2.040 and JUS Z.C2.140 is very easy but the experience is that often is not achieved the desired effect due to improper handling of the device. Therefore it should follow the instructions of manufacturers for handling certain types of fire. Firefighting requires knowledge. Fire extinguishers CO<sub>2</sub> are the highest efficiency in extinguishing fires in enclosed rooms. For larger initial fire effective is the simultaneous use of several hand-held fire extinguishers. After the cease fire stop the gas leakage. By suppressing the fire should remain in the vicinity and monitor the further development of the situation to avoid recurrence flame.

- Type: CO<sub>2</sub> (5kg)
- Diameter of vessels (mm):137
- Height of vessels (mm):650
- Capacity (l): 7.5
- Weight of vessels (kg): 9.40
- Weight (kg): 17.7
- Testing pressure (bar): 250
- Working pressure (bar): 174
- Material: 34CrMo4
- Dimensions (mm): 215x155x770



*Picture 2. Extinguisher for initial fire labeled "CO2"*

#### **6.4.4. Warning signs**

It is necessary to install warning signs that smoking is prohibited in the facility, at characteristic locations. Smoking in public places is considered a risky activity and it is defined by a law prohibiting these activities in public buildings.

#### **6.4.5. Prohibition of use of open fire**

It is prohibited to use open fires during the works, as well as during the use of the facility. Fire poses a direct threat to users of the facility, and persons who perform construction work on the building while under construction.